

# Mental health of higher education students

**Edited by**

Agnes Lai and Wing Fai Yeung

**Published in**

Frontiers in Public Health

Frontiers in Psychiatry

Frontiers in Psychology



## FRONTIERS EBOOK COPYRIGHT STATEMENT

The copyright in the text of individual articles in this ebook is the property of their respective authors or their respective institutions or funders. The copyright in graphics and images within each article may be subject to copyright of other parties. In both cases this is subject to a license granted to Frontiers.

The compilation of articles constituting this ebook is the property of Frontiers.

Each article within this ebook, and the ebook itself, are published under the most recent version of the Creative Commons CC-BY licence. The version current at the date of publication of this ebook is CC-BY 4.0. If the CC-BY licence is updated, the licence granted by Frontiers is automatically updated to the new version.

When exercising any right under the CC-BY licence, Frontiers must be attributed as the original publisher of the article or ebook, as applicable.

Authors have the responsibility of ensuring that any graphics or other materials which are the property of others may be included in the CC-BY licence, but this should be checked before relying on the CC-BY licence to reproduce those materials. Any copyright notices relating to those materials must be complied with.

Copyright and source acknowledgement notices may not be removed and must be displayed in any copy, derivative work or partial copy which includes the elements in question.

All copyright, and all rights therein, are protected by national and international copyright laws. The above represents a summary only. For further information please read Frontiers' Conditions for Website Use and Copyright Statement, and the applicable CC-BY licence.

ISSN 1664-8714  
ISBN 978-2-83251-106-0  
DOI 10.3389/978-2-83251-106-0

## About Frontiers

Frontiers is more than just an open access publisher of scholarly articles: it is a pioneering approach to the world of academia, radically improving the way scholarly research is managed. The grand vision of Frontiers is a world where all people have an equal opportunity to seek, share and generate knowledge. Frontiers provides immediate and permanent online open access to all its publications, but this alone is not enough to realize our grand goals.

## Frontiers journal series

The Frontiers journal series is a multi-tier and interdisciplinary set of open-access, online journals, promising a paradigm shift from the current review, selection and dissemination processes in academic publishing. All Frontiers journals are driven by researchers for researchers; therefore, they constitute a service to the scholarly community. At the same time, the *Frontiers journal series* operates on a revolutionary invention, the tiered publishing system, initially addressing specific communities of scholars, and gradually climbing up to broader public understanding, thus serving the interests of the lay society, too.

## Dedication to quality

Each Frontiers article is a landmark of the highest quality, thanks to genuinely collaborative interactions between authors and review editors, who include some of the world's best academicians. Research must be certified by peers before entering a stream of knowledge that may eventually reach the public - and shape society; therefore, Frontiers only applies the most rigorous and unbiased reviews. Frontiers revolutionizes research publishing by freely delivering the most outstanding research, evaluated with no bias from both the academic and social point of view. By applying the most advanced information technologies, Frontiers is catapulting scholarly publishing into a new generation.

## What are Frontiers Research Topics?

Frontiers Research Topics are very popular trademarks of the *Frontiers journals series*: they are collections of at least ten articles, all centered on a particular subject. With their unique mix of varied contributions from Original Research to Review Articles, Frontiers Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area.

Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers editorial office: [frontiersin.org/about/contact](https://frontiersin.org/about/contact)

# Mental health of higher education students

## Topic editors

Agnes Lai — The University of Hong Kong, SAR China

Wing Fai Yeung — Hong Kong Polytechnic University, SAR China

## Citation

Lai, A., Yeung, W. F., eds. (2023). *Mental health of higher education students*.  
Lausanne: Frontiers Media SA. doi: 10.3389/978-2-83251-106-0

# Table of contents

- 07 **Editorial: Mental health of higher education students**  
Agnes Yuen-Kwan Lai and Wing-Fai Yeung
- 09 **Initial Development and Psychometric Evidence of Physical Education Grit Scale (PE-Grit)**  
Noomen Guelmami, Nasr Chalhaf, Amayra Tannoubi, Luca Puce, Fairouz Azaiez and Nicola Luigi Bragazzi
- 20 **Development and Preliminary Validation of the Physical Education-Study Process Questionnaire : Insights for Physical Education University Students**  
Amayra Tannoubi, Noomen Guelmami, Tore Bonsaksen, Nasr Chalhaf, Fairouz Azaiez and Nicola Luigi Bragazzi
- 31 **Predicting Student Engagement: The Role of Academic Belonging, Social Integration, and Resilience During COVID-19 Emergency Remote Teaching**  
Melissa Versteeg, Rutger F. Kappe and Carlijn Knuiman
- 45 **Validity and Psychometric Evaluation of the Chinese Version of the 5-Item WHO Well-Being Index**  
Sai-fu Fung, Chris Yiu Wah Kong, Yi-man Liu, Qian Huang, Zike Xiong, Zhiquan Jiang, Fangfang Zhu, Zhenting Chen, Kun Sun, Huiqin Zhao and Ping Yu
- 53 **Regional Internet Access and Mental Stress Among University Students: A Representative Nationwide Study of China**  
Shuhan Jiang, Weifang Zhang, Tingzhong Yang, Dan Wu, Lingwei Yu and Randall R. Cottrell
- 61 **The Prevalence of Irritable Bowel Syndrome Among Chinese University Students: A Systematic Review and Meta-Analysis**  
Weixin Yang, Xiao Yang, Xianghao Cai, Zhuoren Zhou, Huan Yao, Xingrong Song, Tianyun Zhao and Peng Xiong
- 77 **Adaptability Protects University Students From Anxiety, Depression, and Insomnia During Remote Learning: A Three-Wave Longitudinal Study From China**  
Keshun Zhang, Zhenhong Mi, Elizabeth J. Parks-Stamm, Wanjun Cao, Yaqi Ji and Runjie Jiang
- 87 **Enhancing Mental Health, Well-Being and Active Lifestyles of University Students by Means of Physical Activity and Exercise Research Programs**  
Cornelia Herbert
- 101 **Mental Health and Wellbeing in Lithuanian Medical Students and Resident Doctors During COVID-19 Pandemic**  
Agne Stanyte, Aurelija Podlipskyte, Egle Milasauskiene, Orsolya Király, Zsolt Demetrovics, Laurynas Ambrasas, Julius Burkauskas and Vesta Steibliene



- 108 **Prospective Association Between Problematic Mobile Phone Use and Eating Disorder Symptoms and the Mediating Effect of Resilience in Chinese College Students: A 1-Year Longitudinal Study**  
Shaojie Li, Guanghui Cui, Yongtian Yin, Kaixuan Tang, Lei Chen and Xinyao Liu
- 117 **Evolution in French University Students' Mental Health One Month After the First COVID-19 Related Quarantine: Results From the COSAME Survey**  
Marielle Wathélet, Camille Vincent, Thomas Fovet, Charles-Edouard Notredame, Enguerrand Habran, Niels Martignène, Thierry Baubet, Guillaume Vaiva and Fabien D'Hondt
- 127 **The Impact of Post-traumatic Stress of SARS-CoV-2 Affliction on Psychological and Mental Health of Student Survivors: Cross Sectional Study**  
Snehil Dixit, Alamin Musa, Audrey Borghi Sillva, Ravi Shankar Reddy, Mohammed Abohashrh, Venkata Nagaraj Kakaraparthi, Faisal Asiri, Flavia Rossi Caruso, Shashi Kumar Govindappa and Arif Ahmad Mohammed
- 135 **Psychological Responses and Strategies Towards the COVID-19 Pandemic Among Higher Education Students in Portugal and Switzerland: A Mixed-Methods Study**  
Françoise Schwander-Maire, Ana Querido, Tanya Cara-Nova, Maria Anjos Dixe, Djamel Aissaoui, Zaida Charepe, Derek Christie and Carlos Laranjeira
- 146 **Intention to Screen for Hepatitis C Among University Students: Influence of Different Communicative Scenarios**  
Pierluigi Diotaiuti, Stefania Mancone, Lavinia Falese, Maria Ferrara, Fernando Bellizzi, Giuseppe Valente, Stefano Corrado and Francesco Misiti
- 157 **Social Capital and Lifestyle Impacts on Mental Health in University Students in Colombia: An Observational Study**  
Lina Sotaquirá, Insa Backhaus, Paula Sotaquirá, Mónica Pinilla-Roncancio, Catalina González-Urbe, Raquel Bernal, Juan José Galeano, Natalia Mejía, Giuseppe La Torre, Elena M. Trujillo-Maza, Daniel E. Suárez, John Duperly and Andrea Ramirez Varela
- 171 **Improving University Students' Mental Health During the COVID-19 Pandemic: Evidence From an Online Counseling Intervention in Italy**  
Giovanna Celia, Francesca Tessitore, Elisa Cavicchiolo, Laura Girelli, Pierpaolo Limone and Mauro Cozzolino
- 181 **The Protective Effect of Health Literacy on Reducing College Students' Stress and Anxiety During the COVID-19 Pandemic**  
Yuting Ying, Chunxia Jing and Fan Zhang

- 188 **Severe Symptoms of Mental Disorders Among Students Majoring in Foreign Languages in Vietnam: A Cross-Sectional Study**  
Nguyen Thi Thang, Dao Thi Dieu Linh, Ta Nhat Anh, Nguyen Thi Phuong, Nguyen Duc Giang, Nguyen Xuan Long, Dao Thi Cam Nhung and Khuong Quynh Long
- 197 **Mental Health and Related Factors Among Undergraduate Students During SARS-CoV-2 Pandemic: A Cross-Sectional Study**  
José Miguel Valdés, Francisco Javier Díaz, Pascale Marie Christiansen, Gabriel Arturo Lorca, Francisco Javier Solorza, Matías Alvear, Saray Ramírez, Daniel Nuñez, Ricardo Araya and Jorge Gaete
- 217 **Understanding Reciprocity Among University Students in Low-Resource Settings: Validation and Measurement Using a Mixed-Methods Approach**  
Mahmoud M. AbuAlSamen and Tamam El-Elmat
- 226 **Mental Health Literacy and Mental Health Information-Seeking Behavior in Iranian University Students**  
Seyed Mohammad Hossein Mahmoodi, Masoud Ahmadzad-Asl, Mohammad Eslami, Mohadeseh Abdi, Yasamin Hosseini Kahnemouli and Maryam Rasoulia
- 232 **Internet Addiction, Symptoms of Anxiety, Depressive Symptoms, Stress Among Higher Education Students During the COVID-19 Pandemic**  
Beata Gavurova, Samer Khouri, Viera Ivankova, Martin Rigelsky and Tawfik Mudarri
- 253 **Family and Academic Stress and Their Impact on Students' Depression Level and Academic Performance**  
Yuwei Deng, Jacob Cherian, Noor Un Nisa Khan, Kalpina Kumari, Muhammad Safdar Sial, Ubaldo Comite, Beata Gavurova and József Popp
- 266 **Multifarious Linkages Between Personality Traits and Psychological Distress During and After COVID-19 Campus Lockdown: A Psychological Network Analysis**  
Tzu-Hsuan Liu, Yiwei Xia and Zhihao Ma
- 277 **The Impact of Family Functioning on College Students' Loneliness: Chain-Mediating Effects of Core Self-Evaluation and Problematic Mobile Phone Use**  
Ling Qian, Die Wang, Min Jiang, Wei Wu and Congying Ni
- 284 **An Authentic Inner Compass and Need Satisfaction as Wellbeing Resources in Bedouin Teaching Students During the COVID-19**  
Rinat Cohen and Ortal Slobodin
- 298 **How Does Shyness Affect Chinese College Students' Tendency to Mobile Phone Addiction? Testing the Mediating Roles of Social Anxiety and Self-Control**  
Xinwei Li, Weijian Li, Mengxian Liu, Weilong Xiao and Hui Zhou

- 306 **Associations Between Academic Stress, Mental Distress, Academic Self-Disclosure to Parents and School Engagement in Hong Kong**  
Esther Pui Yung Chyu and Ji-Kang Chen
- 317 **Mindfulness-Based Student Training Improves Vascular Variability Associated With Sustained Reductions in Physiological Stress Response**  
Andreas Voss, Martin Bogdanski, Mario Walther, Bernd Langohr, Reyk Albrecht, Georg Seifert and Mike Sandbothe
- 333 **College students' cyberloafing and the sense of meaning of life: The mediating role of state anxiety and the moderating role of psychological flexibility**  
Qing Li, Bingnan Xia, Huijia Zhang, Wei Wang and Xiaochen Wang
- 343 **Prediction of problem gambling by demographics, gaming behavior and psychological correlates among gacha gamers: A cross-sectional online survey in Chinese young adults**  
Anson Chui Yan Tang, Paul Hong Lee, Simon Ching Lam, Summer Cho Ngan Siu, Carmen Jiawen Ye and Regina Lai-Tong Lee
- 355 **Analysis of students' positive emotions around the green space in the university campus during the COVID-19 pandemic in China**  
Shaobo Liu, Yifeng Ji, Jiang Li, You Peng, Zhitao Li, Wenbo Lai and Tao Feng
- 368 **Internet addiction in young adults: The role of impulsivity and codependency**  
Pierluigi Diotaiuti, Stefania Mancone, Stefano Corrado, Alfredo De Risio, Elisa Cavicchiolo, Laura Girelli and Andrea Chirico
- 381 **Can ResilienceNHope, an evidence-based text and email messaging innovative suite of programs help to close the psychological treatment and mental health literacy gaps in college students?**  
Belinda Agyapong, Reham Shalaby, Yifeng Wei and Vincent I. O. Agyapong



## OPEN ACCESS

## EDITED AND REVIEWED BY

Wulf Rössler,  
Charité Universitätsmedizin  
Berlin, Germany

## \*CORRESPONDENCE

Agnes Yuen-Kwan Lai  
agneslai@hku.hk

## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

RECEIVED 04 November 2022

ACCEPTED 08 November 2022

PUBLISHED 06 December 2022

## CITATION

Lai AY-K and Yeung W-F (2022)  
Editorial: Mental health of higher  
education students.  
*Front. Psychiatry* 13:1089877.  
doi: 10.3389/fpsy.2022.1089877

## COPYRIGHT

© 2022 Lai and Yeung. This is an  
open-access article distributed under  
the terms of the [Creative Commons  
Attribution License \(CC BY\)](#). The use,  
distribution or reproduction in other  
forums is permitted, provided the  
original author(s) and the copyright  
owner(s) are credited and that the  
original publication in this journal is  
cited, in accordance with accepted  
academic practice. No use, distribution  
or reproduction is permitted which  
does not comply with these terms.

# Editorial: Mental health of higher education students

Agnes Yuen-Kwan Lai<sup>1\*</sup> and Wing-Fai Yeung<sup>2</sup>

<sup>1</sup>Li Ka Shing Faculty of Medicine, School of Nursing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China, <sup>2</sup>Faculty of Health and Social Sciences, School of Nursing, The Hong Kong Polytechnic University, Kowloon, Hong Kong SAR, China

## KEYWORDS

university, higher education, students, depression, anxiety, mental health, support

## Editorial on the Research Topic

### Mental health of higher education students

Mental health of higher education students is a growing concern around the globe. Even before the outbreak of the COVID-19 pandemic, the prevalence of mental health problems among higher education students was already worrying. The Healthy Minds Network, a US national research organization, showed that depression and anxiety were found in 37.1 and 31.3% of higher education students, respectively (1). Higher education students encounter transitional challenges and stressors while preparing themselves to enter adulthood. Besides academic burdens, university students struggle to fulfill expectations from family, adapt to a drastic change in the learning environment, develop good relationships with peers, and overcome financial problems. The unprecedented wave of COVID-19 further worsened the already serious problems. Many students experienced psychological distress during the pandemic, including anxiety, stress, and even suicidal ideation (2–5). This Research Topic attempts to gather empirical findings from all over the world to broaden our understanding of the mental health of higher education students.

This Research Topic collects 34 studies on the mental health of higher education students, with more than 120,000 participants from 18 countries, among nationwide (Gavurova et al.; Jiang et al.; Qian et al.; Wathelet et al.). Studies in the Research Topic investigated a wide range of mental health outcomes, from symptom-related outcomes such as anxiety, depression, and stress (Schwander-Maire et al.; Thang et al.; Valdés et al.; Wathelet et al.; Ying et al.), insomnia (Stanyte et al.; Zhang et al.), to behavioral problems such as internet addiction (Diotaiuti et al.; Gavurova et al.), mobile phone addiction (Li X. et al.), school engagement (Versteeg et al.), academic performance (AbuAlSamen and El-Elimat; Deng et al.), and problem gaming behavior (Tang et al.).

A vast array of factors associated with the outcomes were examined, including hope (Schwander-Maire et al.), impulsivity (Diotaiuti et al.), family functioning (Qian et al.), resilience (Versteeg et al.), shyness (Li X. et al.), cyberloafing (Li Q. et al.). Three studies provided evidence with quantitative analysis to validate the instruments in their populations (AbuAlSamen and El-Elimat; Fung et al.; Guelmami et al.). Findings in this

Research Topic help aggregate knowledge in literature for mental health promotion of higher education students and suggest actionable strategies for future interventions and policies.

## Author contributions

Both authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## Acknowledgments

Thanks to all authors of this Research Topic. This Research Topic would not be realized without their input and dedication.

## References

1. The Healthy Minds Network. *The Healthy Minds Network 2022*. (2022). Available online at: <https://healthymindsnetwork.org/> (accessed November 1, 2022).
2. Browning MH, Larson LR, Sharaievska I, Rigolon A, McAnirlin O, Mullenbach L, et al. Psychological impacts from COVID-19 among university students: Risk factors across seven states in the United States. *PLoS ONE*. (2021) 16:e0245327. doi: 10.1371/journal.pone.0245327
3. McAlpine KJ. *Depression, anxiety, loneliness are peaking in college students*. The Brink (2021).
4. Lai AY, Lee L, Wang MB, Feng Y, Lai TT, Ho LM, et al. Mental health impacts of the COVID-19 pandemic on international university students, related stressors, and coping strategies. *Front Psychiatry*. (2020) 11:584240. doi: 10.3389/fpsy.2020.584240
5. Prowse R, Sherratt F, Abizaid A, Gabrys RL, Hellemans KGC, Patterson ZR, et al. Coping with the COVID-19 pandemic: Examining gender differences in stress and mental health among university students. *Front Psychiatry*. (2021) 12:650759. doi: 10.3389/fpsy.2021.650759

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.



# Initial Development and Psychometric Evidence of Physical Education Grit Scale (PE-Grit)

Noomen Guelmami<sup>1,2,3</sup>, Nasr Chalhaf<sup>1,2,4</sup>, Amayra Tannoubi<sup>1,2,3,4</sup>, Luca Puce<sup>5</sup>, Fairouz Azaiez<sup>1,2,4</sup> and Nicola Luigi Bragazzi<sup>1,6,7\*</sup>

<sup>1</sup> Postgraduate School of Public Health, Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy, <sup>2</sup> Group for the Study of Development and Social Environment (GEDES), Faculty of Human and Social Science of Tunis, Tunis, Tunisia, <sup>3</sup> Department of Human and Social Sciences, Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Jendouba, Tunisia, <sup>4</sup> Department of Human Sciences, Higher Institute of Sport and Physical Education of Sfax, University of Sfax, Sfax, Tunisia, <sup>5</sup> Department of Neuroscience, University of Genoa, Genoa, Italy, <sup>6</sup> Laboratory for Industrial and Applied Mathematics (LIAM), York University, Toronto, ON, Canada, <sup>7</sup> Department of Mathematics and Statistics, York University, Toronto, ON, Canada

## OPEN ACCESS

### Edited by:

Agnes Lai,  
The University of Hong Kong,  
Hong Kong SAR, China

### Reviewed by:

Sai-fu Fung,  
City University of Hong Kong,  
Hong Kong SAR, China  
Pierluigi Diotaiuti,  
University of Cassino, Italy

### \*Correspondence:

Nicola Luigi Bragazzi  
robertobragazzi@gmail.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 19 November 2021

**Accepted:** 06 January 2022

**Published:** 03 March 2022

### Citation:

Guelmami N, Chalhaf N, Tannoubi A,  
Puce L, Azaiez F and Bragazzi NL  
(2022) Initial Development and  
Psychometric Evidence of Physical  
Education Grit Scale (PE-Grit).  
Front. Public Health 10:818749.  
doi: 10.3389/fpubh.2022.818749

**Background:** Grit is a key concept in positive psychology and educational science. The construct measures two related constructs that are interest and effort. Several instruments have been developed to measure this construct in professional and educational contexts, but no tools have been developed considering specific contexts such as physical education and sport.

**Objectives:** The objective of this study is to develop and test a measurement scale to assess Grit in the context of physical education and sport.

**Methods:** Two exploratory (Phase 1) and confirmatory (Phase 2) samples were administered the 16-item PE-Grit scale in Arabic. In addition, the confirmatory sample also was administered the R-SPQ-2F two-factor learning approaches scale. The factor structure was examined first by exploratory factor analysis on the first sample and then by confirmatory factor analysis on the second sample. Reliability testing was performed by checking internal consistency simultaneously by the three indices: McDonald's  $\omega$ , Cronbach's  $\alpha$  and Gutmann's  $\lambda_6$ . Concurrent validity was checked by Pearson's correlation between the PE-Grit and the two dimensions of the SPQ-2F.

**Results:** After the exploratory factor analysis, which identified the factors and gave a preliminary validation of the designed instrument, confirmatory factor analysis was performed on three hierarchical models to be able to identify the best fitting model. A third-order hierarchical model with two physical and academic components each formed by interest and effort presented the best fit indices:  $\chi^2 = 192.95$  ( $p < 0.01$ ), and the  $\chi^2/DF = 1.36$ ; GFI = 0.99; AGFI = 0.99; CFI and TLI close to 1; RMSEA = 0.025. In addition, McDonald's  $\omega$ , internal consistency, and Gutmann's  $\lambda_6$  ranged from 0.78 to 0.86 for all four scale dimensions.

**Conclusion:** The PE-Grit scale displays adequate factor structure, good reliability, and acceptable concurrent validity and can be administered to assess Grit in physical education and sport students.

**Keywords:** Grit, physical education and sports, scale development, scale validation, students



## INTRODUCTION

Today, physical education, as a regular and institutionalized physical activity, has become central to the school and university system in most countries. Indeed, there is a growing interest in the role of physical education. Physical education is no longer focused solely on its impact on physical and mental health but has expanded to prepare young people for the demands and challenges of everyday life (1).

It has been argued elsewhere that physical education teaching is a multiple setting (2, 3), which differs greatly from classroom teaching in terms of characteristics, professional tasks, and specificity of the content offered in learning sessions (4). In detail, to teach physical education, a wide variety of practical and theoretical expertise must be considered (5). In fact, specific requirements must be considered in the student's training program (6). Preparing a future physical education teacher essentially requires multiple practical and theoretical knowledge to develop the necessary professional skills (7). Therefore, student training and learning in this field draws on several interdisciplinary (8) and transdisciplinary fields (9). As an example, the student must have theoretical knowledge in psychology, sociology, pedagogy, statistics, movement science, and biology, in addition to practical training in sport. Likewise, practical training requires mastery of multiple expertise in team and individual sports (10, 11). Therefore, a significant body of research has argued that physical performance and the development of various psychomotor, emotional, and cognitive skills are essential for success. In this regard, students in this field are exposed to adverse conditions similar to those of athletes: for example, physical fatigue (12), pain that is caused by many physical and athletic activities (13), and even high pressure on the lumbar spine (14, 15). Similarly, the student is also exposed to mental fatigue (16, 17), circadian rhythm disruption (18), sleep disturbance, and insomnia related to high activity levels (19).

Indeed, success in this field requires a great deal of courage and Grit. As a matter of fact, in college, schools, and universities, Grit has become a central concept in positive psychology (20), evaluated as a critical predictor of success, and for academic performance (21, 22).

As inspired by the initial research of Duckworth et al. (23) and Duckworth and Quinn (24), the concept of Grit, as an indicator and essential component of success and achievement, has been considered as one of the main concerns of personality investigations and educational psychology among college and undergraduate students along the last decade (24–26). Grit as a favorable individual trait predicting success and achievement has emerged in a variety of contexts and cultures (27). Grit has been used to identify achievement in domains typically assessed as difficult and requiring hard work (23, 24).

In the field of education, Grit encompasses the concepts of passion and long-term perseverance and is becoming an increasingly important characteristic in preparing students for academic or university success (28–30). It can also be defined as effort and determination to achieve goals (31). Grit is negatively associated with stress (32) and burnout (33). Indeed, it describes the ability to recognize good performance, despite all individual

constraints, to achieve a planned goal. The most noted early work perceived Grit as a construct formed by two factors, consistency of interest and perseverance in effort (23, 24, 34).

Consistency of interest refers to the extent to which individuals maintain a preoccupation with achieving long-term goals, whereas the persistence of effort (PE) refers to the extent to which individuals can maintain their efforts to achieve these goals regardless of the challenges and failures they encounter (35). Although defined as “an individual's tendency to persistently pursue long-term goals despite challenges or obstacles” (36), Grit must be distinguished from the related concepts of resilience, or “ability to overcome,” “acute,” “chronic,” “dynamic,” hardships and “everyday resilience” (37). Grit as a stable personality trait has been contested by some researchers who have found that Grit varies over time (38), leading to a reconceptualization of the construct as an out-of-domain cognitive process that may be appropriate for intervention (29).

Overall, Grit has been designed in several measurement instruments in a hierarchical model with two correlated dimensions that are the persistence of effort (PE) and consistency of interest (CI) (39–42). The first refers to the extent to which individuals exert long-term efforts to challenge contextual barriers (24), whereas the second measure shows the tendency of a subject to adopt a long-term choice of interests (24).

Two measurement scales that were initially developed and widely used in different contexts are as follows: the original Grit (Grit-O; 12 items) and the short Grit scale (Grit-S; 8 items), both developed by Duckworth and colleagues (23, 24). Other instruments have been developed in the context of education, such as the Academic Grit Scale (29) and the Grit Scale for Children and Adults (41). However, Datu et al. (43) suggest other alternative measures of Grit that have three factors the Triarchic Model of Grit Scale (TMGS) by adding the factor adaptability to situations. Even though, Grit-O and Grit-S remain the most widely used measures in different contexts and countries (see Arco-Tirado et al., 2018). For example, in sport, according to the scoping review elaborated by Cormier et al. (44), previous research on the measurement of athletes Grit in different levels of practice was achieved by these instruments.

To measure the concept of Grit among PE students, it is necessary to focus mainly on the content of their educational background. Indeed, PE education differs from other education, and this may be mainly due to the physical component in the educational process. If we measure the persistence and interest of these students, this component should not be overlooked. Referring to previous reports, in a particular academic context, student motivation, passions, and interests have been associated with the provided learning content (45–48).

Physical education students are a specific group of individuals who were engaged in physical activity in two contexts: studies and assessment. Successful performance in physical and sporting activities is critical to the student's success in school.

It is worth adding that the practical sessions of physical education teacher training take place in specific structures outside the classroom (e.g., gymnasiums, running tracks, soccer fields, etc.) (49). Scholar sport facilities and their variances from country-to-country can create specific conditions for physical



education and sometimes disadvantageous environments due to lack of comfort (e.g., poor countries). In addition, outside the classroom, the PE student may be exposed to unfavorable weather conditions (e.g., extreme heat or cold), whereas students in other disciplines benefit from sheltered classrooms.

In the academic field of physical education, the Academic Grit Scale cannot assess the concept since it does not include interest and physical effort. Indeed, interest and physical effort cannot be mistaken for academic interest and effort.

Therefore, the purpose of this study was to develop and evaluate a measurement scale to assess Grit in this field. In this procedure, which considered as preliminary in the context of physical education, the factorial structure, the internal consistency, and the concurrent validity will be considered. In the academic context, each student has his own learning strategy: deep learning strategies and surface learning strategies (50). Therefore, to show the concurrent validity of the PE-Grit, we proceed to examine the association of this scale with the R-SPQ-2F scale, which is a measure of learning strategies. We justify this choice by the associations that have been found recently in several studies between Grit and learning strategies (33, 51, 52).

## MATERIALS AND METHODS

### Measurements

#### The Development of the PE-Grit Scale

The development of the PE-Grit scale was conducted in the three steps listed below.

The first one consists of a review of the literature concerning the two-factor Grit in the academic context, its measurement instruments, and the specific characteristics in physical education and sports. In detail, the items of the Grit-S, Grit-O, and AGS measurement scales were considered (23, 24, 29). However, since the training and the assessment in physical education have theoretical subjects and physical practice (53–55), it was necessary to generate a pool of items that took into account on this specificity. Indeed, students in this field may have an interest in physical practice, whereas they may not have an interest in academic training (or vice versa). Likewise, the student can exert an effort which differs between the practical and theoretical sessions.

This work resulted in the development of a 16-item questionnaire in Arabic, which allows for the measurement of Grit through four context-specific dimensions, each comprising four items: interest in physical activity, interest in academic training, effort in physical activity, and academic effort (see **Appendices**).

In a second step, a focus group was formed by three independent and bilingual (English and Arabic) researchers as experts (one expert in humanities, two experts in applied educational sciences in physical education and sport) and two other Arabic and English academics as linguistic experts. The work of the group was to review the Arabic version and to develop an English version of the PE-Grit scale (see **Appendix Table 1**). During the process, the committee checked for any inconsistencies in the items in the two versions and made corrections if necessary.

The third step is a pilot study to examine the relevance of the items in the Arabic version, their face validity and to ensure their understandability by an exploratory sample.

The tool is evaluated on a seven-point Likert scale ranging from strongly disagree to strongly agree.

### Arabic Version of the Revised Two-Factor Study Process Questionnaire R-SPQ-2F

The Arabic version of the R-SPQ-2F by Munshi et al. (56) is an assessment tool for learning approaches. It consists of 20 items that assess deep (10 items) and surface (10 items) learning approaches.

The surface concept means the acquisition of knowledge only with extrinsic motivation (i.e., students experience learning as an external duty necessary to succeed with minimal effort). In contrast, deep learning involves the acquisition of knowledge and understanding of underlying principles and mechanisms, critical thinking, and thus intrinsic motivation.

Data were collected on a five-point Likert scale. The characteristics of the scale in the exploratory factor analysis were satisfactory. However, no deep structure analysis was performed. Similarly, the internal consistency of the scale was good. Cronbach's  $\alpha$  coefficients were 0.93 and 0.90 for the two factors, surface approach and deep approach, respectively.

### Data Collection and Procedures

Data were collected online from a set of students enrolled in the four universities of physical education and sports in Tunisia ( $n = 652$ ). Those recruited for the study were divided into two groups to conduct two exploratory and confirmatory studies.

- Exploratory data were collected from 170 students aged  $22.40 \pm 1.65$  years randomly selected from the data. The subjects were recruited from both sexes, women ( $n = 88$ ; 51.8%) and men ( $n = 82$ ; 48.2%), belonging to the students at the Higher Institute of Physical Education and Sport of Tunisia. They were either athletes playing in several clubs and in different disciplines (34.70%), or heavy athletes (30%), or subjects who had never practiced sports in sports clubs (35.30%) who were admitted to a specific entrance examination allowing them to enroll in the institution.
- Confirmatory data were collected from a total of 482 students who were aged 19–26 years ( $M = 21.94$ ,  $SD = 1.80$ ). Students of both genders are divided into three grades and have different sports experience: current athletes (17.43%), heavy athletes (40.66%), and subjects who have never played sports in a club (41.91%). All students who received practical and theoretical educational contents at the university and classes during that period were not suspended due to COVID-19.

**Table 1** summarizes the distribution of recruited students according to the three variables: sport activity, grade level, and gender.

All data were collected during an online survey designed using Google Forms to protect students from COVID-19. The survey includes a demographic form in which age, gender, education level, and athletic experience were indicated. This process also has an advantage in that the responses can be retrieved on a

**TABLE 1** | Distribution of participants by sport practice, study level, and gender.

Group		Sport practice			Study levels			Gender	
		Abundant athletes	Non-sports subjects	Sports subjects	First	Second	Terminal	Female	Male
Exploratory sample	<i>n</i>	51	60	59	49	58	53	88	82
	%	30	35.30	34.70	28,82%	34,12%	31,18%	51.8%	48.2
Confirmatory sample	<i>n</i>	196	202	84	195	174	113	272	210
	%	40.66	41.91	17.43	40.55	36.01	23.44	56.43	43.57

Microsoft Excel page. The email addresses of the students were obtained by the use of the university system. In addition, no further information was provided (e.g., the student's first and last name).

## Statistical Analyses

Statistical analyses were performed using IBM SPSS version 26.0 for Windows. The reliability of the instrument was tested by the open-source software JASP. Whereas Lavaan's R package (R Studio) was adopted for confirmatory factor analysis, preliminary data analysis was performed by Skewness and Kurtosis normality tests. Exploratory sample responses were performed by unweighted least squares method with Promax rotation and Kaiser normalization. Instrument reliability was obtained by calculating the internal consistency coefficients: Cronbach's  $\alpha$  coefficient, McDonald's  $\omega$  coefficient, and Gutmann's  $\lambda_6$  coefficient.

The recommended threshold for these indexes is 0.70 for acceptability and 0.80 for good reliability. The structure of the confirmatory sample questionnaire was performed by confirmatory factor analysis (CFA), and diagonally weighted least squares (DWLS) was used in this study as an estimation technique (57). Several CFA indices were selected to examine the model: (1) the  $\chi^2$ , (2) the  $\chi^2/DF$ , (3) the goodness-of-fit index (GFI), (4) the goodness-of-fit index (AGFI), (5) the comparative fit index (CFI), (6) the Tucker–Lewis index (TLI), and (7) the root means square error of approximation (RMSEA).

The  $\chi^2$  should not be significant; however, this criterion is highly criticized on large samples, whereas the  $\chi^2/DF$  is widely used and should be less than or equal to 2.

According to the recommendations of Hu and Bentler (58), GFI and AGFI must have values greater than 0.90 to accept the model. TLI and CFI values greater than 0.95 represent a good model fit. RMSEA should be  $<0.06$  for a good model fit and  $<0.08$  for an acceptable model fit (58, 59).

Concurrent validity was tested by examining the association between the four PE-Grit factors and the R-SPQ-2F scale. To examine these associations, we used low ( $<0.35$ ), moderate (between 0.36 and 0.67), and strong ( $>0.67$ ) thresholds for Pearson's correlation coefficients (60).

## Ethical Statement

This work has received approval from the Ethics Committee of the Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education, Kef, University of Jendouba, Jendouba, Tunisia and received

**TABLE 2** | Descriptive statistics, normality test, and factor loadings of exploratory factor analysis.

Items	Mean	SD	Skewness	Kurtosis	Lambda
PHI1	4,36	1,55	−0,20	−0,52	0,78
PHI2	4,44	1,58	−0,18	−0,63	0,75
PHI3	4,41	1,56	−0,14	−0,86	0,72
PHI4	4,41	1,45	−0,22	−0,50	0,72
ACI1	4,23	1,68	−0,12	−0,72	0,80
ACI2	4,34	1,69	−0,24	−0,77	0,80
ACI3	4,30	1,43	−0,20	−0,92	0,74
ACI4	4,26	1,74	−0,15	−0,83	0,79
PHE1	3,88	1,72	−0,05	−0,89	0,76
PHE2	3,99	1,69	−0,01	−1,02	0,73
PHE3	3,63	1,48	0,20	−0,55	0,73
PHE4	3,69	1,50	0,20	−0,63	0,78
ACE1	3,44	1,58	0,28	−0,62	0,78
ACE2	3,24	1,65	0,55	−0,50	0,75
ACE3	3,45	1,59	0,21	−0,78	0,78
ACE4	3,35	1,62	0,30	−0,75	0,81

PI, Physical interest; ACI, academic interest; PPE, physical practice effort; ACE, academic effort. After examining KMO, factor loadings, and scree plot (**Appendix Figure 1**), the factorial solution was retained without deleting any items.

ethical clearance from the UNESCO Chair Health Anthropology Biosphere and Healing Systems, University of Genoa, Genoa (Italy), the Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia), and the Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia). The proposal has been also approved by the Jendouba University Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments.

## RESULTS

Factor analysis was used to extract the four factors from the correlation matrix. All 16 items were subjected to factor analysis using extraction by the unweighted least square method, Kaiser normalization, and Promax rotation. Only the elements with loads equal to or greater than 0.50 were retained.

This analysis resulted in 4 factors with eigenvalues greater than 1, a Kaiser–Meyer–Olkin measure of sampling adequacy index, KMO of 0.88, Bartlett's sphericity test, and chi-square test of value 1,257.81 ( $ddl = 120$ ;  $p < 0.001$ ).

**TABLE 3** | Internal consistency of PE-Grit scale.

Estimate	McDonald's $\omega$	Cronbach's $\alpha$	Guttman's $\lambda_6$	Average interitem correlation	Mean	SD
PH.Interest	0,83	0,83	0,78	0,55	17,62	4,99
PH.Effort	0,86	0,86	0,82	0,61	17,13	5,50
AC.Interest	0,84	0,84	0,80	0,56	15,19	5,24
AC.Effort	0,86	0,86	0,82	0,61	13,48	5,41

The factorial solution resulted in four factors that explained 69.15% of the total variance.

The first factor explained 35.51% of the total variance (eigenvalue = 5.68), whereas the explained variances were 16.94% (eigenvalue = 2.71), 7.37% (eigenvalue = 1.49), and 7.37% (eigenvalue = 1.18). **Table 2** presents the descriptive statistics, the normality coefficients, and factor loadings (lambda) of the item scores obtained in the exploratory phase.

## Reliability

The McDonald's  $\omega$  internal consistency indices for the four dimensions vary between 0.86 for the AC, effort dimension, and 0.83 for PH. interest one. This shows a good consistency of the 4 dimensions of the scale. Also, Cronbach's  $\alpha$  values are good with a minimum value of 0.83 for the academic effort dimension (see **Table 3**).

For Gutmann's  $\lambda_6$  index, the scores vary from 0.78 to 0.82 for the fourth and the first dimensions, respectively (see **Table 3**).

## Confirmatory Factor Analysis

To validate the generalizable of the factor structure, confirmatory factor analysis was carried out on three different models: (a) a model with four factors which form a total score (M1, see **Figure 1**) (b) a third-order model (M2, see **Figure 2**) where the total Grit score is formed from two scores of interest (physical interest and academic interest) and effort (physical effort and academic effort) and the third model also of third-order (M3, see **Figure 3**) is formed from a physical dimension (physical interest and physical effort) and an academic dimension (academic interest and academic effort).

## Review of Adjustment Indices

The models shown in **Figures 1–3** exhibit excellent factor loadings which are greater than 0.71 which are recommended by Comrey and Lee (61).

For model M1, the absolute goodness-of-fit indices X2/DF and RMSEA were not adequate. Indeed, the value of X2/DF was  $3.82 > 2$ , and both error indices were greater than 0.60. Likewise, the TLI and CFI indices were slightly below the recommended threshold for both indices ( $> 0.95$ ). However, the GFI and AGFI indices were adequate. Following these results, the M1 model will be rejected and other models must be examined [see Hu and Bentler, (62)].

Referring to the recommended thresholds, the M2 model exhibits good fit indices with the exception of X2/DF and measurement errors.

Likewise, the M3 model provided the best-fit indices that are faithful to the recommended standards, but with a smaller chi X2 = 67.54 ( $p < 0.01$ ), and the X2/DF = 0.68.

In addition, the indices of GFI = 0.994 and AGFI = 0.992. The parsimony-adjusted measures indices CFI = 0.99 and TLI = 0.99 were close to 1, which justifies the excellence of the model. The RMSEA and the RMR values were 0 and 0.033, respectively. These values indicated a good adjustment index.

## Concurrent Validity

For PH. interest, the results demonstrated significant associations (see **Table 4**). However, the correlation coefficient between this factor was low with deep ( $r = 0.19$ ) and moderate with surface ( $r = 0.37$ ) (see **Table 4**). Likewise, the results showed significant weak correlations between PH. effort with deep ( $r = 0.15$ ) and PH. effort with surface (0.30) (see **Tables 4, 5**).

The results showed a significantly moderate and weak relationship between AC. interest with deep ( $r = 0.43$ ) and AC. interest with surface ( $r = 0.08$ ), respectively. Finally, AC. effort was associated with deep ( $r = 0.31$ ), and no association was demonstrated between the PE-Grit factor with surface (see **Table 5**).

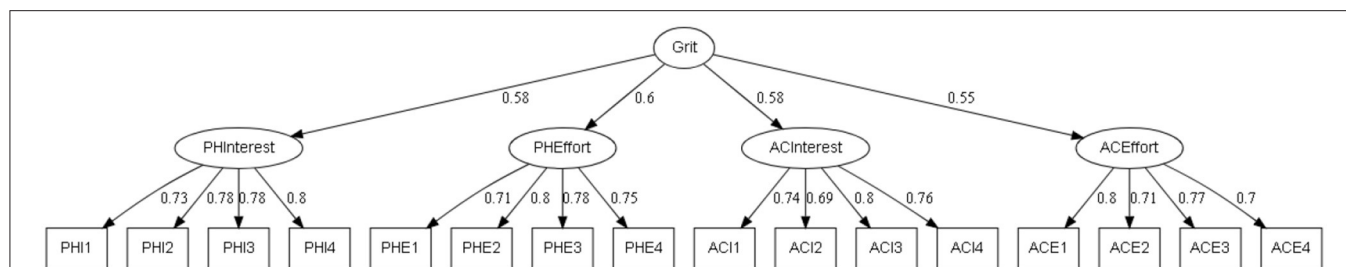
## DISCUSSION

The purpose of this study was to develop and test a measurement scale to assess Grit in the context of physical education and sport. A 16-item, four-factor scale was developed and empirically tested to assess its psychometric properties in a near-target population of physical education and sport university students.

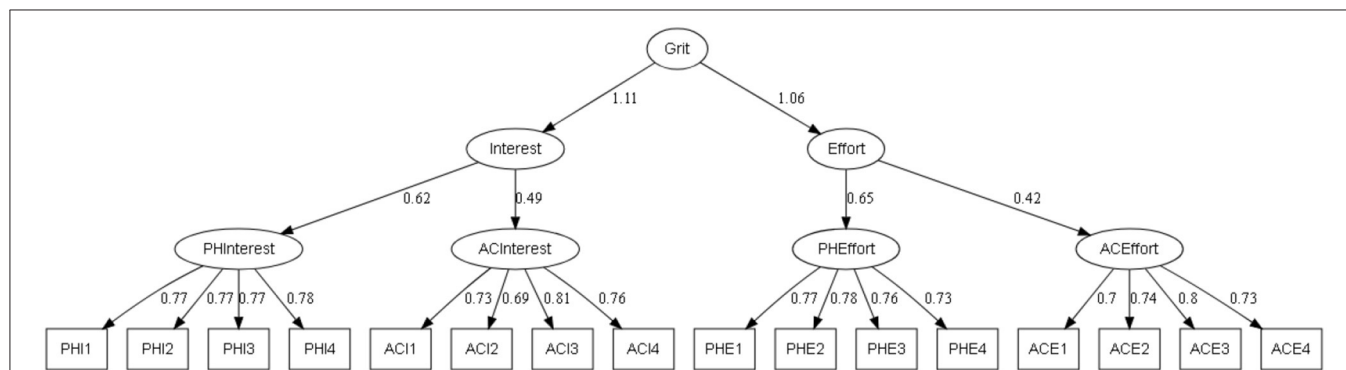
A first second-order model was tested by confirmatory factor analysis and proved to be reliable. Subsequently, two third-order hierarchical models were evaluated to examine the most appropriate structure to represent the empirical data. A third-order model with two physical and academic components better displayed the data.

Afterward, the internal consistency was assessed to test the reliability of the instrument. The results proved that the four dimensions of the instrument have adequate internal consistency. Finally, concurrent validity was assessed using the Pearson's correlation matrix between the four PE-Grit dimensions and the two factors of the R-SPQ-2F scale.

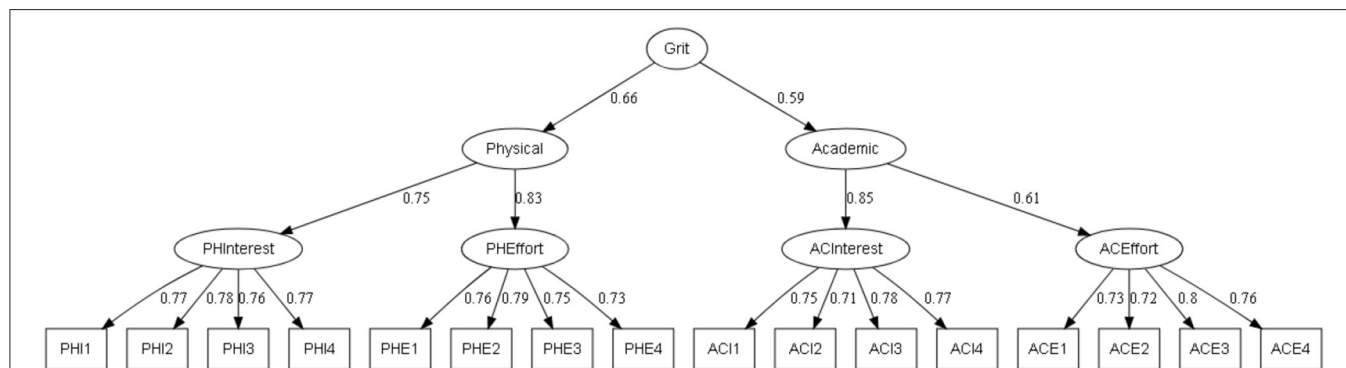
Pearson's correlation results showed that physical interest has a slightly positive correlation with the deep approach and a moderate correlation with the surface approach. In addition, academic interest (AC. I) is moderately associated with the



**FIGURE 1** | Second-order confirmatory factor analysis of the PE-Grit. All parameters are standardized and significant at the 0.01 level.



**FIGURE 2** | Third-order confirmatory factor analysis of the PE-Grit (M2). All parameters are standardized and significant at the 0.01 level.



**FIGURE 3** | Third-order factor analysis of the PE-Grit (M3). All parameters are standardized and significant at the 0.01 level.

**TABLE 4** | Fit indices of the three models of PE-Grit scale.

Model	$\chi^2$ (p)	DF	$\chi^2/DF$	GFI	AGFI	TLI	CFI	RMSEA	[Lo90-Hi 90]
M1	393.89 ( $p < 0.01$ )	103	3,82	0.964	0.952	0.937	0.946	0.077	0.069–0.085
M2	334.31 ( $p < 0.01$ )	99	3,38	0.969	0.958	0.947	0.956	0.070	0.062–0.079
M3	67.54 ( $p < 0.01$ )	99	0,68	0.994	0.992	1	1	0.000	—

deep approach, whereas a weak association of physical effort with both factors of the R-SPQ-2F was proven. Similarly, a moderate correlation between academic interest (AC. E), academic effort, and deep approach was demonstrated. Finally,

no correlation between academic effort (AC. E) and superficial approach was found. These results confirm that students who are more interested in sport activities have a surface approach and therefore extrinsic motivation. Additionally, students who



**TABLE 5 |** Correlation between the dimensions of the PE-Grit scale and the two factors, deep approach, and surface approach.

Dimension	PH.Interest	PH.Effort	AC.Interest	AC.Effort	Deep
PH.Interest					
PH.Effort	0.50**				
AC.Interest	0.26**	0.19**			
AC.Effort	0.11*	0.23**	0.41**		
Deep	0.19**	0.15**	0.43**	0.31**	
Surface	0.37**	0.30**	0.08	0.03	0.29**

\* $p < 0.05$ ; \*\* $p < 0.01$ .

are more motivated to learn have a more academic interest in their academic training.

In line with the latter findings, Datu et al. (43) postulate that many efforts in the university context require students' persistence to achieve long-term goals. They emphasize the importance of being passionate and having the determination to achieve their goals through sustained personal effort in school or university (63). In addition, Tang et al. (64) research showed that Grit is associated with high academic commitment and achievement.

In contrast, King and Ganotice (65) in their study of Filipino students concluded that the deep approach did not necessarily influence academic performance more than the surface approach. Indeed, in this Asian culture, students put a lot of effort into preserving their face and avoiding poor performance that is frowned upon. In this cultural context, academic Grit can be associated with encouragement and respect for the effort exerted to keep face.

Likewise, in line with initial validations of the Grit-O (23) and Grit-S (24) scales, the PE-Grit measure exhibits a multidimensional structure. Similarly, the results of exploratory factor analysis on the Grit Scale for Children and Adults (GSCA) supported the multidimensionality of the instrument (41). In agreement with these studies suggesting that the two factors, interest and effort, are correlated, our first-order model did not show good fit indices. However, the psychometric review of the Academic Grit Scale conducted by both exploratory and confirmatory factor analyses supported a unidimensional structure (29). In addition, factorial reviews of the Triarchic Model of Grit Scale (TMGS) supported a first-order model (43).

Actually, most of the studies across time and countries have focused on the Grit-S. In fact, the tool has provided a good internal consistency, adequate test-retest stability, and good other psychometric proprieties [for example, (36, 40, 66)]. In addition, Grit-S total score was associated with educational level. Despite this, too many controversies of the structure were reported. For the sake of clarity, Gonzalez et al. (67) concluded through parallel analysis, a measure of instability, extrinsic convergent validity, and item response theory models (on two US samples) that the short version of the Grit is unidimensional. In another study, the theory item analysis of a Russian version (68) revealed two uncorrelated dimensions. Much more, in a German version evaluated among

students, Schmidt et al. (36) proved a second-order structure by confirmatory factor analysis. It also found concordances of the scale scores with self-efficacy and general academic self-concept.

Furthermore, in another study by Clark and Malecki (29) on a sample of adolescents, an Academic Grit Scale was subjected to empirical examination. Results from exploratory and confirmatory factor analyses supported second-order structure. Internal consistency was high and positive correlations between academic Grit and academic achievement were reported.

The concept of Grit has always been linked to academic performance (69). To that end, Duckworth and Gross (70), Hochanadel and Finamore (71), and Keegan (72) encourage parents and teachers to teach Grit to children and students. Thus, interventions to improve it are always welcome. However, other researchers argue that other aspects of learning such as learning conditions, mentor's self-efficacy, and access to resources and thus the intervention in this regard will be more desirable (73, 74).

In addition, the study by Steinmayr et al. (75) showed that the effect of Grit on achievement was weaker than that of self-perceived ability and academic commitment. Similarly, an international study in several populations showed that sociodemographic factors, health behaviors, and psychology were associated with academic performance (22, 76).

In conclusion, all of the instruments were tested and validated with a common one-factor and mostly two-factor designs, and high scores on these scales were positively associated with academic or school performance. However, in contexts that also require physical performance, a mismatch may arise between academic and physical interest, similarly between academic effort and physical effort. As a matter of fact, students in physical education and sports in Tunisia have several subjects based on physical practice that can increase their grades and meet the conditions for success. Most of these students have integrated the academic course through a sporting career. Therefore, for them, they can succeed thanks to the grades achieved by the practical disciplines.

Several perspectives and variables need to be examined in the context of physical education and sport such as gender, sport experience, and grade repetition. Indeed, in the context of university medical students, a study by Alzerwi (77) showed that students' Grit scores were higher than those of men and also differences related to repetition were highlighted.

We are aware that our research has some limitations. The first is the examination of the relationship between PE-Grit with different versions of Grit which was not conducted. Second, the multigroup scale sensitivity was not conducted to see the differences between dropout athletes and student athletes. Third limitation of our study is that the version presented in the English manuscript was not empirically tested, and only the Arabic version was tested. The other limitation of the study was the factor variability between the variables gender, sports background, and education level which was not achieved. Finally, it is preferable in a prospective study to examine the association between personality traits and PE-Grit.

## Implications and Future Directions

This study has raised the challenge of developing a scale to measure Grit in the specific context of physical education and sports for future school teachers. The integration of the physical component with two factors, interest and effort, allows for a better assessment of Grit in this field. Future studies on the concept of Grit in this academic context may consider the intensity and frequency of physical exercise in the teaching of future physical education teachers. Indeed, the physical load that exerted during learning sessions may influence both interest and effort factors of the physical dimension and consequently on the total Grit score. It is interesting to conduct studies in this direction to understand how the student plans his or her goals.

Finally, the motivation to exercise, the culture for exercising, the enjoyment of exercising, the credits attributed to physical activities, and the grading systems (e.g., the coefficients of the subjects taught) may be different from one country to another. It is therefore worthwhile to understand the concept in different countries and cultures.

## CONCLUSION

The examination of the beneficial role of positive psychology instruments such as the Grit in specific academic contexts is necessary, as they provide insight into learner performance. The PE-Grit scale developed, obeys an adequate factor structure, good reliability, and acceptable concurrent validity and can be administered to assess Grit in physical education and sport students.

## REFERENCES

- Lee HS, Lee J. Applying artificial intelligence in physical education and future perspectives. *Sustainability*. (2021) 13:351. doi: 10.3390/su13010351
- Ward P. Core practices for teaching physical education: Recommendations for teacher education. *J Teach Phys Educ*. (2020) 40:98–108. doi: 10.1123/jtpe.2019-0114
- Barba-Martín RA, Bores-García D, Hortigüela-Alcalá D, González-Calvo G. The application of the teaching games for understanding in physical education. Systematic review of the last six years. *Int J Environ Res Public Health*. (2020) 17:3330. doi: 10.3390/ijerph17093330
- Chalghaf N, Azaiez C, Krakdiya H, Guelmami N, Re TS, Maldonado Briegas JJ, et al. Trans-cultural validation of the “Academic Flow Scale” (Flow 4D 16) in Arabic language: insights for occupational and educational psychology from an exploratory study. *Front Psychol*. (2019) 10:2330. doi: 10.3389/fpsyg.2019.02330
- Feu S, García-Rubio J, Gamero MDG, Ibáñez SJ. Task planning for sports learning by physical education teachers in the pre-service phase. *PLoS ONE*. (2019) 14:e0212833. doi: 10.1371/journal.pone.0212833
- Lee YH. Emotional labor, teacher burnout, and turnover intention in high-school physical education teaching. *Eur Phys Educ Rev*. (2019) 25:236–53. doi: 10.1177/1356336X17719559
- Chiva-Bartoll O, Montero PJR, Capella-Peris C, Salvador-García C. Effects of service learning on physical education teacher education students’ subjective happiness, prosocial behavior, and professional learning. *Front Psychol*. (2020) 11:331. doi: 10.3389/fpsyg.2020.00331
- Bouffard M, Spencer-Cavaliere N. Interdisciplinarity in adapted physical activity. *Quest*. (2016) 68:4–14. doi: 10.1080/00336297.2015.1117002

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

This work has received approval from the Ethics Committee of the Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education, Kef, University of Jendouba, Jendouba, Tunisia and received ethical clearance from the UNESCO Chair Health Anthropology Biosphere and Healing Systems, University of Genoa, Genoa (Italy), the Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia), and the Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia). The proposal has been also approved by the Jendouba University Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

NG and NB conceived the experiment. NG, NC, AT, and NB collected and analyzed data. All authors critically revised the manuscript. All authors contributed to the article and approved the submitted version.

- Castelli DM. Evidence of the Essential Components: Modeling Transdisciplinary Team Science to Improve Physical Education. *Res Q Exerc Sport*. (2021) 92:199–201. doi: 10.1080/02701367.2021.1877607
- Chang KE, Zhang J, Huang YS, Liu TC, Sung YT. Applying augmented reality in physical education on motor skills learning. *Interact Learn Environ*. (2020) 28:685–97. doi: 10.1080/10494820.2019.1636073
- Dodds EP. Silver bullets, golden visions, and possible dreams: a wish list for the future of research in physical education. In: *Learning and Teaching in Physical Education*. Routledge. (2012). p. 225–37. doi: 10.4324/9780203487150-22
- O’Sullivan K, O’Sullivan PB, Gabbett TJ. Pain and fatigue in sport: are they so different? *Br J Sports Med*. (2018) 52:555–6. doi: 10.1136/bjsports-2017-098159
- Triki M, Koubaa A, Masmoudi L, Fellmann N, Tabka Z. Prevalence and risk factors of low back pain among undergraduate students of a sports and physical education institute in Tunisia. *Libyan J Med*. (2015) 10. doi: 10.3402/ljm.v10.26802
- Iwamoto J, Takeda T, Wakano K. Returning athletes with severe low back pain and spondylolysis to original sporting activities with conservative treatment. *Scand J Med Sci Sports*. (2004) 14:346–51. doi: 10.1111/j.1600-0838.2004.00379.x
- Kolt GS, Kirkby RJ. Epidemiology of injury in elite and subelite female gymnasts: a comparison of retrospective and prospective findings. *Br J Sports Med*. (1999) 33:312–8. doi: 10.1136/bjsm.33.5.312
- Trecroci A, Boccolini G, Duca M, Formenti D, Alberti G. Mental fatigue impairs physical activity, technical and decision-making performance during small-sided games. *PLoS ONE*. (2020) 15:e0238461. doi: 10.1371/journal.pone.0238461

17. Sarkar M, Fletcher D. Psychological resilience in sport performers: a review of stressors and protective factors. *J Sports Sci.* (2014) 32:1419–34. doi: 10.1080/02640414.2014.901551
18. Yamanaka Y, Honma KI, Hashimoto S, Takasu N, Miyazaki T, Honma S. Effects of physical exercise on human circadian rhythms. *Sleep Biol Rhythms.* (2006) 4:199–206. doi: 10.1111/j.1479-8425.2006.00234.x
19. Hartescu I, Morgan K. Regular physical activity and insomnia: an international perspective. *J Sleep Res.* (2019) 28:e12745. doi: 10.1111/jsr.12745
20. Luthans KW, Luthans BC, Chaffin TD. Refining grit in academic performance: The mediational role of psychological capital. *J Manage Educ.* (2019) 43:35–61. doi: 10.1177/1052562918804282
21. Usher EL, Li CR, Butz AR, Rojas JP. Perseverant grit and self-efficacy: Are both essential for children's academic success? *J Educ Psychol.* (2019) 111:877. doi: 10.1037/edu0000324
22. Alhadabi A, Karpinski AC. Grit, self-efficacy, achievement orientation goals, and academic performance in University students. *Int J Adolesc Youth.* (2020) 25:519–35. doi: 10.1080/02673843.2019.1679202
23. Duckworth AL, Peterson C, Matthews MD, Kelly DR. Grit: perseverance and passion for long-term goals. *J Pers Soc Psychol.* (2007) 92:1087. doi: 10.1037/0022-3514.92.6.1087
24. Duckworth AL, Quinn PD. Development and validation of the Short Grit Scale (GRIT-S). *J Pers Assess.* (2009) 91:166–74. doi: 10.1080/00223890802634290
25. Bowman NA, Hill PL, Denson N, Bronkema R. Keep on truckin' or stay the course? Exploring grit dimensions as differential predictors of educational achievement, satisfaction, and intentions. *Soc Psychol Personal Sci.* (2015) 6:639–45. doi: 10.1177/1948550615574300
26. Bazelaïs P, Lemay DJ, Doleck T. How does grit impact college students' academic achievement in science? *Eur J Sci Mathem Educ.* (2016) 4:33–43. doi: 10.30935/scimath/9451
27. Créde M, Tynan MC, Harms PD. Much ado about grit: a meta-analytic synthesis of the grit literature. *J Pers Soc Psychol.* (2017) 113:492. doi: 10.1037/pspp0000102
28. Clark KN, Dorio NB, Eldridge MA, Malecki CK, Demaray MK. Adolescent academic achievement: a model of social support and grit. *Psychol Sch.* (2020) 57:204–21. doi: 10.1002/pits.22318
29. Clark KN, Malecki CK. Academic Grit Scale: psychometric properties and associations with achievement and life satisfaction. *J Sch Psychol.* (2019) 72:49–66. doi: 10.1016/j.jsp.2018.12.001
30. Bliss R, Jacobson E. Doctor of physical therapy student grit as a predictor of academic success: a pilot study. *Health Professions Educ.* (2020) 6:522–8. doi: 10.1016/j.hpe.2020.06.006
31. Howard JM, Nicholson BC, Chesnut SR. Relationships between positive parenting, overparenting, grit, and academic success. *J Coll Stud Dev.* (2019) 60:189–202. doi: 10.1353/csd.2019.0018
32. Lee WWS. Relationships among grit, academic performance, perceived academic failure, and stress in associate degree students. *J Adolesc.* (2017) 60:148–52. doi: 10.1016/j.adolescence.2017.08.006
33. Kim KT. A mediating effect of positive psychological capital on the relationship between academic grit and academic burnout perceived by high school students. *J Korea Convergence Soc.* (2019) 10:219–25. doi: 10.21097/ksw.2019.05.14.2.225
34. Robertson-Kraft C, Duckworth AL. True grit: Trait-level perseverance and passion for long-term goals predicts effectiveness and retention among novice teachers. *Teachers College Record.* (2014) 116. doi: 10.1177/016146811411600306
35. Lan X, Radin R. Direct and interactive effects of peer attachment and grit on mitigating problem behaviors among urban left-behind adolescents. *J Child Fam Stud.* (2020) 29:250–60. doi: 10.1007/s10826-019-01580-9
36. Schmidt FT, Fleckenstein J, Retelsdorf J, Eskreis-Winkler L, Möller J. Measuring grit. *Eur J Psychol Assess.* (2017) 35:436–47. doi: 10.1027/1015-5759/a000407
37. Martin AJ, Marsh HW. Academic buoyancy: Towards an understanding of students' everyday academic resilience. *J Sch Psychol.* (2008) 46:53–83. doi: 10.1016/j.jsp.2007.01.002
38. West MR, Kraft MA, Finn AS, Martin RE, Duckworth AL, Gabrieli CE, et al. Promise and paradox: Measuring students' non-cognitive skills and the impact of schooling. *Educ Eval Policy Anal.* (2016) 38:148–70. doi: 10.3102/0162373715597298
39. Sudina E, Vernon T, Foster H, Del Villano H, Hernandez S, Beck D, et al. Development and initial validation of the L2-teacher grit scale. *TESOL Quarterly.* (2021) 55:156–84. doi: 10.1002/tesq.581
40. Li J, Zhao Y, Kong F, Du S, Yang S, Wang S. Psychometric assessment of the short grit scale among Chinese adolescents. *J Psychoeduc Assess.* (2018) 36:291–6. doi: 10.1177/0734282916674858
41. Sturman ED, Zappala-Piemme K. Development of the grit scale for children and adults and its relation to student efficacy, test anxiety, and academic performance. *Learn Individ Differ.* (2017) 59:1–10. doi: 10.1016/j.lindif.2017.08.004
42. Rojas JP, Reser JA, Usher EL, Toland MD. *Psychometric Properties of the Academic Grit Scale.* Lexington: University of Kentucky. (2012).
43. Datu JAD, Yuen M, Chen G. Grit and determination: A review of literature with implications for theory and research. *J Psychol Counsellors Schools.* (2017) 27:168–76. doi: 10.1017/jgc.2016.2
44. Cormier DL, Ferguson LJ, Gyurcsik NC, Briere JL, Dunn JG, et al. (2021). Grit in sport: a scoping review. *Int Rev Sport Exercise Psychol.* 1–38. doi: 10.1080/1750984X.2021.1934887
45. Sallis JF, McKenzie TL. Physical education's role in public health. *Res Q Exerc Sport.* (1991) 62:124–37. doi: 10.1080/02701367.1991.10608701
46. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol.* (2000) 55:68. doi: 10.1037/0003-066X.55.1.68
47. Dweck CS. Messages that motivate: How praise molds students' beliefs, motivation, and performance (in surprising ways). In: *Improving academic achievement.* Academic Press. (2002). pp. 37–60. doi: 10.1016/B978-012064455-1/50006-3
48. Ulstad SO, Halvari H, Sørebo Ø, Deci EL. Motivation, learning strategies, and performance in physical education at secondary school. *Adv Phys Educ.* (2016) 6:27–41. doi: 10.4236/ape.2016.61004
49. Curtner-Smith MD. The impact of a critically oriented physical education teacher education course on preservice classroom teachers. *J Teach Phys Educ.* (2007) 26:35–56. doi: 10.1123/jtpe.26.1.35
50. Floyd KS, Harrington SJ, Santiago J. The effect of engagement and perceived course value on deep and surface learning strategies. *Informing Sci Int J an Emerg Transdiscipl.* (2009) 12:181–90. doi: 10.28945/435
51. Jiang L, Zhang S, Li X, Luo F. How grit influences high school students' academic performance and the mediation effect of academic self-efficacy and cognitive learning strategies. *Curr Psychol.* (2021) 1–10. doi: 10.1007/s12144-020-01306-x
52. Nussbaum M, Barahona C, Rodriguez F, Guentulle V, Lopez F, Vazquez-Uscanga E, et al. Taking critical thinking, creativity and grit online. *Educ. Technol. Res. Dev.* (2021) 69:201–6. doi: 10.1007/s11423-020-09867-1
53. O'Neil K, Richards KAR. Breaking from traditionalism: strategies for the recruitment of physical education teachers. *J Phys Educ Recreation Dance.* (2018) 89:34–41. doi: 10.1080/07303084.2017.1404511
54. Lander NJ, Barnett LM, Brown H, Telford A. Physical education teacher training in fundamental movement skills makes a difference to instruction and assessment practices. *J Teach Phys Educ.* (2015) 34:548–56. doi: 10.1123/jtpe.2014-0043
55. Domangue E, Solmon M. Motivational responses to fitness testing by award status and gender. *Res Q Exerc Sport.* (2010) 81:310–8. doi: 10.1080/02701367.2010.10599679
56. Munshi FM, Al-Rukban MO, Al-Hoqail I. Reliability and validity of an Arabic version of the revised two-factor study process questionnaire R-SPQ-2F. *J Family Commun Med.* (2012) 19:33. doi: 10.4103/2230-8229.94010
57. Li CH. Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behav Res Methods.* (2016) 48:936–49. doi: 10.3758/s13428-015-0619-7
58. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling Multidisc J.* (1999) 6:1–55. doi: 10.1080/10705519909540118
59. Lewis TF. Evidence regarding the internal structure: confirmatory factor analysis. *Measur Evaluat Counsel Developm.* (2017) 50:239–47. doi: 10.1080/07481756.2017.1336929



60. Taylor R. Interpretation of the correlation coefficient: a basic review. *J Diagnostic Med Sonography*. (1990) 6:35–9. doi: 10.1177/875647939000600106
61. Comrey AL, Lee HB. *A First Course in Factor Analysis*. In: Hillsdale, NJ, Lawrence Erlbaum Associates. Inc., Publishers. (1992).
62. Hu LT, Bentler PM, Kano Y. Can test statistics in covariance structure analysis be trusted? *Psychol Bull*. (1992) 112:351–62. doi: 10.1037/0033-2909.112.2.351
63. Huéscar Hernández E, Moreno-Murcia JA, Cid L, Monteiro D, Rodrigues F. Passion or perseverance? The effect of perceived autonomy support and grit on academic performance in college students. *Int J Environ Res Public Health*. (2020) 17:2143. doi: 10.3390/ijerph17062143
64. Tang X, Wang MT, Guo J, Salmela-Aro K. Building grit: The longitudinal pathways between mindset, commitment, grit, and academic outcomes. *J Youth Adolesc*. (2019) 48:850–63. doi: 10.1007/s10964-019-00998-0
65. King RB, Ganotice Jr FA. Does family obligation matter for students' motivation, engagement, and well-being? It depends on your self-construal. *Pers Individ Dif*. (2015) 86:243–8. doi: 10.1016/j.paid.2015.06.027
66. Fosnacht K, Copridge K, Sarraf SA. How valid is grit in the postsecondary context? A construct and concurrent validity analysis. *Res Higher Educ*. (2019) 60:803–22. doi: 10.1007/s11162-018-9524-0
67. Gonzalez O, Canning JR, Smyth H, MacKinnon DP. A psychometric evaluation of the Short Grit Scale. *Eur J Psychol Assess*. (2019) 36:646–57. doi: 10.1027/1015-5759/a000535
68. Tyumeneva Y, Kuzmina J, Kardanova E. IRT analysis and validation of the Grit Scale: a Russian investigation. *Nat Res Univ Higher School*. (2014) 24:33. doi: 10.2139/ssrn.2527859
69. Hodge B, Wright B, Bennett P. The role of grit in determining engagement and academic outcomes for university students. *Res High Educ*. (2018) 59:448–60. doi: 10.1007/s11162-017-9474-y
70. Duckworth A, Gross JJ. Self-control and grit: Related but separable determinants of success. *Curr Dir Psychol Sci*. (2014) 23:319–25. doi: 10.1177/0963721414541462
71. Hochanadel A, Finamore D. Fixed and growth mindset in education and how grit helps students persist in the face of adversity. *J Int Educ Res (JIER)*. (2015) 11:47–50. doi: 10.19030/jier.v11i1.9099
72. Keegan K. Identifying and Building Grit in Language Learners. In: *English Teaching Forum* (Vol. 55, No. 3, pp. 2-9). US Department of State. Bureau of Educational and Cultural Affairs, Office of English Language Programs, SA-5, 2200 C Street NW 4th Floor, Washington, DC 20037. (2017).
73. Muenks K, Yang JS, Wigfield A. Associations between grit, motivation, and achievement in high school students. *Motivation Sci*. (2018) 4:158. doi: 10.1037/mot0000076
74. Wolters CA, Hussain M. Investigating grit and its relations with college students' self-regulated learning and academic achievement. *Metacogn Learn*. (2015) 10:293–311. doi: 10.1007/s11409-014-9128-9
75. Steinmayr R, Weidinger AF, Wigfield A. Does students' grit predict their school achievement above and beyond their personality, motivation, and engagement? *Contemporary Educ Psychol*. (2018) 53:106–22. doi: 10.1016/j.cedpsych.2018.02.004
76. Peltzer K, Pengpid S. *Health behaviour and self-reported academic performance among university students: an international study*. (2014). doi: 10.5901/mjss.2014.v5n27p998
77. Alzerwi NA. Grit scores: a predictor of medical school success? *Adv Med Educ Pract*. (2020) 11:537. doi: 10.2147/AMEP.S274616

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Guelmami, Chalghaf, Tannoubi, Puce, Azaiez and Bragazzi. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

## APPENDICES

**TABLE A1** | English version of the PE-Grit.

### Physical interest

- Even if I find physical difficulties during the training session, I find them very important.
- Even when I can do more fun things, I do not miss my physical training.
- \*I do not give much importance to physical training sessions.
- I am always interested in new physical exercises in my training sessions.

### Physical effort

- Intense physical exercise never discourages me.
- I can maintain adequate physical effort all year round.
- \*I spare no effort in completing the exercise.
- During the physical practice, I do whatever is necessary.

### Academic interest

- One of my interests is to go deeper into the theoretical side, regardless of the time it takes.
- I am always interested in acquiring new theoretical knowledge.
- \*Not all theoretical subjects are important.
- My theoretical duties are very important to me.

### Academic effort

- I finish my home exercises, no matter how hard they are.
- I always focus on class to acquire new knowledge.
- \*I do not always revise all theoretical subjects.
- I am diligent in all theoretical subjects.

\*The item score must be reversed.

Physical interest
- حتى لو وجدت صعوبات بدنية أثناء حصّة التدريب، أجدّها مهمة للغاية.
- حتى عندما يمكنني القيام بأشياء أكثر متعة، لا أفوت تدريبي البدني.
- لا أعطي أهمية كبيرة لحصص التدريب البدني.
- أنا مهتم دائمًا بالتمارين البدنية الجديدة في حصص التدريب الخاصة بي.
Physical effort
- التمارين البدنية المكثفة لا تحبط عزيمتي أبدًا.
- يمكنني الحفاظ على الجهد البدني الكافي على مدار السنة.
- لا أدخر جهدًا في إكمال التمرين.
- أثناء ممارسة الرياضة، أفعل كل ما هو ضروري.
Academic interest
- أحد اهتماماتي هو التعمق أكثر في الجانب النظري، بغض النظر عن الوقت الذي تستغرقه.
- أنا مهتم دائمًا باكتساب معرفة نظرية جديدة.
- ليست كل الموضوعات النظرية مهمة.
- واجباتي النظرية مهمة جدًا بالنسبة لي.
Academic effort
- أنهى تماريني المنزلية مهما كانت صعبة.
- أنا دائمًا أركز في الفصل لاكتساب معرفة جديدة.
- لا أقوم دائمًا بمراجعة جميع المواضيع النظرية.
- أنا مجتهد في جميع المواد النظرية.

**FIGURE A1** | The Arabic version of the PE-Grit.



# Development and Preliminary Validation of the Physical Education-Study Process Questionnaire : Insights for Physical Education University Students

Amayra Tannoubi<sup>1,2,3,4</sup>, Noomen Guelmami<sup>1,2,3</sup>, Tore Bonsaksen<sup>5,6</sup>, Nasr Chalghaf<sup>2,3,4</sup>, Fairouz Azaiez<sup>2,3,4</sup> and Nicola Luigi Bragazzi<sup>3,7,8\*</sup>

<sup>1</sup> Department of Human and Social Sciences, Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Jendouba, Tunisia, <sup>2</sup> Group for the Study of Development and Social Environment (GEDES), Faculty of Human and Social Science of Sfax, Sfax, Tunisia, <sup>3</sup> Department of Health Sciences, Postgraduate School of Public Health, University of Genoa, Genoa, Italy, <sup>4</sup> Department of Human Sciences, Higher Institute of Sport and Physical Education of Sfax, University of Sfax, Sfax, Tunisia, <sup>5</sup> Department of Health and Nursing Science, Faculty of Social and Health Studies, Inland Norway University of Applied Sciences, Elverum, Norway, <sup>6</sup> Department of Health, Faculty of Health Studies, VID Specialized University, Sandnes, Norway, <sup>7</sup> Department of Mathematics and Statistics, York University, Toronto, ON, Canada, <sup>8</sup> Department of Neuroscience, University of Genoa, Genoa, Italy

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Wanderson Silva,  
Federal University of Alfenas, Brazil  
Sai-fu Fung,  
City University of Hong Kong, Hong  
Kong SAR, China

### \*Correspondence:

Nicola Luigi Bragazzi  
robertobragazzi@gmail.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 16 January 2022

**Accepted:** 21 February 2022

**Published:** 17 March 2022

### Citation:

Tannoubi A, Guelmami N, Bonsaksen T, Chalghaf N, Azaiez F and Bragazzi NL (2022) Development and Preliminary Validation of the Physical Education-Study Process Questionnaire : Insights for Physical Education University Students. *Front. Public Health* 10:856167. doi: 10.3389/fpubh.2022.856167

**Background:** The Revised Two Factor Study Process Questionnaire (R-SPQ-2F) is used to examine students' study approaches in higher education. The questionnaire is designed to measure two factors: deep and surface approaches. In order to measure these approaches for students in physical education and sport, a new measurement instrument should take into consideration the practical context of this field of education that makes it specific to other fields.

**Objective:** The present study aims (a) to develop and empirical test of a new instrument for measuring the study process in physical education and sports students, and (b) to test psychometric properties of the tool.

**Methods:** Two exploratory and confirmatory samples of physical education students enrolled in a bachelor's degree program in physical education at the High Institute of Physical Education and Sports of Kef-Tunisia, aged 19–26 years, were recruited online among female students ( $n = 414$ ) and male students ( $n = 393$ ). The participants filled in Google Form survey including Physical Education-Study Process Questionnaire (PE-SPQ) and the Arabic version of the Revised Study Process Questionnaire-2 Factors (R-SPQ-2F).

**Results:** Exploratory factor analysis showed a suitable four factors solution, which is approved by confirmatory factor analysis indices [ $\chi^2 = 466.47$ , TLI = 0.94, CFI = 0.95; RMSEA = 0.56 IC 90% (0.050–0.062)]. Internal consistency of the PE-SPQ simultaneously checked by McDonald's  $\omega$ , Cronbach's  $\alpha$  and Gutmann's  $\lambda_6$  showed good reliability of the PE-SPQ. Convergent validity examined by Average variance extracted (AVE) was good. The comparison between the AVE root mean square and Pearson correlation coefficients of each factor with his indicators reveals the discriminant

validity of the PE-SPQ. Furthermore, Pearson's correlation between the PE-SPQ factors and the R-SPQ-2F establishes the concurrent validity of the new scale.

**Conclusion:** The PE-SPQ scale is valid and reliable and can be used to assess study process factors in physical education students.

**Keywords:** approach to learning, deep approach, physical education, surface approach, psychometric

## INTRODUCTION

In recent years, the learning process in secondary and higher education has been the subject of research in its proper context. Indeed, understanding the learning process is necessary to increase the quality of learning. Therefore, it is crucial to have a comprehensive view of the student learning process in education (1). In fact, studies have focused on finding ways of explaining some of the main differences in students' approach to learning (2, 3).

In higher education, quality of teaching and learning are as yet topics of debate (4). Moreover, learning approaches adopted by students are common concerns in different fields such as business, nursing, and psychology (5–9). Students do not always adopt the learning approach best suited to bring about desired academic achievements and success. The academic achievement and success seem to vary depending on these approaches (10, 11). Also, learning approaches are different processes by which a student obtains, assimilates, and retains knowledge (12). Indeed, the learning approach denotes the student's overall pattern of study behaviors and attitudes in a given learning context (13).

Hailikari and Parpala (14) specified that learning approaches represent the management of the study tasks by students. Two distinct learning approaches are commonly reported, referred to as the “*deep approach*” (DA), centered on comprehension of course material and seeking to relate ideas; and the “*surface approach*” (SA), driven by rote learning without self-reflection (15). The distinction between DA and SA is particularly useful for academics who want to understand their students' learning and create a suitable educational environment (2, 16). Previous studies reported that an adequate class climate encourages students to use a deep approach to learning (17–19).

In order to measure these learning approaches, researchers have developed several questionnaires (20), such as the “Approaches and Study Skills Inventory for Students (ASSIST)” (21) or the “Learning and Studying Questionnaire” (22). However, one of the most widely used instruments to measure student-learning approaches (2), is the “Study Process Questionnaire” [SPQ; (23)] which was later revised to “Revised Study Process Questionnaire-2 Factor” [R-SPQ-2F, (24)]. The

validity of this scale has been confirmed by various studies (25–32). Also, the R-SPQ-2F has been investigated in several countries, such as the USA (26), Japan (27), Ghana (33) and India (34). The tool confirmed its robustness to operationalize the DA and SA concepts in various fields of higher education, such as biology (32), dental medicine (35), orthopedics (36), and business (27). Likewise, different educational studies suggested that R-SPQ-2F scores were associated with personality, knowledge acquisition, academic performance, learning style preference, self-efficacy, goal orientation, and self-regulation strategies (37, 38).

It seems that to date, Physical education (PE) is a specific educational context with very distinct features, or something similar, and then outline how this discipline is distinct from others. The PE students must have theoretical knowledge in the humanities and social sciences, educational sciences, statistics, and biological and movement sciences (39, 40). Besides that, there is also practical training in individual sports, team sports and Martial arts (41, 42). Furthermore, in this field, the process of student training and learning involves several interdisciplinary (43) and transdisciplinary fields (44), and these students are able to become coaches and physical education teachers (45).

Several previous studies have noted future physical education will differ from education in other disciplines with regards to the physical structure of the classroom, characteristics of teaching content, professional tasks, and the status of the subject matter and teachers (46, 47).

Therefore, PE learning requires particular curriculum and tasks to prepare students for their careers: theoretical concerns, physical performance, technical skills acquisition, and practical knowledge.

PE students' learning approaches, may be related to this specific context. Indeed, the motivation of students in PE generally decreases after the first years. However, practical classes within academic PE settings are typically held in open spaces such as gymnasiums, tracks, and playgrounds, which will encourage students to view these classes as places to release their excess energy (48). As a result, concept measurements such as, satisfaction, autonomy, motivation, engagement and grit in learning of PE students is different from other students (49–52).

In relation to assessment, students who adopt a SA in the various subjects aim toward an accurate reproduction of the course (15). However, in PE the SA is linked to a practical component (e.g., proper execution of the sport movement). Also, the assessment of “theoretical knowledge” for PE students was conducted in a standard way, as in other more established subjects, by examinations, dissertations or multiple-choice questions (53). In contrast, the assessment of “practical

**Abbreviations:** AGFI, adjusted goodness-of-fit index; AVE, average variance extracted; CFI, comparative fit index; DA, deep approach; DPT, deep practical task; DTT, deep theoretical task; DWLS, Diagonally Weighted Least Squares; GFI, goodness-of-fit index; KMO, Kaiser-Meyer-Olkin; PE, physical education; PE-SPQ, physical education study process questionnaire; RMSEA, root mean square error of approximation; R-SPQ-2F, revised study process questionnaire-two-factors; SPT, surface practical task; SRMR, Standardized Root Mean Squared Residual; STT, surface theoretical task; TLI, Tucker-Lewis index.

knowledge” was less easy to achieve. Various assessment tools were developed, such as the use of motor skill and fitness tests, and point tables for performance in areas such as gymnastics, swimming and athletics.

However, hands-on PE classes may involve activities that are dangerous and characterized by its varied and vigorous aspect (54), such as contact sports or gymnastics (55), furthermore, the specificity of this environment may lead to safety-related incidents or issues compared to regular classrooms (56), such as injuries (57), sprains (58) or back pain (59). In addition, the PE student faces a range of contextual factors, that have the potential to present significant emotional demands (60, 61). These need to be addressed in the student’s curriculum in order to prepare them to implement contextually relevant instructional content. It is also important to note that learning in an environment where theoretical principles and practical applications are closely related helps future PE teachers bridge the gap between theory and practice and generate theory from practice (62). Depending on the students’ involvement within a practice or theoretical learning activity a surface approach or a deep approach (63) four possibilities can arise: Deep Theoretical Task (DTT), Surface Theoretical Task (STT), Deep Practical Task (DPT) and Surface Practical Task (SPT).

All these features may distinguish the physical education student from other students in different fields of study. However, to the best of our knowledge, there is no instrument to measure study approaches in the specific context of physical education. Given the importance of the concept of study approach to learning in educational settings, the aim of the present study is (a) to develop a new instrument: Physical Education Study Process Questionnaire (PE-SPQ) for measuring the study process in physical education and sports, and (b) to test the psychometric properties of the instrument in terms of factor structure, validity and reliability.

## MATERIALS AND METHODS

### Declaration of Ethics

This study has received the approval of the Ethics Committee of the “High Institute of Sport and Physical Education, Kef, University of Jendouba, Jendouba, Tunisia,” the “High Institute of Sport and Physical Education of Sfax” and the “High Institute of Sport and Physical Education of Gafsa.” The research was also approved by the Ethics Committee of the “University of Jendouba” and was undertaken in accordance with the legal standards of the “Declaration of Helsinki 1964” and its corresponding amendments.

Each participant was asked to complete the questionnaires after receiving an informed consent form. They were informed that there was no obligation to participate in the study, and that any refusal did not have to be justified. The study was described as a study of the vagaries of school life, without specifying the concepts of commitment to limit response bias.

### Participants and Data Collection

A sample of physical education students ( $n = 807$ ) were recruited online. No exclusion criteria were used. The participants were

enrolled in a bachelor’s degree program in physical education at the High Institute of Physical Education and Sports of Kef-Tunisia.

Participants were invited to take part in the study through social media: Facebook (official page of the institute) and e-mail. An electronic survey was administered using the online survey portal, *Google forms*® (Online survey services), provided by *Google Inc* (Google, California, USA), which is a cloud-based data management tool used universally to design and develop online questionnaires. This tool collects the email addresses of survey participants. By activating this option, each subject will only be limited to submitting one answer.

The age of the subjects varied between 19 and 26 years. Mean age was  $21.82 \pm 1.51$  years. The proportion of female participants ( $n = 414$ , 51.3%) was similar to that of men ( $n = 393$ , 48.7%). The subjects recruited for the study were divided into two groups to conduct both exploratory and confirmatory studies.

- A. Exploratory data were collected from 226 students aged 19–25 years ( $M = 21.90 \pm 1.35$ ). The subjects were recruited from both sexes, women ( $n = 101$ ; 44.69%) and men ( $n = 125$ ; 55.30%).
- B. Confirmatory data were collected from a total of 581 students aged 19–26 years ( $M = 21.79 \pm 1.57$ ). The subjects were male ( $n = 268$ ; 46.12%) and female ( $n = 313$ ; 53.87%).

## Instruments

### Study Variables

In our study, the variables of gender and age were considered as basic demographic characteristics.

### Arabic Version of the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F)

This version was adapted by Khine and Afari (31) among students from a teachers’ college in Abu Dhabi, UAE. The internal consistency (Cronbach alpha) for the 20-item questionnaire was considered acceptable reliability. Factor one, the deep approach (DA) with 10 items provided a Cronbach’s alpha of 0.81, factor two, the surface approach (SA) with 10 items was 0.76, which were considered acceptable. The results were above the acceptable level of 0.70 for a scale consistency test as suggested by Hair et al. (64) and DeVellis and Thorpe (65). The Cronbach alpha reliability results for are comparable somewhat with the Cronbach alpha values 0.73 and 0.64 as reported by the developers of the R-SPQ-2F.

### Physical Education Study Process Questionnaire PE-SPQ

The “Physical Education-Study Process Questionnaire” (PE-SPQ) was developed through a series of meetings among university teachers in educational sciences of pedagogical studies. They explored existing scales in the literature in relation to study processes (66–69). Also, the same procedure has been followed for the physical education context (70–74). However, given the theoretical and practical nature of PE training and assessment (75, 76), it was necessary to generate a pool of items that takes this specificity into account. Indeed, students in this field may opt for a deep approach to the content of practical subjects,



while they may operate using a surface approach to academic knowledge, and vice versa. Similarly, the student may choose different approaches to studying in practical and theoretical courses. The task of the committee charged with this study led to the elaboration of a questionnaire of 20 items, allowing to measure the study process through four dimensions [Deep Theoretical Task (DTT) and Surface Theoretical Task (STT) Deep Practical Task (DPT) and Surface Practical Task (SPT)], each of which includes five items [example: *I am often interested in reviewing the information provided in the theoretical courses (DTT)/ I manage my theoretical courses by repetition, and go over them several times until I memorize them without understanding the content (STT)/ I do my best in the practical courses because I find these sessions interesting (DPT)/ One of my goals is to pass the practical exams with as little effort as possible (SPT)*].

At this point, we were able to identify the key aspects that characterize the dimensions of the study process. In addition, we tried to integrate the specific characteristics of the study population into the items. When writing the items, we chose clearly comprehensible and unambiguous vocabulary. The recommendations were to generate standard items that are not specific to a particular environment and valid for studying the study process in PE students around the world.

Five female and male university teachers/researchers (two professors and three associate professors) with ages ranging from 41 to 48 years old made up a focus group. They devoted at least 15 years to all of their scientific and educational endeavors. Among the group are two of the manuscript's authors.

The focus group discussed to identify potential difficulties, which could pose problems related to the cultural context. The wording of the items that posed potential problems was then revised during the discussion. Finally, a pre-test of the paper version of the questionnaire was conducted on a group of females ( $n = 28$ ) and males ( $n = 24$ ) students to assess item comprehension.

Students participating in the survey responded to each item by choosing a categorical frequency response on a five-point Likert scale ranging from 1 (response A) to 5 (response E) (A: *never or rarely true for me*; B: *true for me occasionally*; C: *true for me every other time*; D: *often true for me*; E: *always or almost always true for me*).

## Statistical Analysis

Statistical analyses were performed using IBM SPSS version 26 (IBM Corp., Armonk, NY, USA), Lavaan package in RStudio and the free JASP 2020 software.

Preliminary analysis of the numerical data was carried out to examine the quality of the data collected and inspect for anomalies or missing boxes. Subsequently, univariate (Skewness and Kurtosis) and multivariate normality tests using the Mardia coefficient were performed and descriptive statistics for each variable were completed.

Exploratory factor analysis was performed by the Unweighted Least Squares method with Direct-Oblimin rotation and Kaiser normalization. Factor analysis was performed if KMO  $> 0.80$  and a significant Bartlett test's Chi-square (77).

**TABLE 1 |** Descriptive statistics, normality coefficients and Lambda factor loadings of the PE-SPQ.

	Mean	Std. deviation	Skewness	Kurtosis	Lambda
I1	3.80	1.11	−0.74	−0.19	0.93
I5	3.97	0.93	−0.69	0.13	0.87
I9	3.82	1.04	−0.55	−0.36	0.86
I13	3.66	1.02	−0.45	−0.19	0.84
I17	3.79	1.09	−0.69	−0.08	0.83
I2	3.37	1.28	−0.36	−0.93	0.86
I6	3.03	1.21	−0.06	−0.90	0.85
I10	2.83	1.22	0.15	−0.88	0.84
I14	2.80	1.28	0.19	−1.00	0.83
I18	2.99	1.24	−0.05	−0.86	0.67
I3	3.09	1.26	−0.01	−1.01	0.81
I7	3.07	0.98	0.12	−0.16	0.75
I11	3.02	1.17	0.03	−0.71	0.74
I15	3.13	1.35	−0.14	−1.14	0.73
I19	2.95	1.28	−0.01	−1.03	0.68
I4	3.00	1.12	−0.05	−0.57	0.85
I8	3.10	1.30	−0.07	−1.02	0.76
I12	3.29	1.34	−0.18	−1.09	0.74
I16	2.85	1.36	0.14	−1.17	0.70
I20	3.10	1.26	−0.11	−0.89	0.69

The reliability of the instrument was examined simultaneously by the Cronbach coefficient  $\alpha$ , the McDonald coefficient  $\omega$  and the Gutmann's coefficient  $\lambda_6$ .

A Cronbach's  $\alpha$  above the threshold of 0.70 was considered as acceptable, above 0.80 as good, and between 0.90 and 0.95 as excellent). The questionnaire structure for the entire population was carried out by confirmatory factor analysis (CFA). For the McDonald coefficient  $\omega$  and the Gutmann's coefficient  $\lambda_6$ , Values above 0.70 were considered appropriate (78–80).

The confirmatory factorial analysis was conducted by the robust Diagonally Weighted Least Squares (DWLS) method (81). According to Comrey and Lee (82), the robustness of an indicator, in CFA, is demonstrated with his high factor loadings. Thresholds suggest that a factor loading  $> 0.71$  is considered excellent,  $> 0.63$  is considered very good,  $> 0.55$  is considered acceptable and  $< 0.45$  is considered poor.

Several CFA indices were used to examine the model: (1) the  $\chi^2$ ; (2)  $\chi^2/DF$ ; (3) the Comparative Fit Index (CFI); (4) the Tucker-Lewis Index (TLI); (5) Standardized Root Mean Square Residual, and (6) the Root Mean Square of error Approximation RMSEA.

Hu and Bentler (83) suggested values  $> 0.95$  for the CFI and TLI, and RMSEA values  $< 0.08$  for reasonable adjustments.

Convergent validity and discriminant validity were assessed, respectively, by calculating the average variance extracted (AVE) and comparing the square roots of the AVE values to the correlation coefficients between latent constructs (84). Discriminant validity is demonstrated when the variance shared by two different latent constructs is less than the variance shared

**TABLE 2** | Internal consistency of the PE-SPQ.

Dimensions	McDonald's $\omega$	Cronbach's $\alpha$	Guttman's $\lambda_6$	Average interitem correlation	Mean	Sd
DTT	0.86	0.86	0.83	0.55	19.04	4.14
DPT	0.86	0.86	0.86	0.55	15.02	4.97
STT	0.91	0.91	0.89	0.66	15.27	5.18
SPT	0.94	0.93	0.92	0.74	15.33	5.70

DPT, Deep Practical Task; DTT, Deep Theoretical Task; SPT, Surface Practical Task; STT, Surface Theoretical Task.

by that variable and its indicators. This implies that the square root of the AVE must be greater than all correlations between latent constructs.

Concurrent validity was examined by Pearson's correlation between the scores of the four scale factors and the scores measured on the Arabic R-SPQ-2F.

## RESULTS

### Normality and Descriptive Statistics

Statistical analysis began with the calculation of descriptive statistics (Table 1) (means and standard deviations) and inspection of the distributions of the 20 questionnaire items. For each item, the distribution appeared to be normal given the measures of kurtosis  $[-2, 2]$  and skewness  $[-3, 3]$ .

### Exploratory Factor Analysis

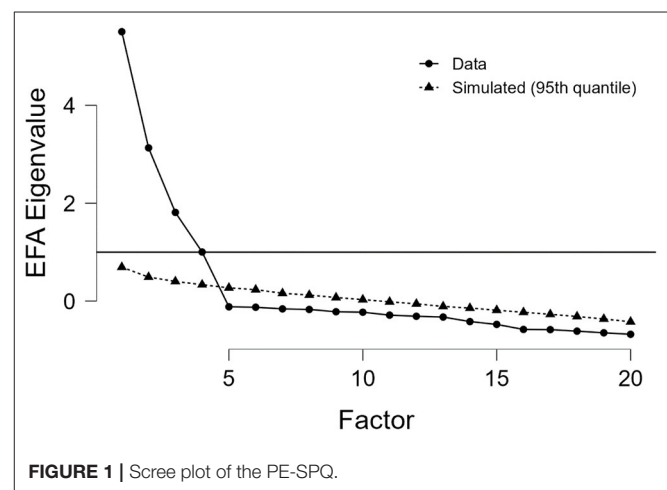
The 20 items of PE-SPQ were submitted to exploratory factor analysis using the Unweighted Least Squares method. Sampling adequacy is supported by the KMO = 0.88, which measures sampling quality and the quality of the correlation matrices by the Bartlett significant test ( $\chi^2 = 4812.023, p < 0.001$ ).

The results of the exploratory factor analysis by the Unweighted Least Squares method holding a Direct-Oblimin rotation with Kaiser normalization suggested the extraction of four factors that explain 64.8% of the variance. The first, the second, the third and the last factors explained 28.8% (Eigenvalue = 5.76), 18.10% (Eigenvalue = 3.61), 11.2% (Eigenvalue = 2.24) and 6.7% (Eigenvalue = 1.35), respectively.

As shown in Figure 1, the purpose of the cut function is to select factors with Eigenvalue's superior to 1. The collected data and the simulated data (which are generated by the JASP software) showed a four-factor solution: the factors retained must be above the cut-off line perpendicular to the axis of the Eigenvalues (intersection for Eigenvalue = 1).

### Internal Consistency

The scale showed a good consistency coefficient for all components. For the DTT, McDonald's  $\omega$ , Cronbach's  $\alpha$  and Guttman's  $\lambda_6$  was 0.86, 0.86 and 0.83, respectively. A similar coefficient with a 0.86 value was demonstrated for DPT. In addition, for STT and SPT reliability coefficient are ranged between 0.89–0.91 and 0.92–0.94, respectively. These values indicated a good internal consistency for each of the four scales (see Table 2).

**FIGURE 1** | Scree plot of the PE-SPQ.

### Confirmatory Factor Analysis

The univariate and descriptive statistics for the sample used in the confirmatory factor analysis are shown in Appendix Table 1. The multivariate Mardia's coefficient (4.56,  $z = 6.59, p < 0.01$ ) indicated adequate multivariate normality.

The CFA results provided evidence for the four-factor structure of PE-SPQ. All the factorial weights of our items range from acceptable to excellent, as shown in Figure 2.

The results of the indices from the CFA showed a consistent first-order model with four factors, consistent with the theoretical model tested for the developed version of the scale (see Figure 2).

The  $\chi^2/df$  value is 2.84, the GFI index is 0.92, the AGFI index is 0.90. Moreover, RMSEA is 0.056, CFI is 0.95 and TLI is 0.94. Therefore, the theoretical model, which is a priori posed, was correctly reproduced by the empirically collected data.

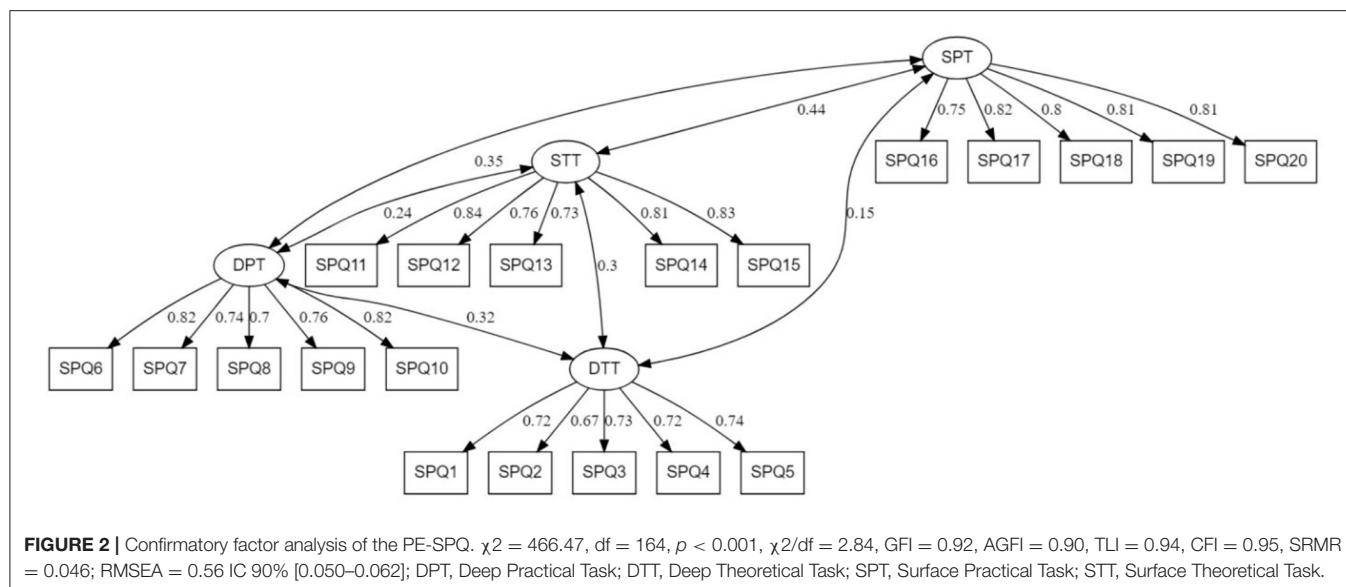
### Convergent and Discriminant Validity

Convergent validity was examined by the average variance extracted (AVE). The AVE values were 0.51, 0.60, 0.62 and 0.64 for DTT, DPT, STT, SPT, respectively. These values demonstrated a good convergent validity of PE-SPQ. In addition, the AVE root mean square was lower than the correlations between factors (see Table 3). This confirms the discriminant validity of PE-SPQ.

### Concurrent Scale Validity

To examine the concurrent validity of the scale, we performed the Pearson correlation of the four dimensions with the R-SPQ-2F scores. The results showed that DTT, and DPT are



**TABLE 3 |** Pearson moment correlation between PE-SPQ and SPQ-2F.

	DTT	DPT	STT	SPT	Deep	Surface
DTT	0.72 <sup>£</sup>					
DPT	0.27**	0.77 <sup>£</sup>				
STT	0.26**	0.23**	0.79 <sup>£</sup>			
SPT	0.12**	0.31**	0.40**	0.80 <sup>£</sup>		
Deep	0.34**	0.12**	0.07	0.024	-	
Surface	-0.03	0.13**	0.21**	0.33**	0.39**	-

\*\* $p < 0.01$ ; £ Root mean square AVE.

significantly and positively correlated with the Deep ( $r = 0.34$  ( $p < 0.01$ ), and  $r = 0.12$  ( $p < 0.01$ ), respectively). However, no links between STT and SPT with Deep was demonstrated ( $r = 0.07$  and  $r = 0.024$ , respectively). No correlation was demonstrated between Surface and DTT. In addition, a weak correlation was found between Surface and DPT. Finally, significant correlations were affirmed on the one hand between Surface and STT ( $r = 0.21$ ,  $p < 0.01$ ), and on the other hand between Surface and SPT ( $r = 0.33$ ,  $p < 0.01$ ).

## DISCUSSION

The aim of the present study is (a) to develop a new instrument: Physical Education Study Process Questionnaire (PE-SPQ) for measuring the study process in physical education and sports, and (b) to test the psychometric properties of the instrument in terms of factor structure, validity and reliability.

A four-factor scale was designed and empirically tested for physical education and sports students in Tunisia. The statistical results showed that the constructed measurement scale was appropriate for exploratory factor analysis. Empirical data for the 20 initially developed items were well-aligned with the proposed

four factors of PE-SPQ. As a result, no item has been deleted. The results of the exploratory factor analysis suggest the presence of four factors that explain 64.8% of total variance. These outcomes are consolidated by the stability of the first-order solution which provided adequate fit indices. The results of the factorial structure in the two analyses are aligned with several studies which highlighting two distinct types of learning process. The distinct learning types suggest that an instrument for measuring learning process should be composed of items reflecting two factors [for example: Munchi et al. (85) and Hernández et al. (86)]. These results are similar to those of Biggs (87), whose study supported a two-factor structure through principal component analysis with varimax rotation. A pervious confirmatory factor analysis also supported the presence of two distinct components for the Surface and Deep subscales (87). However, other studies were unable confirm this structure [e.g., Stes et al. (28)].

Additionally, Justicia et al. (25) criticized the fact that in previous studies, each factor analysis was performed on the same sample. Although the factor loadings from the exploratory factor analysis supported the two-factor structure, mixed results were found in the fit indices from the confirmatory factor analysis [e.g., Fryer et al. (27)]. In contrast, Johnson et al. (32) found low fit indices using the weighted least squares (WLS) estimator. However, considerable improvement was confirmed using a maximum likelihood estimate.

In our study, we addressed the criticism of previous studies by conducting an exploratory factor analysis with one subset of the sample and a confirmatory factor analysis on another subset. The results of the confirmatory analysis supported the four-factor structure found in the exploratory analysis. Also, the factor analysis results from Immekus and Imbrie (26) did not support the factor structure of the original scale, suggesting instead an alternative four-factor model. The addition of the two factors DPT and SPT was similar to the original work, arguing that the hands-on learning process requires a deep component

and a surface component. The present work is considered the first psychometric review of a scale that takes these factors into account.

Similarly, the reliability tests supported that the instrument is reliable among the four constructs. The confirmatory factor analysis showed the measurement robustness of the 20 items scale. These results were sustained by adequate convergent and discriminant validity and confirmed the robustness of the PE-SPQ as a new measure of study process in physical education. Additionally, the factors DTT and DPT are significantly and positively correlated with the Deep learning approach. Likewise, a weak correlation was found between Surface approach learning and DPT. These results demonstrated the concurrent validity of the PE-SPQ.

According to our best knowledge, no study has explored the validity and reliability of a questionnaire that measures the university study process in the context of physical education and sport. Similarly, the Biggs scale (24) widely used in the academic context has never been explored in this area.

In line with our findings regarding the four-factor structure of the questionnaire, Immekus and Imbrie (26) attempted a cross-validation of the two-factor questionnaire (R-SPQ-2F) on the basis of separate data from two samples of students attending a university in the United States ( $n = 1,490$  and  $n = 1,533$ ). The results of the factor analysis did not support the original factor structure of the scale, suggesting instead an alternative four-factor model of the data. Indeed, the integration of items that includes the physical dimension suggests a four-factor model. Similarly, the results of the multi-sample confirmatory factor analysis indicated that the parameters of the scaling model (e.g., factor loadings) were invariant in the independent samples.

The R-SPQ-2F scale was recently used in this study to evaluate learning approaches in 13 different subjects of four degrees (8, 88, 89). Item reliability analysis showed high consistency for the primary scales, but not for the secondary scales of the R-SPQ-2F questionnaire. In line with our results, a strong correlation between the deep and surface scale was observed. In another work, Khine and Afari (31) explored the reliability and validity of an adapted and translated Arabic version of the R-SPQ-2F questionnaire administered to students at a higher education institution in the United Arab Emirates. The analysis showed that the four factor of the Arabic version of the questionnaire was valid, as shown in both exploratory and confirmatory factor analysis. Similarly, the reliability of the tool was demonstrated by the classical Cronbach alpha index and the AVE (Average Variance Extracted) and CR (Composite Reliability).

Indeed, in different studies related to the cultural context, Biggs' questionnaire has been used to evaluate students' learning methods and its effectiveness has been evaluated in different socio-cultural contexts. In fact, the R-SPQ-2F questionnaire has been adapted to several languages (27–33) and has been tested in a variety of contextual areas such as medical students (90, 91), and chemistry students (92). For example, in medical studies, a deep learning approach has been demonstrated among students in Ghana (33), in Saudi Arabia (90) and in Malaysia (93). Similar results were obtained in business, computer science and engineering programs (94, 95). These results are different with

those obtained among our participants. A variety of approaches are used by students in physical education. In fact, studies within the framework of physical education have not taken into account the specific characteristics of this subject (96). As a result, the physical component that is part of the curriculum and in assessments was overlooked (41, 42). By examining the curricula and the training of the students, except to find that the physical practice contributes significantly to the success among students in the institutes of physical education and sport. This systematically leads students to adopt different strategies. A significant mass of students can focus on physical practice to be successful if they have adequate athletic skills, while others focus on theoretical subjects to be successful.

To better explain the learning approach among our participants, we must explore the criteria for admission and success in these universities. For example, in the physical education and sports institutes in Tunisia, the official program of the LMD regime requires the student to capitalize a set of credits or an equivalence in notes of 50% regardless of the nature of the subjects. In other words, a student who has 10/20 as a general average successfully completed his university year. As a result, the student who excels in sports practice can succeed even with low marks in theoretical subjects. If this student has a good sports background as an example elite athlete, he may be successful in this discipline. While a middle-level student concentrates on theoretical subjects to fill in athletic deficiencies. These justifications can well explain the weak association between Deep approach with STT and SPT.

In Saudi Arabia, DA learning was generally associated with more hours of study and higher grades. In the same context and according to a study in the Netherlands (97), law students scored higher on DA than on SA, although many scored low on both learning approaches. Similarly, students of physical education have a very heavy learning content through practical and theoretical sessions. Because of this, these students may have different orientations and a different Grit (52).

Another study conducted in Australia with chemistry students using Biggs' original questionnaire found that DA learning was related to the assessment of learning objectives and the approach to learning and benefits was primarily affected by age (16). However, our study, was conducted among students without a great difference in age and academic years practice (3 years). Meanwhile, in Hong Kong, research using Biggs' unedited questionnaire and interviews revealed that DA learning was strongly correlated with age and negatively correlated with academic year (98).

However, according to studies conducted in Japan by Fryer et al. (27), validation of the Biggs questionnaire was performed against the DA and SA, but not against the subscales of the questionnaire, which showed distinct relationships that were not found in previous studies and could be explained by cultural motives. Work also conducted in China by Leung, Ginns et al. (99) found that learners adopted more intermediate approaches to learning, where memorization was a tool for understanding. Biggs' questionnaire was even used to test learners' progress in a subject area and the influence of the flipped lesson approach (100). Positive correlations were found between the DA and

learners' learning outcomes (16, 100, 101). More studies are needed to examine PE-SPQ, in other cultural context.

As well as comparative studies of different question choice models that determine DA and SA learning in the Biggs questionnaire (102). The latter compared the findings of Biggs' work (24) in Hong Kong with those that evaluated the questionnaire in different contexts, [e.g., Spain (103); Japan (27); the United States (26, 102), Netherlands (28) or Norway (104)]. These studies have also indicated that there may be cultural differences that explain different results and have shown controversy regarding the grouping of test questions (26, 102, 104). In addition, another study comparing the results of students in Hong Kong and Sydney confirmed differences that could be attributed to cultural causes (99).

These studies analyzed the approach to learning in many contexts, but there is no detailed study that includes Tunisia's sociocultural conditions in a sport science learning environment. In the study, the approach of PE students was analyzed according to different degrees and levels, and the factors that influence their response were assessed.

We are aware that our research has some limitations. First, the instrument was only tested on a single population living in a single country. Second, multiple studies are needed to examine the study processes surveyed by the PE-SPQ across socio-demographic variables such as age and gender.

## CONCLUSION AND IMPLICATIONS

The present study led to the design of the PE-SPQ questionnaire which is a new instrument adapted to the discipline. The tool was empirically tested in terms of its psychometric properties. The data confirmed the validity of the questionnaire in physical education and sport degrees. The measurement scale was stable, as evidenced by the exploratory factor analysis. Similarly, reliability tests proved that the scales derived from the instrument have good internal consistency. The confirmatory factor analysis showed the measurement robustness of the 20 items of the scale. Also, the four dimensions of the scale (DTT, DPT, STT, SPT) correlated with the deep and surface learning approach scales according to the expected pattern, which demonstrates its concurrent validity.

## REFERENCES

1. Strom KJ, Viesca KM. Towards a complex framework of teacher learning-practice. *Prof Dev Educ.* (2021) 47:209–24. doi: 10.1080/19415257.2020.1827449
2. Asikainen H, Gijbels D. Do students develop towards more deep approaches to learning during studies? a systematic review on the development of students' deep and surface approaches to learning in higher education. *Educ Psychol Rev.* (2017) 29:205–34. doi: 10.1007/s10648-017-9406-6
3. Campos DG, Alvarenga MRM, Morais SCRV, Gonçalves N, Silva TBC, Jarvill M, et al. A multi-centre study of learning styles of new nursing students. *J Clin Nurs.* (2022) 31:111–20. doi: 10.1111/jocn.15888
4. Owusu GMY, Kwakye TO, Bekoe RA, Welbeck E. Approaches to learning of accounting students in Ghana. *UCP Manag Rev UCPMR.* (2019) 3:69–93. doi: 10.24312/ucpmr030112

The findings of the study could be strengthened in future research by including more subjects from different disciplines and related subjects, and from other Tunisian universities. Future studies could confirm the number of factors and the associations of questions with the different scales of the R-SPQ-2F questionnaire and investigate the influence of pedagogical dynamics in the students' learning approaches in each subject.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Jendouba, Tunisia, the Higher Institute of Sport and Physical Education of Sfax and the Higher Institute of Sport and Physical Education of Gafsa. The research was also approved by the Ethics Committee of the University of Jendouba and was undertaken in accordance with the legal standards of the Declaration of Helsinki 1964 and its corresponding amendments. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

AT conceived and designed the experiment. AT, NG, and NB collected and analyzed data. AT, NG, TB, NC, FA, and NB wrote the manuscript. All authors approved the submission.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.856167/full#supplementary-material>

5. Stover S, Holland C. Students' approach to learning over time. *Nurse Educ Pract.* (2021) 52:103026. doi: 10.1016/j.nepr.2021.103026
6. Alhammadi S. The effect of the COVID-19 pandemic on learning quality and practices in higher education—using deep and surface approaches. *Educ Sci.* (2021) 11:462. doi: 10.3390/educsci11090462
7. Piumatti G, Abbiati M, Gerbase MW, Baroffio A. Patterns of change in approaches to learning and their impact on academic performance among medical students: longitudinal analysis. *Teach Learn Med.* (2021) 33:173–83. doi: 10.1080/10401334.2020.1814295
8. Appleton-Knapp SL, Krentler KA. Measuring student expectations and their effects on satisfaction: the importance of managing student expectations. *J Mark Educ.* (2006) 28:254–64. doi: 10.1177/0273475306293359
9. Hard BM, Dunn DS, Musselman R, Hudson DL, Richmond AS. Designing the introductory psychology course: an evidence-informed framework.

- In: *Transforming Introductory Psychology: Expert Advice on Teacher Training, Course Design, and Student Success*. Washington, DC; American Psychological Association (2022).
10. Kyndt E, Dochy F, Struyven K, Cascallar E. The perception of workload and task complexity and its influence on students' approaches to learning. A study in higher education. *Eur J Psychol Educ*. (2011) 26:393–415. doi: 10.1007/s10212-010-0053-2
  11. Sam L. Relationship between learning approaches and academic achievement of accounting education students. *Int J Sci Res Publ IJSRP*. (2020) 10:919–24. doi: 10.29322/IJSRP.10.07.2020.p103103
  12. Alsayed S, Alshammari F, Pasay-an E, Dator WL. Investigating the learning approaches of students in nursing education. *J Taibah Univ Med Sci*. (2021) 16:43–9. doi: 10.1016/j.jtumed.2020.10.008
  13. Shah DK, Yadav RL, Sharma D, Yadav PK, Sapkota NK, Jha RK, et al. Learning approach among health sciences students in a medical college in Nepal: a cross-sectional study. *Adv Med Educ Pract*. (2016) 7:137–43. doi: 10.2147/AMEP.S100968
  14. Hailikari TK, Parpala A. What impedes or enhances my studying? the interrelation between approaches to learning, factors influencing study progress and earned credits. *Teach High Educ*. (2014) 19:812–24. doi: 10.1080/13562517.2014.934348
  15. Entwistle N, Peterson E. Learning styles and approaches to studying. *Encycl Appl Psychol*. (2004) 537–42. doi: 10.1016/B0-12-657410-3/00487-6
  16. Zeegers P. Approaches to learning in science: a longitudinal study. *Br J Educ Psychol*. (2001) 71:115–32. doi: 10.1348/000709901158424
  17. Dart BC, Burnett PC, Purdie N, Boulton-Lewis G, Campbell J, Smith D. Students' conceptions of learning, the classroom environment, and approaches to learning. *J Educ Res*. (2000) 93:262–70. doi: 10.1080/00220670009598715
  18. Jamilah, Isnani G. The influence of classroom climate, learning interest, learning discipline and learning motivation to learning outcomes on productive subjects. *JPBM J Pendidikan Bisnis Dan Manaj*. (2017) 3:85–96. doi: 10.17977/um003v3i22017p085
  19. Roslan TRN, Ch'ng CK, Chuah F. Understanding Students' Intention to Engage in Deep Learning: Application of the Theory of Planned Behaviour. *Ilk Online*. (2021) 20:490–501. doi: 10.17051/ilkonline.2021.04.54
  20. Smarandache IG, Maricutoiu LP, Ilie MD, Iancu DE, Mladenovici V. Students' approach to learning: evidence regarding the importance of the interest-to-effort ratio. *High Educ Res Dev*. (2021) 1–6. doi: 10.1080/07294360.2020.1865283
  21. Entwistle NJ, McCune V, Tait H. *The Approaches and Study Skills Inventory for Students (ASSIST)*. Edinburgh: Centre for Research on Learning and Instruction, University of Edinburgh (1997). p. 1–21.
  22. Entwistle N. Threshold concepts and transformative ways of thinking within research into higher education. *Threshold Concepts Discip*. (2008) 16:21–36. doi: 10.1163/9789460911477\_003
  23. Biggs JB. *Student Approaches to Learning and Studying*. Research Monograph, Australian Council for Educational Research Ltd. ERIC (1987).
  24. Biggs J, Kember D, Leung DYP. The revised two factor study process questionnaire: R-SPQ-2E. *Br Jounai Educ Psycho*. (2001) 71:133–49. doi: 10.1348/000709901158433
  25. Justicia F, Pichardo MC, Cano F, Berben A, De la Fuente J. The revised two-factor study process questionnaire (R-SPQ-2F): exploratory and confirmatory factor analyses at item level. *Eur J Psychol Educ*. (2008) 23:355–72. doi: 10.1007/BF03173004
  26. Immekus JC, Imbrie P. A test and cross-validation of the revised two-factor study process questionnaire factor structure among western university students. *Educ Psychol Meas*. (2010) 70:495–510. doi: 10.1177/0013164409355685
  27. Fryer LK, Ginns P, Walker RA, Nakao K. The adaptation and validation of the CEQ and the R-SPQ-2F to the Japanese tertiary environment. *Br J Educ Psychol*. (2012) 82:549–63. doi: 10.1111/j.2044-8279.2011.02045.x
  28. Stes A, De Maeyer S, Van Petegem P. Examining the cross-cultural sensitivity of the revised two-factor study process questionnaire (R-SPQ-2F) and validation of a Dutch version. *PLoS ONE*. (2013) 8:e54099. doi: 10.1371/journal.pone.0054099
  29. Xie Q. Validating the revised two-factor study process questionnaire among Chinese university students. *Int J*. (2014) 16:1.
  30. McLaughlin J, Durrant P. Student learning approaches in the UAE: the case for the achieving domain. *High Educ Res Dev*. (2017) 36:158–70. doi: 10.1080/07294360.2016.1176998
  31. Khine MS, Afari E. Cross-cultural adaptation of R-SPQ-2F: validation and psychometric properties. *Int J Quant Res Educ*. (2018) 4:255–68. doi: 10.1504/IJQRE.2018.092333
  32. Johnson SN, Gallagher ED, Vagnozzi AM. Validity concerns with the revised study process questionnaire (R-SPQ-2F) in undergraduate anatomy & physiology students. *PLoS ONE*. (2021) 16:e0250600. doi: 10.1371/journal.pone.0250600
  33. Mogre V, Amalba A. Assessing the reliability and validity of the revised two factor study process questionnaire (R-SPQ2F) in Ghanaian medical students. *J Educ Eval Health Prof*. (2014) 11:19. doi: 10.3352/jeehp.2014.11.19
  34. Bhuria M, Mangalesh S, Dudani S, Malik A. Learning approaches adopted by Indian medical students during distance learning: the revised two-factor study process questionnaire. *BLDE Univ J Health Sci*. (2021) 6:150. doi: 10.4103/bjhs.bjhs\_104\_20
  35. Bana K, Fatima K. Comparing the learning approaches using biggs revised study process questionnaire (R-SPQ-2F) among dental undergraduates. *JPDA*. (2019) 28:68–73. doi: 10.25301/JPDA.282.68
  36. Vaughan B. A rasch analysis of the revised study process questionnaire in an Australian osteopathy student cohort. *Stud Educ Eval*. (2018) 56:144–53. doi: 10.1016/j.stueduc.2017.12.003
  37. Chamorro-Premuzic T, Furnham A, Lewis M. Personality and approaches to learning predict preference for different teaching methods. *Learn Individ Differ*. (2007) 17:241–50. doi: 10.1016/j.lindif.2006.12.001
  38. Skogsberg K, Clump M. Do psychology and biology majors differ in their study processes and learning styles? *Coll Stud J*. (2003) 37:27–34. doi: 10.1037/e416902005-760
  39. Kinchin GD, O'Sullivan M. Incidences of student support for and resistance to a curricular innovation in high school physical education. *J Teach Phys Educ*. (2003) 22:245–60. doi: 10.1123/jtpe.22.3.245
  40. O'Donovan T. A changing culture? interrogating the dynamics of peer affiliations over the course of a sport education season. *Eur Phys Educ Rev*. (2003) 9:237–51. doi: 10.1177/1356336X030093003
  41. MacPhail A, Kirk D, Kinchin G. Sport education: promoting team affiliation through physical education. *J Teach Phys Educ*. (2004) 23:106–22. doi: 10.1123/jtpe.23.2.106
  42. Wallhead TL, Ntoumanis N. Effects of a sport education intervention on students' motivational responses in physical education. *J Teach Phys Educ*. (2004) 23:4–18. doi: 10.1123/jtpe.23.1.4
  43. Bouffard M, Spencer-Cavaliere N. Interdisciplinarity in adapted physical activity. *Quest*. (2016) 68:4–14. doi: 10.1080/00336297.2015.1117002
  44. Castelli DM. Evidence of the essential components: modeling transdisciplinary team science to improve physical education. *Res Q Exerc Sport*. (2021) 92:199–201. doi: 10.1080/02701367.2021.1877607
  45. Zhang T, Wang Y, Yli-Piipari S, Chen A. Power of the curriculum: content, context, and learning in physical education. *Res Q Exerc Sport*. (2021) 92:689–700. doi: 10.1080/02701367.2020.1768202
  46. Koustelios A, Tsigilis N. The relationship between burnout and job satisfaction among physical education teachers: a multivariate approach. *Eur Phys Educ Rev*. (2005) 11:189–203. doi: 10.1177/1356336X05052896
  47. Tsigilis N, Zournatzi E, Koustelios A. Burnout among physical education teachers in primary and secondary schools. *Int J Humanit Soc Sci*. (2011) 1:53–8. Available online at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.453.9284&rep=rep1&type=pdf>
  48. MacDonald CJ, Baker D, Stewart S. Student teachers in the classroom: associate teachers' perspectives. *McGill J Educ*. (1995) 30:73–96.
  49. White RL, Bennie A, Vasconcellos D, Cinelli R, Hilland T, Owen KB, et al. Self-determination theory in physical education: a systematic review of qualitative studies. *Teach Teach Educ*. (2021) 99:103247. doi: 10.1016/j.tate.2020.103247
  50. Vasconcellos D, Parker PD, Hilland T, Cinelli R, Owen KB, Kapsal N, et al. Self-determination theory applied to physical education: a systematic review and meta-analysis. *J Educ Psychol*. (2020) 112:1444. doi: 10.1037/edu0000420
  51. Brooks C, McMullen J. Level up: strategies to increase student engagement using gamification in physical education.



- Strategies*. (2021) 34:3–10. doi: 10.1080/08924562.2021.1977749
52. Choi J-A, Seo G. Structural relationship between teachers' passion and autonomy, relationship support, and grit in middle school physical education. *J Korean Appl Sci Technol*. (2020) 37:1752–63. doi: 10.12925/jkocs.2020.37.6.1752
  53. López-Pastor VM, Kirk D, Lorente-Catalán E, MacPhail A, Macdonald D. Alternative assessment in physical education: a review of international literature. *Sport Educ Soc*. (2013) 18:57–76. doi: 10.1080/13573322.2012.713860
  54. Porsanger L. Risk and safety management in physical education: teachers' knowledge. *Phys Educ Sport Pedagogy*. (2021) 11:321. doi: 10.1080/17408989.2021.1934663
  55. Spittle M, Kremer P, Sullivan S. Burnout in secondary school physical education teaching. *Facta Univ Ser Phys Educ Sport*. (2015) 13:33–43.
  56. Shoval E, Erlich I, Feigin N. Mapping and interpreting novice physical education teachers' self-perceptions of strengths and difficulties. *Phys Educ Sport Pedagogy*. (2010) 15:85–101. doi: 10.1080/17408980902731350
  57. Dobrosielski DA, Sweeney L, Lisman PJ. The association between poor sleep and the incidence of sport and physical training-related injuries in adult athletic populations: a systematic review. *Sports Med*. (2021) 51:777–93. doi: 10.1007/s40279-020-01416-3
  58. Lysdal FG, Bandholm T, Tolstrup J, Clausen M, Mann S, Petersen P, et al. 018 Spraino® reduces the risk of lateral ankle sprain injury among indoor sport athletes: a pilot randomized controlled trial with 510 participants. *Br J Sports Med*. (2021) 55(Suppl. 1):A7–8. doi: 10.1136/bjsports-2021-IOC.17
  59. Wilson F, Thornton JS, Wilkie K, Hartvigsen J, Vinther A, Ackerman KE, et al. 2021 consensus statement for preventing and managing low back pain in elite and subelite adult rowers. *Br J Sports Med*. (2021) 55:893–9. doi: 10.1136/bjsports-2020-103385
  60. Lee YH. Emotional labor, teacher burnout, and turnover intention in high-school physical education teaching. *Eur Phys Educ Rev*. (2019) 25:236–53. doi: 10.1177/1356336X171719559
  61. Barker D, Nyberg G, Larsson H. Joy, fear and resignation: investigating emotions in physical education using a symbolic interactionist approach. *Sport Educ Soc*. (2020) 25:872–88. doi: 10.1080/13573322.2019.1672148
  62. Sevimli-Celik S. Moving between theory and practice: preparing early childhood pre-service teachers for teaching physical education. *J Early Child Teach Educ*. (2021) 42:281–98. doi: 10.1080/10901027.2020.1735588
  63. Dolmans DH, Loyens SM, Marcq H, Gijbels D. Deep and surface learning in problem-based learning: a review of the literature. *Adv Health Sci Educ*. (2016) 21:1087–112. doi: 10.1007/s10459-015-9645-6
  64. Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL. Multivariate data analysis 6th Edition. *Pearson Prentice Hall N J Hum Crit Reformul J Abnorm Psychol*. (2006) 87:49–74.
  65. DeVellis RF, Thorpe CT. *Scale Development: Theory and Applications*. Newbury Park, CA: Sage Publications (2021).
  66. Riechmann SW, Grasha AF. A rational approach to developing and assessing the construct validity of a student learning style scales instrument. *J Psychol*. (1974) 87:213–23. doi: 10.1080/00223980.1974.9915693
  67. Uygün MA. Scale for determining learning approaches to piano lesson: development, validity and reliability. *Procedia-Soc Behav Sci*. (2012) 51:916–27. doi: 10.1016/j.sbspro.2012.08.263
  68. Dolmans DH, Wolfhagen IH, Ginns P. Measuring approaches to learning in a problem based learning context. *Int J Med Educ*. (2010) 1:55–60. doi: 10.5116/ijme.4c50.b666
  69. Abedin NFZ, Jaafar Z, Husain S, Abdullah R. The validity of ASSIST as a measurement of learning approach among MDAB students. *Procedia-Soc Behav Sci*. (2013) 90:549–57. doi: 10.1016/j.sbspro.2013.07.125
  70. Gusthart JL, Kelly IM, Rink JE. The validity of the qualitative measures of teaching performance scale as a measure of teacher effectiveness. *J Teach Phys Educ*. (1997) 16:196–210. doi: 10.1123/jtpe.16.2.196
  71. Soini M, Liukkonen J, Watt A, Yli-Piipari S, Jaakkola T. Factorial validity and internal consistency of the motivational climate in physical education scale. *J Sports Sci Med*. (2014) 13:137–44.
  72. Kayisoglu NB. Validity and reliability studies for scale of evaluating physical education teachers based on student ratings (SEPETBSR). *J Phys Educ Sport Manag*. (2015) 6:60–9. doi: 10.5897/JPEM2015.0238
  73. Hilland TA, Brown TD, Fairclough SJ. The physical education predisposition scale: preliminary tests of reliability and validity in Australian students. *J Sports Sci*. (2018) 36:384–92. doi: 10.1080/02640414.2017.1308002
  74. Selickaite D, Hutzler Y, Pukenas K, Block ME, Reklaitiene D. The analysis of the structure, validity, and reliability of an inclusive physical education self-efficacy instrument for Lithuanian physical education teachers. *SAGE Open*. (2019) 9. doi: 10.1177/2158244019852473
  75. Feu S, García-Rubio J, Gamero M de G, Ibáñez SJ. Task planning for sports learning by physical education teachers in the pre-service phase. *PLoS ONE*. (2019) 14:e0212833. doi: 10.1371/journal.pone.0212833
  76. Lander NJ, Barnett LM, Brown H, Telford A. Physical education teacher training in fundamental movement skills makes a difference to instruction and assessment practices. *J Teach Phys Educ*. (2015) 34:548–56. doi: 10.1123/jtpe.2014-0043
  77. Sharma S. *Applied Multivariate Techniques*. New York, NY: John Wiley & Sons Inc. (1996).
  78. Bland J, Altman DG. Cronbach's alpha. *BMJ*. (1997) 314:572. doi: 10.1136/bmj.314.7080.572
  79. Nunnally J, Bernstein I. *Psychometric Theory 3Edn*. New York, NY: Tata McGraw-hill Education (1994).
  80. Hair JF, Hult GTM, Ringle CM, Sarstedt M, Danks NP, Ray S. An introduction to structural equation modeling. In: *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R*. Springer (2021). p. 1–29.
  81. Li C-H. Confirmatory factor analysis with ordinal data: comparing robust maximum likelihood and diagonally weighted least squares. *Behav Res Methods*. (2016) 48:936–49. doi: 10.3758/s13428-015-0619-7
  82. Comrey A, Lee H. *A First Course in Factor Analysis: Psychology Press*. New York, NY: Taylor and Francis Group (2013).
  83. Hu L, Bentler PM. Structural equation modeling: a multidisciplinary journal cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Model*. (1999) 6:37–41. doi: 10.1080/10705519909540118
  84. Hair Jr JF, Sarstedt M, Hopkins L, Kuppelwieser VG. Partial least squares structural equation modeling (PLS-SEM): an emerging tool in business research. *Eur Bus Rev*. (2014) 26:106–21. doi: 10.1108/EBR-10-2013-0128
  85. Munshi FM, Al-Rukban MO, Al-Hoqail I. Reliability and validity of an Arabic version of the revised two-factor study process questionnaire R-SPQ-2F. *J Fam Community Med*. (2012) 19:33. doi: 10.4103/2230-8229.94010
  86. Hernández CV, Pallares MS, Muñoz ZC. Psychometric properties of the revised two-factor study process questionnaire R-SPQ-2F-Spanish version. *Duazary Rev Int Cienc Salud*. (2019) 16:205–18. doi: 10.21676/2389783X.2744
  87. Biggs J. What do inventories of students' learning processes really measure? a theoretical review and clarification. *Br J Educ Psychol*. (1993) 63:3–19. doi: 10.1111/j.2044-8279.1993.tb01038.x
  88. Floyd KS, Harrington SJ, Santiago J. The effect of engagement and perceived course value on deep and surface learning strategies. *Informing Sci Int J Emerg Transdiscipl*. (2009) 12:181–90. doi: 10.28945/435
  89. Hu X, Yeo GB. Emotional exhaustion and reduced self-efficacy: the mediating role of deep and surface learning strategies. *Motiv Emot*. (2020) 44:785–95. doi: 10.1007/s11031-020-09846-2
  90. Shaik SA, Almarzuqi A, Almogheer R, Alharbi O, Jalal A, Alorainy M. Assessing Saudi medical students learning approach using the revised two-factor study process questionnaire. *Int J Med Educ*. (2017) 8:292. doi: 10.5116/ijme.5974.7a06
  91. Paudel KR, Nepal HP, Shrestha B, Panta R, Toth S. Distribution and academic significance of learning approaches among pre-clinical medical students at Trinity School of Medicine, St Vincent and the Grenadines. *J Educ Eval Health Prof*. (2018) 15:9. doi: 10.3352/jeehp.2018.15.9
  92. Ninković SO, Adamov J, Ješić LV. Relation between learning approaches of chemistry students and their achievement in general chemistry. *Maced J Chem Chem Eng*. (2019) 38:293–300. doi: 10.20450/mjce.2019.1784
  93. Ismail H, Hassan A, Muhamad MM, Ali WZW, Konting MM. Epistemological belief and learning approaches of students in higher institutions of learning in Malaysia. *Int J Instr*. (2013) 6.
  94. Choo PGS. Assessing the approaches to learning of twinning programme students in Malaysia. *Malays J Learn Instr*. (2006) 3:93–116. doi: 10.32890/mjli.3.2006.7585



95. Rahman WRA, Dzulkifli MA, Sulaiman W. Reliability of second-order factor of a revised two-factor study process questionnaire (R-SPQ-2F) among university students in Malaysia. *AJTLHE ASEAN J Teach Learn High Educ.* (2013) 5:1–13. Available online at: [http://journalarticle.ukm.my/6492/1/1\\_AJTLHE\\_56\\_shahrazad.pdf](http://journalarticle.ukm.my/6492/1/1_AJTLHE_56_shahrazad.pdf)
  96. Guelmami N, Chalghaf N, Tannoubi A, Puce L, Fairouz A, Bragazzi NL. Initial development and psychometric evidence of physical education grit scale (PE-GRIT). *Front Public Health.* (2022) 53.
  97. Gijbels D, Van de Watering G, Dochy F, Van den Bossche P. The relationship between students' approaches to learning and the assessment of learning outcomes. *Eur J Psychol Educ.* (2005) 20:327–41. doi: 10.1007/BF03173560
  98. Gow L, Kember D. Does higher education promote independent learning? *High Educ.* (1990) 19:307–22. doi: 10.1007/BF00133895
  99. Leung DY, Ginns B, Kember D. Examining the cultural specificity of approaches to learning in universities in Hong Kong and Sydney. *J Cross-Cult Psychol.* (2008) 39:251–66. doi: 10.1177/0022022107313905
  100. Jeong SY, Kim W, Byun BH, Kong C-B, Song WS, Lim I, et al. Prediction of chemotherapy response of osteosarcoma using baseline 18F-FDG textural features machine learning approaches with PCA. *Contrast Media Mol Imaging.* (2019) 2019:3515080. doi: 10.1155/2019/3515080
  101. Watkins C. *Learning About Learning Enhances Performance*. London: Institute of Education, University of London (2001)
  102. Socha A, Sigler EA. Exploring and “reconciling” the factor structure for the revised two-factor study process questionnaire. *Learn Individ Differ.* (2014) 31:43–50. doi: 10.1016/j.lindif.2013.12.010
  103. Frăsineanu ES. Approach to learning process: superficial learning and deep learning at students. *Procedia-Soc Behav Sci.* (2013) 76:346–50. doi: 10.1016/j.sbspro.2013.04.125
  104. Zakariya YF. Study approaches in higher education mathematics: Investigating the statistical behaviour of an instrument translated into Norwegian. *Educ Sci.* (2019) 9:191. doi: 10.3390/educsci9030191
- Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
- Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Tannoubi, Guelmami, Bonsaksen, Chalghaf, Azaiez and Bragazzi. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Predicting Student Engagement: The Role of Academic Belonging, Social Integration, and Resilience During COVID-19 Emergency Remote Teaching

Melissa Versteeg, Rutger F. Kappe\* and Carlijn Knuiman

Research Group Study Success, Department Education and Innovation, Inholland University of Applied Sciences, Haarlem, Netherlands

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic  
University, China

### Reviewed by:

Joshua Weidlich,  
Leibniz Institute for Research and  
Information in Education  
(DIPF), Germany  
Laura Jefferson,  
University of York, United Kingdom

### \*Correspondence:

Rutger F. Kappe  
rutger.kappe@inholland.nl

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 06 January 2022

**Accepted:** 11 February 2022

**Published:** 18 March 2022

### Citation:

Versteeg M, Kappe RF and  
Knuiman C (2022) Predicting Student  
Engagement: The Role of Academic  
Belonging, Social Integration, and  
Resilience During COVID-19  
Emergency Remote Teaching.  
Front. Public Health 10:849594.  
doi: 10.3389/fpubh.2022.849594

**Background:** The COVID-19 pandemic has forced higher education (HE) to shift to emergency remote teaching (ERT), subsequently influencing academic belonging and social integration, as well as challenging students' engagement with their studies.

**Aims:** This study investigated influences on student engagement during ERT, based on student resilience. Serial mediation analyses were used to test the predictive effects between resilience, academic belonging, social integration, and engagement.

**Methods:** The Student Well-being Monitor (SWM 2021) was completed by 1332 HE students studying at Inholland University of Applied Sciences in the Netherlands. Predictive models were compared among students with low, normal, or high resilience using SPSS extension Macro PROCESS.

**Results:** A significant serial mediation model was found among all HE students, including positive mediating effects of academic belonging and social integration. More so, independent partial predictive effects of academic belonging and social integration on engagement were also present. Assessment of student resilience profiles revealed substantial differences between predictive models. For low resilience students, serial mediation was present and included the largest partial predictive effect from social integration compared to other groups. For highly resilient students, mediation via academic belonging was found, including the strongest partial and indirect effects compared to other groups.

**Conclusions:** Overall, academic belonging and social integration positively mediate the effect of resilience on engagement in addition to demonstrating independent positive predictive effects. Inspection of resilience profiles reveals substantial model fit differences, suggesting use of different engagement strategies between student groups. Findings contribute to understanding of HE student engagement during ERT in the Netherlands and provide novel insight on the mechanisms between resilience and engagement. While

ERT continues to be required, engagement may be enhanced by stimulating academic belonging for all students generally, but low resilience students could be best served by additionally targeting social integration and resilience.

**Keywords:** resilience, engagement, academic belonging, social integration, higher education, students, emergency remote teaching

## INTRODUCTION

The rapid transition toward emergency remote teaching (ERT) during the COVID-19 pandemic has had major impacts on student life (1–6). Implemented among higher education institutes (HEIs) as a strategy to curb the spread of the corona virus (7), ERT has been found to coincide with decreased quality of education, negative reactions to online learning, psychological distress, and feelings of uncertainty (8–15). Lack of interaction with teachers and students, prolonged negative mood, and fear of academic delay are impacting higher education (HE) students' well-being and learning (9, 11, 16–18). To date, no detailed study has examined wellbeing and student success during ERT among HE students in the Netherlands.

Engagement is an important precursor of student success (19–21), with studies linking engagement to academic achievement and adaptive coping styles (19, 20). Moreover, significant relationships exist between engagement and wellbeing aspects such as burn-out, depression, and anxiety (6, 9, 22–26). Engagement of HE students can be conceptualized as an enduring and widespread affective-cognitive state (27) including subcomponents of vigor, absorption, and dedication (23, 28–33). Vigor entails a willingness to invest in academic studies, dedication regards a sense of enthusiasm toward studying, and absorption involves becoming engrossed or absorbed by study materials when studying (23).

Engagement has also been found to depend on students' learning environments and interactions with fellow students and teachers (19, 34). The academic environment influences students' sense of belonging, including feeling accepted and valued, and whether they 'fit' with their environment (35–37). Moreover, sense of belonging is described as an essential psychological human need, which can be extrapolated to the need to belong within educational settings (38). The level by which individuals experience belongingness within educational settings affects engagement, the quality of social interactions with peer students, and academic performance (39, 40).

Social integration plays a significant direct and indirect role in engagement too (40, 41), as studies positively link students' sense of belonging to social interactions with fellow students and engagement (42–44). Students who feel like they do not belong will extend such beliefs into their social behaviors, risking isolation from peer students and risking reduced academic success (38, 39). A study even reported the strongest predictive effect between students' social interactions and engagement levels (41). Although ERT research has investigated changes in engagement related to study activity dynamics, student mindsets, and technology use among students (3, 12, 45), it has yet to examine belongingness and social integration during ERT.

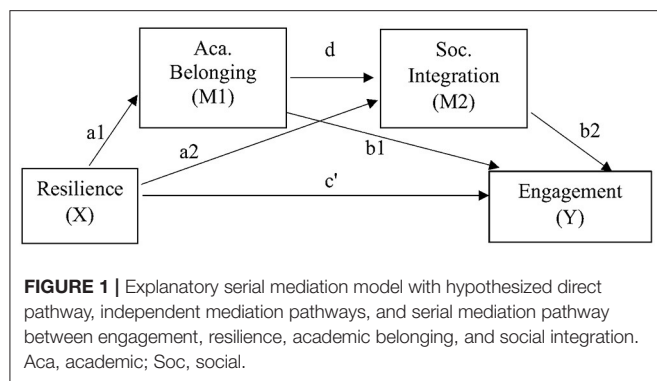
With students reporting increased isolation (46) and decreased quality of student social interactions (47) during the pandemic, investigation into these variables is called for.

Resilience is also pivotal to engagement, academic achievement, and wellbeing (24, 38, 43–55), and is defined as an individual's ability to bounce back following stress exposure (56). Resilience is furthermore deemed critical to maintained mental wellbeing throughout stressful experiences linked to the COVID-19 pandemic (13, 57). The increased experience of stress among students during this time (58, 59), may thus be navigated more successfully by sufficiently resilient students, and positive relationships between student resilience and engagement have been reported under non-ERT conditions (60, 61). More so, a recent study on teacher resilience during ERT did show significant associations between maintenance of teaching quality and resilience during ERT (62), though no studies on resilience and engagement among HE students during ERT exist currently.

ERT differs from online distance learning as ERT is developed to provide educational access during an emergency or crisis and is quick to set up, focused on short-term solutions, and pays little attention to design (63–65). As a consequence, engagement during ERT involves specific challenges, with engagement linked to adaptivity to online teaching, attendance, emotional states, and teaching strategies (6, 10, 16, 18). Studies have yet to analyse student resilience profiles related to engagement during ERT. As a result, the current study elected to examine the relationships between these constructs among students studying via ERT at HEIs.

With research on face-to-face learning indicating positive directional associations between resilience, engagement, belongingness and collaborations with fellow students (24, 35, 37–40, 49–51, 60), we also expect positive predictive effects among these constructs in HE students during ERT. Regarding group differences, expectations draw from findings indicating that resilient students utilize their academic environment effectively (50), and successfully use social relationships with peers to promote engagement (41, 43). Furthermore, given study outcomes indicating that highly resilient individuals can 'thrive' during stress exposure (56, 66), we expect the predictive model effects to be lowest among HE students with low resilience, and highest among highly resilient HE students.

The hypothesized model explores the presence of a direct predictive effect of resilience on engagement, in addition to exploring the presence of indirect predictive effects from academic belonging, social integration, and a serial mediating effect between the two (**Figure 1**). More so, student groups were included based on resilience levels, so as to assess predictive model fit between groups. The extended study hypotheses



#### BOX 1 | Study hypotheses.

- A direct predictive effect of resilience on engagement, where resilience positively predicts engagement.
- A mediation effect of academic belonging, where a higher sense of academic belonging has a stronger positive effect on engagement.
- A mediation effect of social integration, where a higher level of social integration has a stronger positive effect on engagement.
- A serial mediation effect where the indirect effect of academic belonging on social integration predicts a positive effect on engagement.

can be viewed in detail in **Box 1**. To our knowledge, no studies to date have sought to analyse academic belonging, social integration, and engagement among resilience-based HE student groups during the COVID-19 pandemic and ERT. As such, the current study will serve to expand scientific insight, in addition to informing student engagement and well-being strategies during periods of emergency remote teaching in higher education.

## METHOD

### Survey

Between May 17th and May 22nd, 2021, students were invited to complete the Student Well-being Monitor 2021 (SWM 2021). Invitations were sent via email, and the survey was completed online via Qualtrics survey tool in accordance with European guidelines on General Data Protection Regulation (GDPR). The study was approved on ethical standards as defined by the institutional review board at Inholland University of Applied Sciences.

The SWM 2021 entails an extensive survey to assess well-being and student success via multiple broad domains including concerns and worries centered around the COVID-19 pandemic, the experienced changes due to the ERT transition, experience of study-related burn-out symptoms, engagement and resilience, and aspects of study behavior and integration. All domains and items included in the SWM 2021 are available elsewhere (46).

In the Netherlands, the HE system offers two distinct forms of higher education. The first includes an academic research oriented higher education offered by research universities (in Dutch: wetenschappelijk onderwijs), whereas the second entails higher professional education offered by universities of applied sciences (in Dutch: hoger beroepsonderwijs). The current study focused exclusively on participants from universities of applied sciences.

## Participation

Participation was voluntary and participants were invited to partake in the study if they were currently enrolled and were aged 17 years or older, and were studying at Inholland University of Applied Science. Consent was required prior to proceeding. All participants who had successfully completed the survey were included in the dataset.

## Measurements

### Engagement

Student engagement was measured with the ultra-short Utrecht Work Engagement Scale-Student Form (UWES-3SF), a self-reported three-item scale with acceptable reliability and validity for use among HE students (30–32). The questionnaire required respondents to indicate occurrence frequency along a 7-point scale ranging from ‘never’ (1) to ‘always’ (7). The UWES-3SF captures student engagement along three subdomains, namely vigor, dedication, and absorption. Items include the statements ‘I have an abundance of energy when I study’, ‘I am enthusiastic about my study’, and ‘I am completely absorbed by my study’. Total scores were averaged with higher scores indicating a higher level of engagement. Cronbach’s alpha for the UWES-3SF was .822.

### Resilience

Resilience was measured using the Brief Resilience Scale (BRS) which is a short, self-reported 6-item measure of which validity and reliability has been assessed in other cohort studies (56). An indication of agreement with the statements was required according to a 5-point Likert scale, ranging from ‘total disagreement’ (1) to ‘total agreement’ (5). BRS items include ‘I tend to bounce back quickly after hard times’, ‘I have a hard time making it through stressful events’, and ‘it does not take me long to recover from a stressful event’. Four items had to be reversed prior to summing and averaging scale scores. BRS summed mean scores can be grouped to classify resilience as low, normal, or high using mean scores and standard deviations (66). Within the sample, the Cronbach’s alpha value of the BRS was .872.

### Academic Belonging

With available literature emphasizing a need for clearly defined constructs (21, 34, 35, 67, 68), this study developed and evaluated a short scale of academic belonging. Based on available questionnaires on behavioral, emotional, extracurricular, academic, and social engagement within the HE study context (69–71), relevant items were selected by the authors for analyses. Subsequently, items were assessed to scrutinize content validity,

ambiguity, and applicability within online educational settings. Finally, items were analyzed using oblique factor analysis, reliability analysis, and Pearson's moment-product correlation testing to confirm valid and reliable subscale use (72).

The analyses revealed that academic belonging could be measured using a 6-item scale (Table 1). The items included statements such as 'I feel like I can be myself within this study', 'my teachers know me', and 'teachers make sure students feel safe to ask questions', all of which required responses along a 5-point Likert scale. Response categories ranged from 'strong disagreement' (1) to 'strong agreement' (5). Summed mean scores were calculated with higher scores indicating a higher sense of academic belonging. Reliability analysis of the scale demonstrated a Cronbach's alpha of .837.

## Social Integration

To assess social integration, four out of thirteen original items from the Social Integration subscale were used (69). The four items were selected based on applicability within the ERT context and 'Cronbach's alpha if item deleted'. Implications of this selection process are further described in the limitations. Subsequently, an oblique principal components analysis was run to assess factor loadings, in addition to analyzing reliability and construct validity (Table 1). Results indicate that the reduced number of items taken from the original social integration subscale could assess social integration in the student sample. Items required participants to assess their level of agreement with the statements along a 5-point Likert scale, ranging from 'strong disagreement' (1) to 'strong agreement' (5). The items included 'I can share my emotions and stories with fellow students', and 'I approach fellow students to work together on (online) assignments'. Average scores were calculated, with higher scores indicating higher social integration. The 4-item scale demonstrated a Cronbach's alpha of .784.

## Statistical Analysis

IBM SPSS Statistics for Windows, Version 27.0 was used to carry out analyses. The extension Macro PROCESS (73) version 3.5 was used to test model fit of a serial mediation effect of academic belonging and social integration on the direct effect of resilience on engagement. Bootstrapping techniques used in Macro PROCESS are robust against violations of normality by using confidence intervals to assess effect significance (74, 75), so no data transformations are required. Bootstrap resampling value was set at 5,000. To assess *post-hoc* power probabilities for the student groups, G\*Power software version 3.1.9.6 was used (76).

A serial mediation analysis was conducted to estimate effect sizes and model fit for four groups: (1) all HE students, (2) students who reported low levels of resilience, (3) students who reported normal levels of resilience, and (4) students who reported high levels of resilience during the COVID-19 pandemic. During each analysis, the nature of the relationship between resilience and engagement (X and Y) was assessed directly, in addition to testing the indirect effect resulting from the two mediators academic belonging and social integration

(M1 and M2), as well as their indirect serial mediating effect (Figure 1). The analytical workflow was derived from previous methods where multiple mediation analysis is based on two conditions. First, an examination is made to conclude whether the set of mediators transmits the effect of X to Y, and second, the specific indirect effect associated with each presumed mediator is tested. Within this framework, total indirect effects need not be significant for identification of relevant specific indirect effects (74).

Total, direct, indirect, and partial effects included in the model were described as statistically significant when the corresponding 95% confidence interval of the unstandardized effect size coefficient *b* did not contain zero. If the direct path between X and Y (*c'*) was significant, and all three indirect pathways ( $a_1 \times b_1$ ;  $a_2 \times b_2$ ; and  $a_1 \times d \times b_2$ ) yielded significant results, a partial serial mediation model is present. If the *c'* path effect between X and Y is non-significant and the three indirect pathways are significant, a full serial mediation model is present. If any of the indirect pathways fail to reach significance, the remaining partial pathways were examined. Each of the pathways was tested by regressing the corresponding variables. If the *b* coefficient of the estimated direct, serial indirect, or independent indirect effects occurred within a 95% confidence interval range excluding zero, the null hypothesis of no significant predictive effect was rejected.

A covariate inspection was conducted to identify variables that should be controlled for during the model fit analyses. To identify these, relevant sociodemographic and study trajectory variables were included based on indications of associations to engagement in available literature (25, 29, 32). As such, age, gender, study year, living arrangements, and study domain were inspected to determine if they displayed significant correlations to the dependent variable engagement. Subsequently, significantly correlated variables were examined to determine correlations with the independent variables. If a significant correlation to the dependent variable was present without additional significant correlations to the independent variables, inclusion criteria as covariate were met (72).

## RESULTS

### Sample

A total of 1,848 participants completed the SWM 2021 survey. Data homogeneity inspection revealed that enrolment status created a significant impact on the distribution of the dependent variable;  $F(2,1844) = 27.590$ ,  $p < 0.001$ . *Post-hoc* contrasts indicated that fulltime enrolment was significantly different from other forms of enrolment. Furthermore, students who identified as gender 'x' included 19 individuals, which failed to meet sample size criteria (72). A significant effect of study year was also found, where students studying 5 years or longer demonstrated different academic performance outcomes;  $F(4,1842) = 81.148$ ,  $p < 0.001$ . Language (Dutch or English) displayed no significant effect on the outcome variable. As a result, all fulltime HE enrollers, studying for no more than 4 years, who identified as male or female were included in the final sample. The final sample contained 1,332 students of mean age 21.62 years ( $SD = 3.162$ ).



**TABLE 1 |** Scale assessment using Oblimin principal components analysis with Kaiser Normalization and Pearson's moment product correlation coefficient analysis for items and scale constructs of academic belonging.

Item	Component loadings						
	1	2	3	4	5		
I feel at home at this study	0.735	0.102	−0.132	0.210	0.248		
I feel like I can be myself within this study	0.713	0.054	−0.154	0.182	0.220		
My teachers know me	0.513	0.087	−0.060	0.021	−0.307		
Teachers are committed to their students	0.673	−0.051	−0.016	−0.047	−0.314		
Teachers make sure students feel safe to ask questions	0.764	−0.058	0.026	−0.036	−0.133		
Teachers are receptive to suggestions and feedback for improvements	0.778	−0.012	0.111	−0.146	−0.066		
I participate in thinking about, and discussing, ways to improve education	−0.050	0.542	−0.108	0.065	−0.316		
I commit myself to the higher education institute	−0.022	0.733	−0.035	−0.083	−0.109		
I participate in extra (online) activities provided by my study	0.029	0.760	0.039	0.097	0.088		
I participate in (online) social activities that are hosted by my study or study association	0.028	0.779	−0.022	−0.062	0.131		
I am committed to my fellow students	−0.025	0.152	−0.733	0.095	−0.069		
I can share my emotions and stories with fellow students	0.065	−0.032	−0.777	−0.010	−0.073		
Being in touch with my fellow students helps me to perform well	0.061	−0.008	−0.752	−0.097	−0.002		
I approach fellow students to work together on (online) assessments	−0.096	0.027	−0.737	0.099	−0.060		
I work hard to succeed in my studies and spend a sufficient amount of time	−0.050	−0.002	−0.033	0.837	0.050		
Usually, I participate in all study activities	0.122	0.015	−0.070	0.690	−0.004		
I am rarely behind with the coursework for my study	−0.011	−0.045	−0.012	0.781	−0.051		
I do not regularly do other things during class (e.g., Whatsapp, Facebook)	−0.046	0.144	0.293	0.357	−0.273		
On occasions I discuss personal matters with teachers	0.113	0.167	−0.124	−0.085	−0.655		
I know the names of the teachers whose classes I follow	0.048	−0.106	−0.126	0.201	−0.552		
I discuss gained insights with teachers	0.120	0.080	−0.096	0.106	−0.655		
Keeping in contact with teachers has a positive effect on my results	0.439	0.006	−0.059	−0.037	−0.453		
Pearson's moment product cross-correlations							
Academic belonging (6 items)	1.	2.	3.	4.	5.	6.	Scale
1. I feel at home at this study	(−)	0.676***	0.431***	0.405***	0.404***	0.344***	0.720***
2. I feel like I can be myself within this study	.	(−)	0.460***	0.395***	0.404***	0.322***	0.716***
3. My teachers know me	.	.	(−)	0.509***	0.425***	0.360***	0.726***
4. Teachers are committed to their students	.	.	.	(−)	0.604***	0.589***	0.792***
5. Teachers make sure students feel safe to ask questions	.	.	.	.	(−)	0.621***	0.774***
6. Teachers are receptive to suggestions and feedback for improvements	.	.	.	.	.	(−)	0.731***
Social Integration (4 items)							
1. I am committed to my fellow students			(−)	0.586***	0.440***	0.477***	0.792***
2. I can share my emotions and stories with fellow students			.	(−)	0.494***	0.448***	0.819***
3. Being in touch with my fellow students helps me to perform well			.	.	(−)	0.422***	0.748***
4. I approach fellow students to work together on (online) assessments			.	.	.	(−)	0.760***

\*significant at  $p < 0.05$ . \*\*significant at  $p < 0.01$ . \*\*\*significant at  $p < 0.001$ .

Of the respondents 481 were male (36.1%), and the remaining 851 were female (63.9%). The sample is described in further detail in **Table 2**.

No missing data was detected. More so, no outliers were identified as all variables were measured using Likert-scale

responses. The final dataset was screened for violations that would prevent accurate use of Macro PROCESS. A Shapiro-Wilk normality test revealed non-normal data (Shapiro-Wilk statistic = 0.988,  $p < 0.001$ ). However, the bootstrapping techniques used in Macro PROCESS are robust against

**TABLE 2 |** Sociodemographic characteristics of participants ( $N = 1,332$ ).

	<i>N</i>	%
<b>Age in years</b>		
<18	33	2.5
18–20	481	36.1
21–23	563	42.3
24–27	200	15.0
>28	55	4.1
<b>Gender</b>		
Male	481	36.1
Female	851	63.9
<b>Study year</b>		
First	397	29.8
Second	397	29.8
Third	289	21.7
Fourth	249	18.7
<b>Living arrangements</b>		
Living at home with parent(s) or guardian(s)	981	73.6
Living independently with(out) roommates	351	26.4
<b>Language status</b>		
Dutch	1,174	88.1
English	158	11.9
<b>Study domain</b>		
Agri, food and life science	100	7.5
Business, finance, and law	310	23.3
Creative business	301	22.6
Health, sport, and well-being	307	23.0
Education and Innovation	79	5.9
Engineering, design & IT	235	17.6

violations of normality (74, 75), so no data transformations were needed.

Average scores of the final sample are displayed in **Table 3**. Calculation of low, normal, and high resilience student groups utilized the sample mean and standard deviation for all HE students ( $M = 2.894$ ,  $SD = 0.793$ ). As such, scores up to 2.101 were used to indicate 'low' resilience, scores ranging between 2.101 and 3.687 indicated 'normal' resilience, and scores above 3.687 were labeled as demonstrating 'high' resilience. 15.77% ( $N = 210$ ) could be classified as having low resilience, 68.77% ( $N = 916$ ) were classified as having normal resilience, and 15.47% ( $N = 206$ ) reported a high level of resilience. *Post-hoc* examination of statistical power demonstrated sufficient detection power for all HE students groups (73). The power coefficient to detect small effect sizes was 1.000 for all HE students and the group of students with normal resilience. Among low resilience students the power coefficient was 0.998, and for high resilience students it came to 0.997.

## Covariates

Covariate analyses demonstrated that study year and living arrangement were the only variables with a significant correlation to engagement (age:  $r = -0.014$ ,  $p = 0.607$ ; gender:  $r = 0.034$ ,  $p =$

$0.213$ ; study domain:  $r = 0.029$ ,  $p = 0.289$ ; study year:  $r = -0.165$ ,  $p < 0.001$ ; living arrangement:  $r = -0.070$ ,  $p = 0.011$ ). More so, no significant correlations were found between either study year, or living arrangements, and the independent variables. Therefore, study year and living arrangement were controlled as covariates in the subsequent model analyses.

## All Students

For all HE students, the total predictive effect of the hypothesized model was 0.137 (**Tables 3, 4**), with indirect effects accounting for 67.79% of the total effects. Furthermore, the  $R^2$  indicates an explained variance of 21%, suggesting moderate and adequate model fit (77). For both academic belonging and social integration, higher levels of resilience predicted higher levels of the mediators, which in turn predicted higher engagement (**Figure 2A**). Results demonstrate a full serial mediation model for all HE students' engagement, where resilience, academic belonging, and social integration are significant positive predictors of engagement, which aligns with the research expectations.

Of the indirect effects, the strongest predictive effect involves the pathway via academic belonging, at 78.73% of total indirect effect, with effect size 0.073. The indirect effect via social integration was smaller at 8.21% of the total indirect effects, whereas the serial mediating indirect effect was 13.07% of the total indirect effects. In addition, results display positive partial effects between academic belonging and social integration, and from academic belonging on engagement, with effects classified as large and very large (78).

## Students With Low Resilience

Students with low levels of resilience also reported the lowest levels of academic belonging, social integration, and engagement (**Table 3**). More so, total predictive effects of the model did not reach significance, although the  $R^2$  value indicates moderate and adequate model fit (77) at 0.20 (**Table 4**). Of the total effects, 94.72% originated from significant indirect effects via independent and serial mediation of academic belonging and social integration. Of the indirect effect total, 55.20% stemmed from the significant indirect pathway through academic belonging, and 20.35% came from the significant serial mediation effect of both mediators.

No significant indirect effect via social integration was found, even though the partial predictive effect from social integration on engagement was largest compared to other student groups (compared to all students: +170%, compared to normal resilience: +220%, compared to high resilience: +180%) (**Figure 2B**). Furthermore, compared to other groups, low resilience students display the smallest partial effect of academic belonging on engagement, at  $B = 0.285$  (compared to all students:  $-15.68\%$ , compared to normal resilience:  $-13.64\%$ , compared to high resilience:  $-27.11\%$ ).

In contrast to research expectations, a larger serial mediation effect was present at an effect size of 0.022 (compared to all students: +183%, compared to normal resilience: +440%, compared to high resilience: +220%). Findings demonstrate the presence of serial mediation via both academic belonging and

**TABLE 3 |** Descriptive statistics and Pearson's correlations of engagement, resilience, academic belonging, and social integration measures for all HE students and resilience groups.

		M	SD	1	2	3	4
<b>All students (N = 1,332)</b>							
1.	Engagement	3.750	1.248	(-)	0.134***	0.405***	0.286***
2.	Resilience	2.894	0.793	.	(-)	0.217***	0.143***
3.	Academic belonging	3.426	0.739	.	.	(-)	0.414***
4.	Social integration	3.372	0.813	.	.	.	(-)
<b>Low resilience (N = 210)</b>							
1.	Engagement	3.460	1.257	(-)	0.105*	0.398***	0.364***
2.	Resilience	1.732	0.302	.	(-)	0.216**	0.188**
3.	Academic belonging	3.205	0.823	.	.	(-)	0.452***
4.	Social integration	3.148	0.884	.	.	.	(-)
<b>Normal resilience (N = 916)</b>							
1.	Engagement	3.740	1.221	(-)	0.010	0.373***	0.245***
2.	Resilience	2.881	0.461	.	(-)	0.120***	0.081**
3.	Academic belonging	3.425	0.696	.	.	(-)	0.384***
4.	Social integration	3.397	0.770	.	.	.	(-)
<b>High resilience (N = 206)</b>							
1.	Engagement	4.070	1.286	(-)	0.125*	0.456***	0.299***
2.	Resilience	4.134	0.329	.	(-)	0.176**	0.006
3.	Academic belonging	3.660	0.764	.	.	(-)	0.415***
4.	Social integration	3.494	0.883	.	.	.	(-)

\*significant at  $p < 0.05$ , \*\*significant at  $p < 0.01$ , \*\*\*significant at  $p < 0.001$ .

social integration and additionally indicate that students with low resilience show the strongest serial predictive effects compared to the other student groups. In addition, the partial predictive effect from social integration on engagement was largest compared to other student groups which contrasted expected outcomes. In line with expectations, results did indicate a smaller partial effect of academic belonging on engagement for students with low resilience.

## Students With Normal Resilience

Students with normal resilience levels scored in the middle range regarding engagement, academic belonging, and social integration in comparison to low and high resilience groups (Table 3). Concerning predictive model outcomes, although the model fit is moderate and adequate (77) and explains 19% of the variance, the total effects are insignificant (Table 4). In addition, the relationship between X and Y was insignificant at  $r = 0.010$  (Table 3), indicating the absence of a direct association between resilience and engagement. Consequently, no mediation model can be seen among this group, with results instead indicating predictive indirect and partial effects (Figure 2C).

The total indirect effects were significant, although, at 0.048, this effect size was smallest compared to the other student groups. Of the indirect effects, 81.25% originated from the indirect effect via academic belonging, and 10.42% originated from the serial effects via both mediators. The serial effect size was also smallest for this group compared to the other groups (compared to all students:  $-58.33\%$ , compared to low resilience:  $-77.27\%$ ).

Of the significant partial effects, three effects were smallest compared to the other student groups. The partial effect of resilience on academic belonging displayed a small effect (78), which was lowest compared to other groups (compared to all students:  $-45.37\%$ , compared to low resilience:  $-43.54\%$ , compared to high resilience:  $-33.71\%$ ). The predictive serial effect between the two mediators was also smallest compared to the other groups (compared to all students:  $-5.75\%$ , compared to low resilience:  $-14.32\%$ , compared to high resilience:  $-11.71\%$ ). The partial effect from social integration to engagement was again smallest compared to other groups, with the decrease ranging between 20.00% and 53.14%. These results misalign with research expectations, as a direct predictive effect of resilience on engagement was absent amongst this group. Instead, results indicate an indirect predictive effect via academic belonging and a serial indirect effect via both academic belonging and social integration on engagement. Additionally, results contrast expectations concerning effect sizes compared to other student groups with the group of students with normal resilience displaying predictive effects that are smaller compared to other groups.

## Students With High Resilience

The students with high resilience reported the highest levels of academic belonging, social integration, and engagement compared to other student groups (Table 3). Furthermore, the analysis revealed that the model explained 26% of the variance, indicating adequate and substantial fit (77). The total effects of the model were marginally insignificant at  $p = 0.050$  (Table 4).

**TABLE 4 |** Standardized (B) and unstandardised (b) regression coefficients, and significance tests for the explanatory model pathways between the HE student group and resilience groups.

Pathway	B	b	t	p	R <sup>2</sup>	95% CI
<b>All students (N = 1,332)</b>					0.21	
a1	0.216	0.201	8.051	<0.001***		0.152 to 0.250
a2	0.055	0.056	2.137	0.033*		0.005 to 0.108
b1	0.338	0.570	12.409	<0.001***		0.480 to 0.661
b2	0.140	0.214	5.198	<0.001***		0.133 to 0.295
d	0.400	0.441	15.663	<0.001***		0.386 to 0.496
c'	0.044	0.069	1.755	0.080		−0.008 to 0.147
Cov. 1	−0.165	−0.190	−6.664	<0.001***		−0.246 to −0.134
Cov. 2	−0.020	−0.056	−0.790	0.430		−0.193 to 0.082
<b>X on Y</b>	<b>Effect</b>		<b>se</b>	<b>t</b>	<b>p</b>	<b>95% CI</b>
Total	0.137		0.042	5.092	<0.001***	0.132 to 0.298
Ind. total	0.093		0.014			0.066 to 0.120
Ind1 (a1 x b1)	0.073		0.012			0.051 to 0.097
Ind2 (a2 x b2)	0.008		0.004			0.0003 to 0.0165
Ind3 (a1 x d x b2)	0.012		0.003			0.007 to 0.019
<b>Low resilience (N = 210)</b>					0.21	
a1	0.209	0.568	3.044	0.003**		0.200 to 0.936
a2	0.111	0.323	1.743	0.083		−0.042 to 0.688
b1	0.285	0.435	4.003	<0.001***		0.221 to 0.649
b2	0.239	0.339	3.369	<0.001***		0.141 to 0.538
d	0.440	0.472	6.983	<0.001***		0.339 to 0.606
c'	−0.006	−0.025	−0.091	0.928		−0.555 to 0.506
Cov. 1	−0.057	−0.066	−0.897	0.371		−0.212 to 0.080
Cov. 2	−0.073	−0.203	−1.135	0.258		−0.555 to 0.149
<b>X on Y</b>	<b>Effect</b>		<b>se</b>	<b>t</b>	<b>p</b>	<b>95% CI</b>
Total	0.114		0.289	1.462	0.145	−0.147 to 0.994
Ind. total	0.108		0.039			0.036 to 0.187
Ind1 (a1 x b1)	0.059		0.029			0.011 to 0.125
Ind2 (a2 x b2)	0.026		0.018			−0.005 to 0.065
Ind3 (a1 x d x b2)	0.022		0.012			0.004 to 0.049
<b>Normal resilience (N = 916)</b>					0.19	
a1	0.118	0.178	3.582	<0.001***		0.081 to 0.276
a2	0.031	0.052	1.017	0.310		−0.049 to 0.153
b1	0.330	0.579	10.194	<0.001***		0.467 to 0.690
b2	0.122	0.193	3.770	<0.001***		0.093 to 0.294
d	0.377	0.417	12.290	<0.001***		0.351 to 0.484
c'	−0.048	−0.128	−1.607	0.108		−0.285 to 0.028
Cov. 1	−0.193	−0.219	−6.329	<0.001***		−0.287 to −0.151
Cov. 2	−0.034	−0.094	−1.099	0.272		−0.262 to 0.074
<b>X on Y</b>	<b>Effect</b>		<b>se</b>	<b>t</b>	<b>p</b>	<b>95% CI</b>
Total	0.097		0.086	0.003	0.997	−0.169 to 0.169
Ind. total	0.048		0.014			0.023 to 0.075
Ind1 (a1 x b1)	0.039		0.011			0.018 to 0.062
Ind2 (a2 x b2)	0.004		0.004			−0.004 to 0.013
Ind3 (a1 x d x b2)	0.005		0.002			0.002 to 0.011
<b>High resilience (N = 206)</b>					0.25	
a1	0.178	0.412	2.541	0.012*		0.092 to 0.731
a2	−0.067	−0.178	−1.022	0.308		−0.526 to 0.167
b1	0.391	0.658	5.714	<0.001***		0.431 to 0.886
b2	0.133	0.193	1.968	0.050		−0.003 to 0.387
d	0.427	0.493	6.570	<0.001***		0.346 to 0.642
c'	0.066	0.258	1.051	0.295		−0.226 to 0.741
Cov. 1	−0.157	−0.180	−2.561	0.011*		−0.318 to −0.041
Cov. 2	0.053	0.152	0.855	0.393		−0.199 to 0.503

(Continued)

TABLE 4 | Continued

Pathway	B	b	t	p	R <sup>2</sup>	95% CI
X on Y	Effect		se	t	p	95% CI
Total	0.137		0.271	1.968	0.050	−0.001 to 1.067
Ind. total	0.071		0.044			−0.013 to 0.164
Ind1 (a1 × b1)	0.069		0.038			0.003 to 0.150
Ind2 (a2 × b2)	−0.009		0.011			−0.032 to 0.010
Ind3 (a1 × d × b2)	0.010		0.007			−0.001 to 0.025

a1, independent variable (IV) to mediator 1; a2, IV to mediator 2; b1, mediator 1 to dependent variable (DV); b2, mediator 2 to DV; d, mediator 1 to mediator 2; c', IV to dependent variable; Cov.1, study year control variable; Cov.2, living arrangement control variable; \*significant at  $p < 0.05$ ; \*\*significant at  $p < 0.01$ ; \*\*\*significant at  $p < 0.001$ .

Further inspection revealed that the direct pathway between resilience and engagement, the indirect pathway through social integration, and the serial mediation pathway were all insignificant (**Figure 2D**). The only significant pathway involved an indirect mediation effect via academic integration, where higher resilience predicts higher academic belonging and this subsequently predicts higher engagement, at 97.18% of the total indirect effects. At an effect size of 0.069, this indirect mediation effect is larger compared to other student groups (compared to low resilience: +14.49%, compared to normal resilience: +43.48%). Although a very large partial effect (78) was revealed between the two mediators at 0.427, no subsequent predictive partial effect on engagement was indicated. These findings partly contrast research expectations as serial mediation was absent, but also partially aligned with expectations as the partial effect of academic belonging on engagement was largest compared to low and normal resilience groups.

## DISCUSSION

This study researched engagement predictors among HE students studying via ERT in the Netherlands during the COVID-19 pandemic. The relationship between resilience and engagement was examined, in addition to assessing mediating and indirect effects via academic belonging and social integration. For all HE students, serial mediation was demonstrated where the direct effect of resilience on engagement was fully mediated by academic belonging and social integration. Resilience positively predicts academic belonging, which in turn positively predicts engagement and social integration. Resilience additionally positively predicts social integration with fellow students, which in turn positively predicts engagement. Moreover, independent partial predictive effects from academic belonging and social integration on engagement were found. As such, findings aligned with research expectations for the entire HE student sample.

The confirmation of a significant relationship between resilience and engagement during ERT, lines up with findings regarding face-to-face teaching (24, 49). Among all students, mediation by both academic belonging and social integration are in keeping with studies on the positive mediating role of feeling at home at the HEI and positive peer relationships on engagement (29, 35). Distinct from studies on engagement during face-to-face teaching, the current study reveals that engagement

during ERT was predicted with greatest effect through academic belonging (42–44).

Results also displayed serial mediation among low resilience students, with the largest effect size of all student groups in contrast to expectations. The indirect predictive effect from academic belonging on engagement contained the largest predictive effect, although this effect was smaller relative to the other groups. Furthermore, independent mediation via social integration was absent, even though the partial predictive effect was largest compared to other student groups.

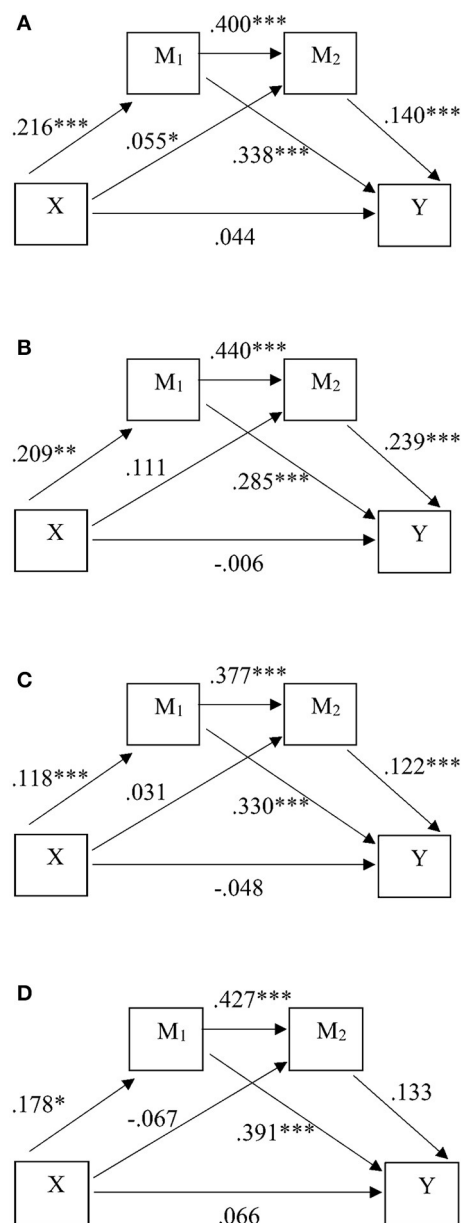
These findings suggest several points. First, students with low resilience experience lower levels of belonging at their HEIs during ERT, and it stimulates engagement to a lesser extent than among other student groups. Students with lower resilience may thus be more prone to feeling unsafe within the academic context, or may experience lower connectedness to their educational programs, both under face-to-face teaching circumstances and during ERT (79–81), potentially indicating a characteristic of low resilience students. Low resilience students may also experience more difficulty expressing their needs and questions within the academic setting, limiting the positive effect on engagement compared to other groups.

Second, low resilience students reported the lowest mean levels of social integration, whilst simultaneously demonstrating the largest partial effects related to social integration. This indicates the presence of lower positive relationships with fellow students during ERT, while depending on social integration to facilitate engagement to a higher degree than the other student groups. Given the suboptimal quality of social integration during ERT (47), engagement for this group could be improved by enhancing social integration.

Third, as the largest relative serial mediation effect was found among low resilience students, this group utilizes this indirect pathway to a larger extent. As such, targeting academic belonging among low resilience students could include a two-hit approach during ERT: it could facilitate engagement directly, and it could increase social integration, subsequently enhancing engagement.

Finally, promoting resilience among low resilience students could prove a promising strategy. Based on results from the other student groups, increasing resilience could enhance students' sense of academic belonging during ERT, which is particularly relevant during the changing educational contexts related to the COVID-19 pandemic. More so, with resilience so prominently





**FIGURE 2 |** Predictive model standardized effects for the HE student groups: (A) all students ( $N = 1,332$ ), (B) students with low resilience ( $N = 210$ ), (C) students with normal resilience ( $N = 916$ ), and (D) students with high resilience ( $N = 206$ ). \* significant at  $p < 0.05$ , \*\* significant at  $p < 0.01$ , \*\*\* significant at  $p < 0.001$ , X, resilience; Y, engagement; M1, academic belonging; M2, social integration.

linked to maintained wellbeing during the pandemic (57), targeting HE students with suboptimal resilience could provide positive benefits to wellbeing that extend beyond the realm of the educational setting (55).

When students reported normal levels of resilience the direct association between resilience and engagement ceased to be found, which misaligned with the study's expectations. Instead,

students with normal resilience exhibited significant indirect effects, including a serial indirect effect via academic belonging and social integration that was smallest compared to the other groups. The sense of academic belonging during ERT displayed the strongest indirect predictive effect on engagement, although it was ultimately smaller compared to other groups, due to the relative smaller effect from resilience. This suggests that resilience had a lesser effect on engagement maintenance among normally resilient students.

Furthermore, the explained variance of the model was lowest, suggesting application of alternative engagement strategies among these students. With previous research indicating that intrinsic values such as motivation, desire to succeed, determination, and future orientation are present amongst resilient individuals (82, 83) our findings may indicate that this student group is using intrinsic factors excluded from the current study design. They may also be utilizing alternate engagement resources, as higher resourcefulness is also instrumental to engagement (49).

For highly resilient students, serial mediation was absent and social integration failed to predict engagement during ERT. Instead, indirect mediation through academic belonging alone demonstrated the strongest predictive effect relative to other groups. Highly resilient students' sense of academic belonging displayed the highest average scores, the largest indirect effect, and the largest partial predictive effect on engagement, suggesting a superior sense of belonging within a limited ERT higher educational context. This outcome aligns with studies indicating higher levels of connectedness among highly resilient students under face-to-face educational conditions (55) and aligns with increased adaptability among students with higher engagement during ERT (6).

Additionally, none of the predictive pathways associated with social integration were significantly present among highly resilient students, even though these students reported the highest levels of social integration during ERT. These findings differ from previous indications of advanced utilization of peer student support among highly resilient students (82) and contrast findings for low resilience students. The current model may have captured a context driven adaptation, where, given the limitations of social integration under ERT, highly resilient students have shifted engagement tactics away from social integration. After all, with social integration potentially hindered during ERT if fellow students do not participate (18), our findings could reflect stronger application of self-controlled strategies among this student group.

Our explanation lines up with research demonstrating increased positive adaptability among more engaged students (6) and expands on studies indicating that HE students report an increased need for self-discipline, motivation, self-teaching skills, and organization to successfully maintain learning and engagement during ERT (18). Thus, although highly resilient students are reporting social relationships and collaborations with fellow students to a higher level than other student groups, they boost engagement during ERT primarily through their heightened sense of academic belonging.

## Limitations

This study has some limitations. First, operationalization of engagement can be highly variable between studies, limiting comparability (67, 68). Though the current study included an engagement scale that has been used previously in global cohort studies (23, 28–33), comparability to alternate engagement scales depends on subcomponent overlap and construct definition. The UWES-SF does not focus on behavioral components of engagement, which limits comparability of findings to cognitive-affective engagement studies. Second, although the current study included sociodemographic and study related covariates to control their independent influence on the outcome variable, unincluded variables such as social economic status, family social support, or family educational background may also be relevant. Future studies should include additional sociodemographic variables to allow control of covariance. Third, initial selection of a subset of items from the social integration scale lacked a primary factor analysis to test validity. Though the entire scale has been validated in a sample of HE students (51) the subset was not, which could have influenced validity optimization of the current subscale. Future research should establish validity of reduced scales to validate utilization of short forms. Finally, based on available literature indicating directional associations, the current serial mediation model assumes the presence of predictive effects between included constructs. However, studies also indicate alternative associations between these constructs (38, 84) including feedback effects, which are not captured in the current model. More so, assessment of directionality is limited in cross-sectional datasets, as opposed to longitudinal monitoring or experimental designs. Further research should focus on examining additional aspects relevant to engagement and resilience, and should further clarify directional processes by using longitudinal approaches or interventions.

## Practical Implications and Future Directions

For all HE students who are studying via ERT in the Netherlands, interventions geared toward stimulation of resilience, academic belonging, and social integration all stand to provide significant engagement benefits. The current study also underlines the need for individualized, profile-oriented approaches, as engagement interventions might affect HE students differently depending on their resilience profiles. HEIs should consider student resilience characteristics to assess which intervention targets are promising among their student populations.

Students with low resilience could benefit more from interventions aimed at improving the level of student interactions with fellow students, increasing academic belonging, as well as increasing resilience. Highly resilient students on the other hand, stand to profit most from interventions aimed solely at raising academic belonging, whereas students with normal resilience would be supported by interventions targeting academic belonging and social integration, but not resilience.

The current study provides several important directions for future research. Regarding different resilience profiles, future studies should expand current knowledge by continuing examination of predictive models while ERT endures and once face-to-face teaching at HEIs re-opens. In doing so, predictive stability among different resilience groups can be analyzed, and adaptability to shifts between ERT and face-to-face teaching in HEIs can be assessed.

In addition, incorporation of other relevant aspects of engagement, including measures of determination, self-motivation, and organization skills will help determine to what extent such tactics are also pivotal to engagement maintenance. Examining these constructs will diversify applicable intervention targets that HEIs could utilize to support HE students' engagement levels during ERT. Finally, future research on student engagement should further focus on risk factors and protective influences on engagement among students with low resilience. As these students display the lowest levels of academic belonging, social integration, and engagement, this group could be more at risk of slipping through the cracks during ERT. As such, continued assessment of student groups with higher risk profiles is warranted to ensure prevention, early signaling, and timely support.

Inspecting predictive models for HE students based on distinct resilience typologies offer new insights on intra-group differences and has been recognized previously as an important yet underrepresented area of research (29, 85). Overall, our study reveals resilience dependent changes in student engagement predictors during ERT in the Netherlands. In addition, the current study demonstrates model outcomes that contrast studies conducted in face-to-face higher educational settings, potentially reflecting impacts of ERT. As ERT is linked to limited interactions with peer students, lowered participation in class discussion, and a lack of instant feedback (79), HE students may well be reconfiguring how to best maintain engagement during this time. Current findings argue for continued research focussed on student resilience and engagement during ERT, especially given the potential recurrence of lockdown restrictions for HEIs in the Netherlands following identification of new COVID-19 variants (86).

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because study participants did not consent to public availability of their data. Requests to access the datasets should be directed to [rutger.kappe@inholland.nl](mailto:rutger.kappe@inholland.nl).

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board Inholland University of Applied Sciences. Online consent was required prior to study participation of students. Written informed consent from the participants' legal guardian/next

of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

MV contributed to the survey design, conducted the data analysis, and led the literature research and manuscript production. RK aided in survey design and contributed to the literature research. CK contributed to survey design, scale development, and literature research. All authors contributed to the article and approved the submitted version.

## REFERENCES

- Aladsani HK. A narrative approach to university instructors' stories about promoting student engagement during COVID-19 emergency remote teaching in Saudi Arabia. *Res Technol Educ.* (2021) 54:165–81. doi: 10.1080/15391523.2021.1922958
- De Jonge E, Kloppenburg R, Hendriks P. The impact of the COVID-19 pandemic on social work education and practice in the Netherlands. *Soc. Work. Educ.* (2020) 39:1027–036. doi: 10.1080/02615479.2020.1823363
- Klasen JM, Meienberg A, Bogie B J. Medical student engagement during COVID-19: lessons learned and areas for improvement. *Med. Educ.* (2020) 55: 115–8. doi: 10.1111/medu.14405
- Marques L, Giol, G. Cultural leisure in the time of COVID-19: impressions from the Netherlands. *World Leis.* (2020) 62:344–8. doi: 10.1080/16078055.2020.1825256
- Meeter M, Bele T, Hartogh CD, Bakker T, de Vries RE, Plak S. College students' motivation and study results after COVID-19 stay-at-home orders. [Preprint]. (2020). (accessed July 15, 2021). doi: 10.31234/osf.io/kn6v9
- Zhang K, Wu S, Xu Y, Cao W, Goetz T, Parks-Stamm EJ. Adaptability promotes student engagement under COVID-19: the multiple mediating effects of academic emotion. *Front Psychol.* (2021) 11:633265. doi: 10.3389/fpsyg.2020.633265
- Rijksinstituut voor Volksgezondheid en Milieu (RIVM). Coronavirus Tijdljn (2020). Available online at: <https://www.rijksoverheid.nl/onderwerpen/coronavirus-tijdljn> (accessed October 14, 2021).
- Awoke M, Mamo G, Abdu S, Terefe B. Perceived stress and coping strategies among undergraduate health science students of Jimma university amid the COVID-19 outbreak: online cross-sectional survey. *Front Psychol.* (2021) 12:639955. doi: 10.3389/fpsyg.2021.639955
- Besser A, Flett GL, Zeigler-Hill V. Adaptability to a sudden transition to online learning during the COVID-19 pandemic: understanding the challenges for students. *Scholarsh. Teach. Learn. Psychol.* [Preprint]. (2020). (accessed October 14, 2021). doi: 10.1037/stl0000198
- Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* (2020) 287:112934. doi: 10.1016/j.psychres.2020.112934
- De Boer H. COVID-19 in Dutch higher education. *Stud. High. Educ.* (2021) 46:96–106. doi: 10.1080/03075079.2020.1859684
- Lima KR, das Neves BHS, Ramires CC, dos Santos Soares M, Martini VÁ, Lopes LF, et al. Student assessment of online tools to foster engagement during the COVID-19 quarantine. *Adv. Physiol. Educ.* (2020) 44:4: 679–83. doi: 10.1152/advan.00131.2020
- Versteeg M, Kappe FR. Resilience and higher education support as protective factors for student academic stress and depression during Covid-19 in the Netherlands. *Front Public Health.* (2021) 9:737223. doi: 10.3389/fpubh.2021.737223
- Warps J, van den Broek A. Studeren, studievoortgang en welbevinden tijdens corona. (2020). Available online at: [http://www.researchned.nl/wp-content/](http://www.researchned.nl/wp-content/uploads/2020/06/Warps-Van-den-Broek-2020-Studeren-tijdens-Corona-Nijmegen-ResearchNed2.pdf)

## FUNDING

This work was supported by the Department of Education and Innovation, Research Group Study Success, Inholland University of Applied Sciences, Haarlem, Netherlands.

## ACKNOWLEDGMENTS

We would like to thank all higher education students who participated in this study on well-being during the COVID-19 pandemic. We also thank Elisabeth Klinkenberg and Sanne van Herpen for their critical insight and detailed feedback throughout the development of this study.

- uploads/2020/06/Warps-Van-den-Broek-2020-Studeren-tijdens-Corona-Nijmegen-ResearchNed2.pdf (accessed October 11, 2021).
- Wu S, Zhang K, Parks-Stamm EJ, Hu Z, Ji Y, Cui X. Increases in anxiety and depression during COVID-19: a large longitudinal study from China. *Front Psychol.* (2021) 12:706601. doi: 10.3389/fpsyg.2021.706601
- Farooq F, Rathore FA, Mansoor SN. Challenges of online medical education in Pakistan during COVID-19 pandemic. *J Coll Physicians Surg Pak.* (2020) 30:67–9. doi: 10.29271/jcpsp.2020.Supp1.S67
- Hossain MJ, Ahmmmed F, Rahman SMA, Sanam S, Emran TB, Mitra S. Impact of online education on fear of academic delay and psychological distress among university students following 1 year of COVID-19 outbreak in Bangladesh. *Heliyon.* (2021) 7: e07388. doi: 10.1016/j.heliyon.2021.e07388
- Nickerson LA, Shea KM. (2020). First-semester organic chemistry during COVID-19: prioritizing group work, flexibility, and student engagement. (2020). Available online at: [https://scholarworks.smith.edu/chm\\_facpubs/20](https://scholarworks.smith.edu/chm_facpubs/20) (accessed September 30, 2021).
- Boulton CA, Hughes E, Kent C, Smith JR, Williams HTP. Student engagement and wellbeing over time at a higher education institution. *PLoS ONE.* (2019) 14:e0225770. doi: 10.1371/journal.pone.0225770
- Kuh GD, Kinzie J, Schuh JH, Whitt EJ. *Student Success in College: Creating Conditions That Matter.* San Francisco: Jossey-Bass (2005). 416 p.
- Zepke N, Leach L. Beyond hard outcomes: 'Soft' outcomes and engagement as student success. *Teach. High. Educ.* (2010) 15: 661–73. doi: 10.1080/13562517.2010.522084
- Salmela-Aro K, Tolvanen A, Nurmi J. Achievement strategies during university studies predict early career burnout and engagement. *J. Vocat. Behav.* (2009) 75: 162–72. doi: 10.1016/j.jvb.2009.03.009
- Schaufeli WB, Martínez IM, Pinto AM, Salanova M, Bakker AB. Burnout and engagement in university students: a cross-national study. *J. Cross. Cult. Psychol.* (2002) 33:464–81. doi: 10.1177/0022022102033005003
- Ahmed U, Umrani WA, Qureshi MA, Samad A. Examining the links between teachers support, academic efficacy, academic resilience, and student engagement in Bahrain. *Int. J. Advances. Appl. Sci.* (2018) 5: 39–46. doi: 10.21833/ijaas.2018.09.008
- Asghar H. Patterns of engagement and anxiety in university students: first year to senior year. In: Pracana C, Wang M, editors. *Psychology Applications & Development V. Advances in Psychology and Psychological Trends.* Lisbon: InScience Press (2014). p. 242.
- Chu TL. Applying positive psychology to foster student engagement and classroom community amid the COVID-19 pandemic and beyond. *Scholarsh Teach Learn Psychol* [Preprint]. (2020). doi: 10.1037/stl0000238. (accessed September 30, 2021).
- Schaufeli WB, Bakker AB, Salanova M. The measurement of work engagement with a short questionnaire: a cross-national study. *Educ. Psychol. Meas.* (2006) 66:701–16. doi: 10.1177/0013164405282471
- Carmona-Halty MA, Schaufeli WB, Salanova M. The utrecht work engagement scale for students (UWES–9S): factorial validity, reliability, and

- measurement invariance in a Chilean sample of undergraduate university students. *Front Psychol.* (2019) 10:1017. doi: 10.3389/fpsyg.2019.01017
29. Salmela-Aro K, Read S. Study engagement and burnout profiles among Finnish higher education students. *Burn Res.* (2017) 7:21–8. doi: 10.1016/j.burn.2017.11.001
  30. Schaufeli WB, Shimazu A, Hakanen J, Salanova M, de Witte H. An ultra-short measure for work engagement: the UWES-3 validation across five countries. *Eur. J. Psychol. Assess.* (2019) 35:577–91. doi: 10.1027/1015-5759/a000430
  31. Gusy B, Lesener T, Wolter C. Measuring well-being with the Utrecht work engagement scale–student form. *Eur. J. Health. Psychol.* (2019) 26:31–8. doi: 10.1027/2512-8442/a000027
  32. Lara SAD, Arata MF, Viera RAS. Análisis psicométrico de una medida ultra-breve para el engagement académico: UWES-3S. *Rev. Argent. Cienc. Comport.* (2021) 13:25–37. doi: 10.32348/1852.4206.v13.n1.27780
  33. Tayama J, Schaufeli W, Shimazu A, Tanaka M, Takahama A. Validation of a Japanese version of the Work Engagement Scale for Students. *Jpn. Psychol. Res.* (2019) 61:262–72. doi: 10.1111/jpr.12229
  34. Redmond P, Abawi LA, Brown A, Henderson R, Heffernan A. An online engagement framework for higher education. *Online Learn. J.* (2018) 22:1:183–204. doi: 10.24059/olj.v22i1.1175
  35. Masika R, Jones J. Building student belonging and engagement: insights into higher education students' experiences of participating and learning together. *Teach. High. Educ.* (2016) 21:138–50. doi: 10.1080/13562517.2015.1122585
  36. Thomas L. *Building Student Engagement and Belonging in Higher Education at a Time of Change*. London: Paul Hamlyn Foundation (2012). 102 p.
  37. Hagerty BM, Lynch-Sauer J, Patuskyl KL, Bouwsema M, Collier P. Sense of belonging: a vital mental health concept. *Arch Psychiatr Nurs.* (1992) 6:172–7. doi: 10.1016/0883-9417(92)90028-h
  38. Goodenow C. The psychological sense of school membership among adolescents: Scale development and educational correlates. *Psychol. Sch.* (1993) 30:79–90. doi: 10.1002/1520-6807
  39. Osterman KF. Students' need for belonging in the school community. *Rev Educ Res.* (2000) 70:323–67. doi: 10.3102/00346543070003323
  40. Nowicki A. (2008). Self-efficacy, sense of belonging and social support as predictors of resilience in adolescents. [Thesis]. [Joondalup]: Edith Cowan University. Available online at: [https://ro.ecu.edu.au/theses\\_hons/1155](https://ro.ecu.edu.au/theses_hons/1155)
  41. Salmela-Aro K. Dark and bright sides of thriving – school burnout and engagement in the Finnish context. *Eur J Dev Psychol.* (2017) 14:337–49. doi: 10.1080/17405629.2016.1207517
  42. Johnson DRM, Soldner JB, Leonard P, Alvarez KK, Inkelas HT, Rowan-Kenyon H, et al. Examining sense of belonging among first-year undergraduates from different racial/ethnic groups. *J. Coll. Stud. Dev.* (2007) 48:525–42. doi: 10.1353/csd.2007.0054
  43. Krause KL. *Understanding and Promoting Student Engagement in University Learning Communities*. [keynote address]. *Engaged, Inert or Otherwise Occupied? Deconstructing the 21st Century Undergraduate Student*. Queensland (2005). Available online at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.659.6304&rep=rep1&type=pdf>
  44. Moran E, Gonyea T. The influence of academically-focused peer interaction on college students' development. (2003). Available online at: <https://files.eric.ed.gov/fulltext/ED478773.pdf> (accessed October 21, 2021).
  45. Zhao H, Xiong J, Zhang Z, Qi C. Growth mindset and college students' learning engagement during the COVID-19 pandemic: a serial mediation model. *Front Psychol.* (2021) 12:621094. doi: 10.3389/fpsyg.2021.621094
  46. Versteeg M, Kappe FR. Studenten Welzijn Monitor (SWM): Uitwerking Inholland Resultaten. (2021). Available online at: <https://www.inholland.nl/onderzoek/publicaties/studenten-welzijn-monitor-swm> (accessed December 17, 2021).
  47. Dvůřáková K, Emmer J, Janktová R, Klementová K. From F2F to ERT: University students' perception of remote learning during the first COVID-19 lockdown. *ERIES.* (2021) 14:89–100. doi: 10.7160/eriesj.2021.140203
  48. Burns D, Dagnall N, Holt M. Assessing the impact of the COVID-19 pandemic on student well-being at universities in the United Kingdom: a conceptual analysis. *Front Educ.* (2020) 5:582882. doi: 10.3389/feeduc.2020.582882
  49. Ayala JC, Manzano G. Academic performance of first-year university students: the influence of resilience and engagement. *High. Educ. Res. Dev.* (2018) 37:1321–35. doi: 10.1080/07294360.2018.1502258
  50. Furrer CJ, Skinner EA, Pitzer JR. The influence of teacher and peer relationships on students' classroom engagement and everyday motivational resilience. *Nat. Soc. Stud. Educ.* (2014) 116:101–23. Available online at: <https://www.tcrecord.org> (accessed November 15, 2021).
  51. Hartley MT. Examining the relationships between resilience, mental health, and academic persistence in undergraduate college students. *J. Am. Coll. Health.* (2011) 59:596–604. doi: 10.1080/07448481.2010.515632
  52. Fergus S, Zimmerman MA. Adolescent resilience: A framework for understanding healthy development in the face of risk. *Annu Rev Public Health.* (2005) 6:399–419. doi: 10.1146/annurev.publhealth.26.021304.144357
  53. Hu T, Zhang D, Wang J, A meta-analysis of the trait resilience and mental health. *Pers Individ Differ.* (2015) 76:18–27. doi: 10.1016/j.paid.2014.11.039
  54. Richardson GE, Neiger B, Jensen S, Kumpfer K. The resiliency model. *Health Educ. J.* (1990) 21:33–9. doi: 10.1080/00970050.1990.10614589
  55. Pidgen AM, Rowe N, Stapleton P, Magyar H, Lo B. Examining characteristics of resilience among university students: an international study. *J. Soc. Sci.* (2014) 2:14–22. doi: 10.4236/jss.2014.211003
  56. Smith BW, Dalen J, Wiggins K, Tooley E, Christopher P, Bernard J. The brief resilience scale: assessing the ability to bounce back. *Int. J. Behav. Med.* (2008) 15:194–200. doi: 10.1080/10705500802222972
  57. Vinkers CH, van Amelsvoort T, Bisson JI, Branchi I, Cryan JF, Domschke K, et al. Stress resilience during the coronavirus pandemic. *Eur Neuropsychopharmacol.* (2020) 35:12–6. doi: 10.1016/j.euroneuro.2020.05.003
  58. Veronese G, Mahamid F, Bdier D, Pancake R. Stress of COVID-19 and mental health outcomes in Palestine: the mediating role of well-being and resilience. *Health Psychol. Rep.* (2021) 4:398–410. doi: 10.5114/hpr.2021.104490
  59. Yalçın I, Can N, Mançe Çalişır Ö, Yalçın S, Çolak B. Latent profile analysis of COVID-19 fear, depression, anxiety, stress, mindfulness, and resilience. *Curr Psychol.* (2021). doi: 10.1007/s12144-021-01667-x
  60. Zeng G, Hou H, Peng K. Effect of growth mindset on school engagement and psychological well-being of Chinese primary and middle school students: the mediating role of resilience. *Front. Psychol.* (2016) 7:1873. doi: 10.3389/fpsyg.2016.01873
  61. Enthoven MEM. (2007). *The ability to bounce beyond: the contribution of the school environment to the resilience of Dutch middle-adolescents from a low SES background*. [PhD dissertation]. Utrecht: Hogeschool Utrecht.
  62. Weidlich J, Kalz M. Exploring predictors of instructional resilience during emergency remote teaching in higher education. *Int J Educ Technol High Educ.* (2021) 18:43. doi: 10.1186/s41239-021-00278-7
  63. Hodges CB, Moore S, Locke, BB, Trust T, Bond MA. The difference between emergency remote teaching and online learning. (2020). Available online at: <https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning> (accessed December 2, 2021).
  64. Bozkurt A, Sharma RC. Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic. *AsianJDE.* (2020) 15: i–vi. doi: 10.5281/zenodo.3778083
  65. Naidu S. It is the worst—and the best—of times! *Distance Educ.* (2020) 41:425–8. doi: 10.1080/01587919.2020.1825929
  66. Smith BW, Epstein EE, Oritz JA, Christopher PK, Tooley EM. The foundations of resilience: What are the critical resources for bouncing back from stress? In: Prince-Embury S, Saklofske DH, editors. *Resilience in Children, Adolescents, and Adults: Translating Research into Practice*. The Springer Series on Human Exceptionality. New York: Springer (2013). 357 p.
  67. Fredricks JA, McColskey W. The measurement of student engagement: a comparative analysis of various methods and student self-report instruments. In: Christenson SL, Reschly AL, Wylie C, editors. *Handbook of Research on Student Engagement*. New York: Springer (2012). 840 p.
  68. Libbey HP. Measuring student relationships to school: attachment, bonding, connectedness, and engagement. *J. Sch. Health.* (2004) 74:274–83. doi: 10.1111/j.1746-1561.2004.tb08284.x
  69. Severiens SE, Joukes G. *Studenten in Het Hoger Technisch Beroepsopleiding. Verschillen in Leerstrategieën, Motivatie En Positie*. Delft: Stichting Axis (2001). Available online at: <https://hdl.handle.net/11245/1.193184> (accessed October 21, 2021).
  70. Van Diepen M, Elffers L. *Meten van studentbetrokkenheid in het hbo. Amsterdam: Lectoraat Kansrijke Schoolloopbanen in een Diverse Stad*. Amsterdam: Hogeschool van Amsterdam (2021). Available online at: <https://www.hva.nl/binaries/content/assets/subsites/kansrijke-schoolloopbanen/>



- publicaties/meetinstrument-studentbetrokkenheid-informatie-website-v2.3.pdf?1631273800338 (accessed November 24, 2021).
71. Van de Velde S, Buffel V, Bracke P, Van Hal G, Somogyi NM, Willems B, et al. The COVID-19 international student well-being study. *Scand. J. Public Health*. (2021) 49:114–22. doi: 10.1177/1403494820981186
  72. Agresti A, Finlay B. *Statistical Methods for the Social Sciences (4th edition)*. London: Pearson. (2009). 568 p.
  73. Hayes AF, Little TD. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach (2nd edition)*. New York: Guildford Press (2018). 692 p.
  74. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav. Res. Methods*. (2008) 40:879–91. doi: 10.3758/BRM.40.3.879
  75. Fritz MS, MacKinnon DP. Required sample size to detect the mediated effect. *Psychol. Sci.* (2007) 18:233–9. doi: 10.1111/j.1467-9280.2007.01882.x
  76. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G\*Power 3.1: tests for correlation and regression analyses. *Behav. Res. Methods*. (2009) 41:1149–60. doi: 10.3758/BRM.41.4.1149
  77. Mattan SSB, Makowski D, Lüdtke D. *Indices of Effect Size and Standard Parameters*. CRAN (2022). 85p.
  78. Funder DC, Ozer DJ. Evaluating effect size in psychological research: sense and non-sense. *Adv. Meth. Pract. Psychol. Sci.* (2019) 2:156–68. doi: 10.1177/2515245919847202
  79. Ali S, Amat S, Mahmud MI, Abidin MHZ, Subhan M, Bakar AYA. Resilience and sense of belonging among medical students in a Malaysian public university. *Int. J. Eng. Technol.* (2018) 7:70–3. doi: 10.14419/ijet.v7i2.10.11014
  80. Grüttner M. Belonging as a resource of resilience: psychological well-being of international and refugee students in study preparation at German higher education institutions. *Student Success*. (2019) 10:36–44. doi: 10.5204/ssj.v10i3.1275
  81. Wu Y, Sang Z, Zhang XC, Margraf J. The relationship between resilience and mental health in Chinese college students: a longitudinal cross-lagged analysis. *Front Psychol.* (2020) 11:108. doi: 10.3389/fpsyg.2020.00108
  82. Ang WHD, Shorey S, Lopez V, Chew HSJ, Lau Y. Generation Z undergraduate students' resilience during the COVID-19 pandemic: a qualitative study. *Curr. Psychol [preprint]*. (2021) doi: 10.1007/s12144-021-01830-4
  83. Azmitia M, Sumabat-Estrada G, Cheong Y, Covarrubias R. Dropping out is not an option: how educationally resilient first-generation students see the future. *New. Dir. Child. Adolesc. Dev.* (2018) 160:89–100. doi: 10.1002/cad.20240
  84. Pitzer J, Skinner E. Predictors of changes in students' motivational resilience over the school year: The roles of teacher support, self-appraisals, and emotional reactivity. *Int. J. Behav. Dev.* (2017) 41:15–29. doi: 10.1177/0165025416642051
  85. Portoghese I, Leiter MP, Maslach C, Galletta M, Porru F, D'Aloja E, et al. Measuring burnout among university students: factorial validity, invariance, and latent profiles of the Italian version of the Maslach burnout inventory student survey (MBI-SS). *Front Psychol.* (2018) 9:2105. doi: 10.3389/fpsyg.2018.02105
  86. Rijksinstituut voor Volksgezondheid en Milieu (RIVM). Verspreiding omikron vertragen: Nederland in lockdown. (2021). Available online at: <https://www.rijksoverheid.nl/actueel/nieuws/2021/12/18/verspreiding-omikron-vertragen-nederland-in-lockdown> (accessed December 20, 2021).

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Versteeg, Kappe and Knuiman. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





# Validity and Psychometric Evaluation of the Chinese Version of the 5-Item WHO Well-Being Index

Sai-fu Fung<sup>1\*</sup>, Chris Yiu Wah Kong<sup>1</sup>, Yi-man Liu<sup>2,3</sup>, Qian Huang<sup>4</sup>, Zike Xiong<sup>3</sup>, Zhiquan Jiang<sup>5</sup>, Fangfang Zhu<sup>6</sup>, Zhenting Chen<sup>7</sup>, Kun Sun<sup>6</sup>, Huiqin Zhao<sup>6</sup> and Ping Yu<sup>8,9</sup>

<sup>1</sup> Department of Social and Behavioural Sciences, City University of Hong Kong, Kowloon, Hong Kong SAR, China, <sup>2</sup> School of Economics, Finance and Marketing, Royal Melbourne Institute of Technology, Melbourne, VIC, Australia, <sup>3</sup> University Administrative Office, Guangzhou Huashang College, Guangzhou, China, <sup>4</sup> Department of Sports Training, Xi'an Physical Education University, Xi'an, China, <sup>5</sup> Society Hub, The Hong Kong University of Science and Technology (Guangzhou), Guangzhou, China, <sup>6</sup> School of Economics and Trade, Guangzhou Huashang College, Guangzhou, China, <sup>7</sup> School of Data Sciences, Guangzhou Huashang College, Guangzhou, China, <sup>8</sup> Managing Director Office, Global Business College of Australia, Melbourne, VIC, Australia, <sup>9</sup> General Manager Office, Edvantage Institute Australia, Melbourne, VIC, Australia

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Makoto Kyougoku,  
Kibi International University, Japan  
Tomás Caycho-Rodríguez,  
Universidad Privada del Norte, Peru

### \*Correspondence:

Sai-fu Fung  
sffung@cityu.edu.hk  
orcid.org/0000-0002-3526-6568

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 09 February 2022

**Accepted:** 08 March 2022

**Published:** 30 March 2022

### Citation:

Fung S-f, Kong CYW, Liu Y-m, Huang Q, Xiong Z, Jiang Z, Zhu F, Chen Z, Sun K, Zhao H and Yu P (2022) Validity and Psychometric Evaluation of the Chinese Version of the 5-Item WHO Well-Being Index. *Front. Public Health* 10:872436. doi: 10.3389/fpubh.2022.872436

**Aims:** This article evaluates the psychometric properties of the Chinese version of the 5-item WHO Well-Being Index (WHO-5) in mainland China.

**Methods:** Two cross-sectional studies with 1,414 participants from a university in China were conducted. The Chinese version of the WHO-5 was assessed to determine its internal consistency, concurrent validity, factorial validity, and construct validity.

**Results:** The results indicate that the WHO-5 is unidimensional and has good internal consistency, with Cronbach's  $\alpha = 0.85$  and  $0.81$  in Study 1 ( $n = 903$ ) and Study 2 ( $n = 511$ ), respectively. The findings also demonstrate that the WHO-5 has good concurrent validity with other well-established measures of wellbeing, self-efficacy, self-esteem, and mental wellbeing. The results of confirmatory factor analysis also suggest that the scale has a good model fit.

**Conclusions:** This study provides empirical data demonstrating that the Chinese version of the WHO-5 has good psychometric properties. The scale can be a useful measure in epistemological studies and clinical research related to wellbeing in Chinese populations.

**Keywords:** wellbeing, WHO-5, CFA, Chinese, validation, student

## INTRODUCTION

The WHO 5-item Well-Being Index (WHO-5) is a well-known psychological measurement scale that assesses subjective wellbeing through a non-symptomatic and positively worded self-report instrument for a 14-day period (1, 2). The development of the scale began with its longer versions, the WHO-28 and WHO-10 (3–5). By 1998, researchers had successfully reduced the instrument to a more user-friendly 5-item scale using a 6-point Likert scale, ranging from 0 (*at no time*) to 5 (*all of the time*) (6). Since then, it has gained worldwide popularity as a screening tool in epidemiological

research on areas such as depression, suicidal ideation, infertility, and diabetes (7–9). Recently, numerous studies have applied the WHO-5 to measure comprehensive bio-psychosocial wellbeing (10, 11), indicating an attempt at wider application.

The wider application of the scale depends on its continuous improvement in work by scholars and clinical researchers translating and validating its applicability in Western, Asian, and Latin American countries (6, 11–13). However, in its positive application in various cultures, the construct validity of the WHO-5 has been overlooked (14, 15), with researchers focusing on exploratory factor analysis (EFA) to evaluate the unidimensional latent construct of the scale (16). As such, there are various validation studies on WHO-5 only evaluated the factorial validity of the measure with EFA (9, 17). EFA cannot constrain data, whilst confirmatory factor analysis (CFA) imposes meaningful constraints in assessing the validity of a measure (15). The development and use of CFA was a crucial step in scale validation (18). Yet, surprisingly, WHO-5 assessments using CFA are scarce (1). To the best of our knowledge, this is the first validation study on the Chinese version of WHO-5 with empirical data from two cross-sectional studies using both EFA and CFA to evaluate its construct validity.

This study aimed to fill this gap by conducted two studies. One study evaluated the Chinese version of the WHO-5 with Chinese university students to reveal its psychometric properties. The second study was aimed at validating and confirming the factors in the WHO-5 to reveal its robustness in CFA. Last, the concurrent validity of the WHO-5 with several well-established construct-related concepts related to mental wellbeing (6, 8, 9, 12, 19), life satisfaction, self-esteem, and self-efficacy (1, 20, 21) was also investigated.

Overall, this study provides empirical evidence of the psychometric properties of the Chinese version of the WHO-5, as well as evidence confirming its academic development and application. The validation should be beneficial for comprehensive psychological measurements of other student populations in China. The wider application of this validated scale should help practitioners monitor the mental health and wellbeing of Chinese university students.

## MATERIALS AND METHODS

### Participants

To evaluate the psychometric properties of the WHO-5, two cross-sectional studies were conducted in a university in Guangdong, China with 1,414 valid participants. We have set 95% confidence level and 5% margin of error when determining the sampling size. The minimum sample size was 377 in the research setting (22). Study 1 took place between June and July 2018 with 903 undergraduate students with an average age of 20.56 years ( $SD = 2.75$  years) who voluntarily participated. The sample comprised 111 male and 792 female participants. In addition, 511 students participated in Study 2 from April to May 2019. The margin of error for the above samples was 3.12% ( $n = 903$ ) in Study 1 and 4.19% ( $n = 511$ ) in Study 2. The sample comprised 85.5% female and 14.5% male participants with an

average age of 20.41 years ( $SD = 2.49$  years). The gender ratio reflected the overall student demographic profile of the setting.

Both studies used the university's student intranet system to recruit participants and distribute the questionnaire. The collected data stored on the system were completely anonymous. The participants were invited to participate on a voluntary basis. Informed consent was obtained from all of the participants. Parental consent was not required as the participants are all over 18 years old. The participants were allowed to withdraw at any time during the data collection process. The studies were approved by the university's research ethics committee. The entire research process strictly adhered to relevant national and international ethical standards.

### Measures

The WHO-5 consists of five items with a 6-point Likert-type scale ranging from 0 (*at no time*) to 5 (*all of the time*) that measure wellbeing. A higher score indicates a higher level of wellbeing (5, 16, 23). The development of the Chinese WHO-5 used standard translation and back-translation procedures by two translators with proficiency in both English and Simplified Chinese (24). To avoid geographical and cross-cultural differences within China, two pilot studies were conducted in Xi'an, Shaanxi and in Guangzhou, Guangdong with 10 pilot participants with at least a degree qualification (25, 26). None of the participants reported any difficulty understanding the questions. The data collected from the pilot studies were excluded from subsequent analysis.

The Satisfaction with Life Scale (SWLS) is made up of five items with a 7-point Likert-type scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) (27–30). The Chinese version of the SWLS was validated by Bai et al. (31) with a nationally representative sample. The Cronbach's alpha in Study 1 and Study 2 are 0.883 and 0.819, respectively.

The Personal Well-Being Index (PWI) is evaluated on an 11-point Likert-type scale (0 = *no satisfaction at all* to 10 = *completely satisfied*) with seven questions related to various quality of life domains, including standard of living, health, achieving in life, relationships, safety, community-connectedness, and future security ( $\alpha = 0.902$  in Study 1; 0.916 in Study 2). The original scale developer validated the Chinese version (32). The Cronbach's alpha of PWI in both Study 1 and Study 2 are above the acceptable range with 0.902 and 0.916.

The Rosenberg Self-Esteem (RSE) Scale comprises 10 statements (with five items reverse-coded) evaluated using a 4-point Likert-type scale (1 = *strongly disagree* to 4 = *strongly agree*) (33, 34). Wu et al. (34) validated the Chinese version of the RSE with 982 adolescents. The current study also reported the acceptable alpha coefficient (Study 1 = 0.830; Study 2 = 0.755).

The General Self-Efficacy Scale (GSE) consists of 10 items on a 4-point Likert-type scale (1 = *not at all true* to 4 = *exactly true*) (35–37). The Chinese version of the GSE has recently been validated (34, 38). The GSE in Study 1 and Study 2 with Cronbach's alpha 0.903 and 0.884, respectively.

The Short Warwick Edinburgh Mental Well-Being Scale (SWEMWBS) evaluates hedonic and eudaimonic wellbeing with a 5-point scale (1 = *none of the time* to 5 = *all of the time*) with seven positively worded questions (14, 39). The Chinese version

has been validated in both school and clinical settings (40–43). The Cronbach's alpha in Study 1 = 0.884 and Study 2 = 0.824.

Last, the 12-item General Health Questionnaire (GHQ-12) contains 12 items to evaluate the severity of health-related problems with a 4-point scale (44). Higher scores indicate worse health. The Chinese version has been validated in various contexts (45, 46). The Cronbach's alpha in Study 1 and Study 2 are 0.773 and 0.751, respectively.

## Ethical Statement

This study was conducted in accordance with the ethical standards of City University of Hong Kong and Guangzhou Huashang College research ethics committee and with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants included in the study.

## Procedure

Using data from Study 1 ( $n = 903$ ) and Study 2 ( $n = 511$ ), the internal consistency of the WHO-5 was evaluated using Cronbach's alpha (47) and McDonald's omega (48–50), and the corrected item-total correlations between the five items were examined (51, 52).

EFA with principal component analysis was used to evaluate the factorial validity of the WHO-5 (1, 18, 53). To avoid the potential problem of overfitting when conducting EFA and CFA on the same dataset (54), EFA was only conducted on the sample from Study 2 ( $n = 511$ ). EFA adopted the cut-off values of the Kaiser–Mayer–Olkin (KMO) test ( $>0.70$ ) and Bartlett's test of sphericity ( $p < 0.01$ ). In addition, the identified factors should have eigenvalues  $>1$  and their loadings should be  $>0.350$  (51, 55).

The construct validity of the WHO-5 was further evaluated with CFA based on the sample obtained from Study 1 ( $n = 903$ ) (56). Recent studies on CFA have suggested that the maximum likelihood estimator is inappropriate for a scale measured with ordinal items (57); hence, a diagonally weighted least squares (DWLS) estimator was used (58–60) in Model 1 and 2. The recent simulate study recommended that maximum likelihood with mean- and variance-adjusted likelihood ratio test (MLMV) yields better results. Hence, we adopted this estimator in Model 3 (61, 62). The following well-established fit indices were used to evaluate the model fit: comparative fit index (CFI)  $> 0.90$ , Tucker–Lewis index (TLI)  $> 0.90$ , root mean square error of approximation (RMSEA)  $< 0.08$ , and root mean square residual (SRMR)  $< 0.08$  (51, 63–65). In addition, the ratio of the chi-square test statistic to degrees of freedom,  $\chi^2/df \leq 3$ , was used to determine an acceptable model fit (66–69) with the exception of Model 3, as the chi-square value of MLMV cannot be used for regular way (70).

Concurrent validity was assessed using the data from both Study 1 ( $n = 903$ ) and Study 2 ( $n = 511$ ) along with other validation constructs or measures reported in relevant studies on the WHO-5 (18, 71). Specifically, the WHO-5 has been shown to be significantly positively correlated with life satisfaction, self-esteem, and self-efficacy (1, 20, 21) and negatively correlated with mental health and psychiatric morbidity (6, 8, 12, 19). Hence, the

following scales were used to evaluate the concurrent validity of the WHO-5: SWLS, PWI, RSE, GSE, SWEMWBS, and GHQ-12.

The above analyses were conducted using the R (3.6.3) computing environment with the lavaan package 0.6-5 (72), Mplus 8.5 (70), and IBM SPSS 26.0.

## RESULTS

### Internal Consistency

Table 1 presents the descriptive statistics, including the mean, standard deviation, skewness, kurtosis, corrected item-total correlations, and Cronbach's alpha (if an item was deleted) for the five items of the WHO-5, based on the data from Study 1 ( $n = 903$ ) and Study 2 ( $n = 511$ ). The results showed that the WHO-5 had good internal consistency. The corrected item-total correlations for the WHO-5 ranged from 0.585 to 0.751 in Study 1 and from 0.529 to 0.618 in Study 2. The Cronbach's alpha and McDonald's omega values were above the acceptable range, with  $\alpha = 0.85$  and  $\omega = 0.86$  in Study 1 and  $\alpha = 0.81$  and  $\omega = 0.82$  in Study 2. There were no significant differences, and relationships were observed in the scale scores by gender, based on the independent-sample  $t$ -test and correlation results.

### Factorial Validity

Table 2 illustrates the EFA results using principal component analysis for Study 2 ( $n = 511$ ). The results of the KMO and Bartlett's test of sphericity for the WHO-5 were 0.804 ( $\chi^2 = 833.749$ ,  $p < 0.001$ ), indicating appropriate scale construction. The scale was unidimensional with only one factor with an eigenvalue  $>1$ . The factor loadings ranged from 0.478 to 0.674, explaining 57.593% of the total variance.

### Construct Validity

Table 3 and Figure 1 show the CFA results for the WHO-5 based on Study 1 ( $n = 903$ ). Model 1 evaluated the WHO-5 based on a single factor, without correlating the error terms. The results generally satisfied the criteria for an adequate model fit, with CFI = 0.996, TLI = 0.992, and SRMR = 0.037. However, the following two indices failed to fit the model:  $\chi^2 (50.536)/5 = 10.107$  and RMSEA = 0.100. Following recent studies on the WHO-5 (73), Model 2 re-evaluated the scale, with the error correlations based on the modification indices. It included one covariance factor between the error terms for the WHO5-1 and WHO5-2. The CFA results indicated a good fit of the model, with  $\chi^2 (10.988)/4 = 2.747$ ,  $p < 0.05$ , SRMR = 0.019, CFI = 0.999, TLI = 0.998, and RMSEA = 0.044. Model 3 further evaluated the WHO-5 with MLMV estimator without correlated errors. The results indicated that the WHO-5 generally had an adequate fit with a unidimensional factor structure without any *post-hoc* modifications, with SRMR = 0.030, CFI = 0.974, TLI = 0.947, and RMSEA = 0.080 (Model 3).

### Concurrent Validity

The results of Study 1 ( $n = 903$ ) replicated the relationships between the WHO-5 and the other construct-related scales suggested in the wellbeing literature (Table 4). In particular, the WHO-5 had significant and strong positive relationships with the

**TABLE 1 |** Descriptive statistics for the WHO-5 items in Study 1 and Study 2.

Item	$\bar{x}$	SD	sk	ku	$r_{it}$	$a_{iid}$
<b>Study 1</b>						
WHO5-1	3.80	0.993	−0.242	0.025	0.669	0.819
WHO5-2	3.54	0.992	0.082	0.019	0.709	0.808
WHO5-3	3.56	0.935	0.136	0.096	0.751	0.799
WHO5-4	3.37	1.056	0.175	−0.105	0.585	0.843
WHO5-5	3.47	0.933	0.145	0.067	0.611	0.834
<b>Study 2</b>						
WHO5-1	3.64	0.968	−0.405	0.341	0.588	0.780
WHO5-2	3.53	0.924	−0.188	0.294	0.618	0.771
WHO5-3	3.52	0.957	−0.099	−0.080	0.683	0.751
WHO5-4	3.38	1.070	−0.152	−0.166	0.529	0.801
WHO5-5	3.36	0.958	0.055	−0.184	0.598	0.777

$R$ , Reversed item;  $sk$ , Skewness;  $ku$ , Kurtosis;  $r_{it}$ , Corrected item-total correlations;  $a_{iid}$ , Cronbach's alpha, if item deleted.

**TABLE 2 |** Exploratory factor analysis with principal component analysis on WHO-5 items.

Item	Study 2
1. I have felt cheerful and in good spirits.	0.569
2. I have felt calm and relaxed.	0.598
3. I have felt active and vigorous.	0.674
4. I woke up feeling fresh and rested.	0.478
5. My daily life has been filled with things that interest me.	0.561

SWLS ( $r = 0.507, p < 0.001$ ) and PWI ( $r = 0.500, p < 0.001$ ). The RSE ( $r = 0.351, p < 0.001$ ) and GSE ( $r = 0.394, p < 0.001$ ) also had a moderate positive relationship with the WHO-5. In general, these results were similar in Study 2 ( $n = 511$ ).

Regarding the concurrent validity of the WHO-5, the scale was expected to demonstrate a negative relationship with the psychological symptom-related scales. As predicted, the WHO-5 was positively related to the SWEMWBS, a scale in which a lower score indicates psychiatric morbidity, with  $r = 0.438$  ( $p < 0.001$ ) in Study 1 and  $r = 0.537$  ( $p < 0.001$ ) in Study 2 ( $n = 511$ ). The results also demonstrated that the Chinese version of the WHO-5 had a significant moderate negative relationship with the GHQ-12 in Study 1 ( $r = -0.342, p < 0.001$ ) and Study 2 ( $r = -0.411, p < 0.001$ ). In summary, the WHO-5 showed good concurrent validity based on Pearson's correlation coefficients.

## DISCUSSION

Subjective wellbeing is an important denominator in various mental health issues. The WHO-5 offers a set list for evaluating the effectiveness of treatment with a friendly, easy to understand, and non-invasive assessment. Its wider application to assess psychological responses to various types of disease is apparent in its capacity for early and effective identification. By validating the Chinese version of the WHO-5, this study opens its wider application to investigate the wellbeing of Chinese undergraduate students, such as stress-related issues in work and education

**TABLE 3 |** Factor loadings and fit indices in confirmatory factor analysis for the WHO-5 (see Figure 1 for estimated model).

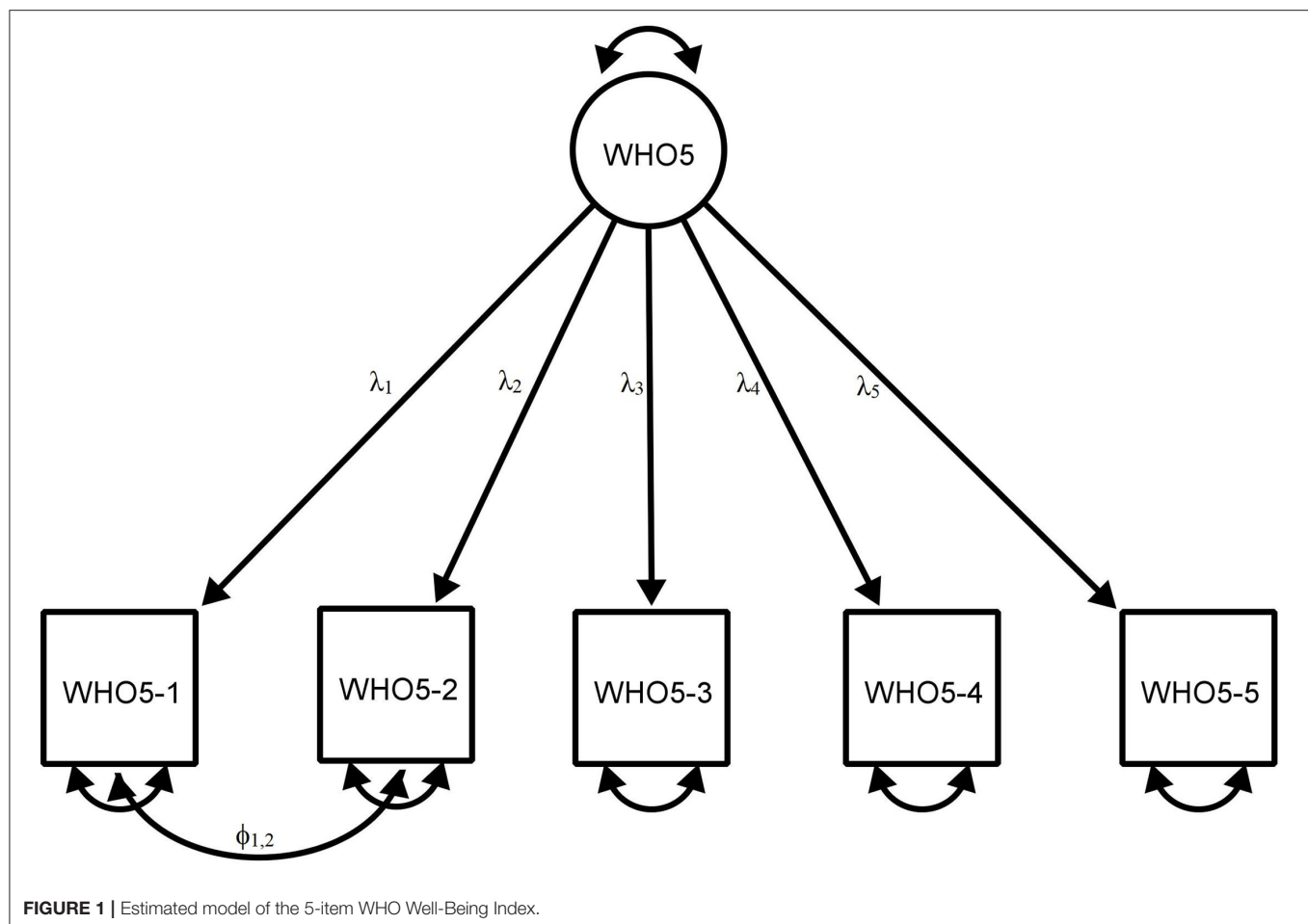
Item		Study 1		
		Model 1	Model 2	Model 3
WHO5-1	$\lambda_1$	0.799	0.725	0.756
WHO5-2	$\lambda_2$	0.838	0.769	0.798
WHO5-3	$\lambda_3$	0.856	0.905	0.829
WHO5-4	$\lambda_4$	0.662	0.676	0.632
WHO5-5	$\lambda_5$	0.693	0.708	0.654
<b>Residual correlations</b>				
WHO5-1–WHO5-2	$\phi_{1,2}$	-	0.160	-
<b>Model fit</b>				
$N$		903	903	903
RMSEA		0.100	0.044	0.080
RMSEA 90% CI		0.076–0.127	0.014–0.076	0.064–0.115
SRMR		0.037	0.019	0.030
$\chi^2$		50.536	10.988	-
df		5	4	-
$\chi^2/df$		10.107	2.747	-
CFI		0.996	0.999	0.974
TLI		0.992	0.998	0.947

settings (2). Specifically, the results of this study showed that the Chinese version of the WHO-5 has good psychometric properties. Indeed, the results indicated that the scale has good internal consistency, with Cronbach's alpha values of 0.85 and 0.81 in Study 1 and Study 2, respectively, similar to the values reported in recent WHO-5 studies (ranging from 0.78 to 0.85) based on adolescents and adults in various settings (8, 11, 12, 19, 73). The unidimensional factor structure of the Chinese version of the WHO-5 replicated that of the original WHO-5 (5, 16, 23). The results in this study also showed that the WHO-5 has good concurrent validity with well-established measures related to wellbeing, self-esteem, self-efficacy, and mental wellbeing. In short, the Chinese version of the WHO-5 is suitable for studying the wellbeing of Chinese university students.

This study contributes to the measurement of wellbeing in the following ways. First, this study is one of the first to validate the Chinese version of the WHO-5 for the student population. Although many epistemological studies have used the WHO-5 in Chinese contexts (74–80), there is a paucity of studies validating the Chinese version of the scale. In addition, most of the WHO-5 studies conducted in other countries have focused on clinical populations (1, 9, 12). As such, many existing studies reported that the WHO-5 has been used as outcome measure for the clinical trials amongst the patients with medical conditions related to oncology, endocrinology, otolaryngology, etc. (2). The findings of this study indicated that the WHO-5 is a reliable tool to address mental health challenges in a non-clinical sample, which can contribute to the field of public health.

The second contribution of this study is to provide empirical data to evaluate the construct validity of the WHO-5 through CFA. Validation studies have mainly evaluated construct validity using only EFA (4, 6, 12, 19). However, validation scholars have





advocated the use of CFA (18, 38, 81). Many recent studies have demonstrated that scales developed and validated using only EFA may suffer from various methodological issues, such as poor factorial validity and difficulty replicating the factor structure (82, 83). This study conducted two cross-sectional studies to evaluate the scale through both EFA (Study 2) and CFA (Study 1) to avoid the above issues.

This study may have the following limitations. First, the results of this study were based on two cross-sectional studies conducted in a Chinese university located in Guangdong Province in southern China. This may limit the generalizability of the findings to Chinese society or to the Chinese diaspora as a whole. Second, the construct-related measures used in this study are limited by the availability of validated Chinese versions of the scales related to wellbeing, self-efficacy, self-esteem, and mental wellbeing, which may be slightly different from the measures used by the original developers. To overcome this potential limitation, we adopted measures and concepts that have been frequently discussed and applied in WHO-5 studies (1, 6, 8, 9, 12, 19–21). The last potential limitation is related to the *post-hoc* modifications in CFA to meet all of the criteria for a good model fit. Model 1 (Table 3) reported that SRMR, CFI, and TLI met the criteria for a good model fit and that  $\chi^2/df$  and RMSEA did not. We are fully aware of the discussion about avoiding the

**TABLE 4 |** Correlations between the WHO-5 in relation to other well-established scales.

Scale	Study 1 WHO-5	Study 2 WHO-5
Satisfaction with Life Scale (SWLS)	0.507	0.519
Personal Well-Being Index (PWI)	0.500	0.499
Rosenberg self-esteem (RSE) scale	0.351	0.478
General self-efficacy scale (GSE)	0.394	0.408
Short Warwick Edinburgh Mental Well-being Scale (SWEMWBS)	0.438	0.537
12-item General Health Questionnaire (GHQ-12)	−0.342	−0.411

All correlations are significant at the 0.001 level (2-tailed).

use of correlated error terms in CFA without strong justifications (84, 85). Recent WHO-5 validation studies that used CFA have also correlated the error terms (8, 15, 73). This practice has been justified in the literature (86–90). Hence, after correlating



the error terms for items 1 and 2, Model 2 showed that the WHO-5 met all of the stringent indices for a good model fit [ $\chi^2$  (10.988)/4 = 2.747,  $p < 0.05$ , SRMR = 0.019, CFI = 0.999, TLI = 0.998, RMSEA = 0.044], indicating that the Chinese version has good construct validity. To overcome this limitation, we computed additional CFA analysis with MLMV estimator in Model 3 without correlating any error terms between the items. The results fulfilled the requirement of adequate model fit, with SRMR = 0.030, CFI = 0.974, TLI = 0.947, and RMSEA = 0.080 (Table 3).

Future studies should include wider population samples, such as young working adults, and non-university youth populations, such as primary and secondary Chinese students. By establishing the broader applicability of the WHO-5 to social work and counseling interventions, the rapid screening enabled by this instrument will provide a viable means of detecting the emotional and psychological wellbeing of young people, making early intervention possible, especially for stress-related issues at work or school. If longitudinal research were conducted, the scale would be available to examine the psychosocial wellbeing of Chinese primary and secondary students. The important data obtained would provide teachers, parents, and students themselves with insight into their psychosocial and emotional health. Another direction could be to compare the subjective wellbeing of primary, secondary, university, and working youth populations at these important stages of development.

## CONCLUSIONS

In summary, this study validated the Chinese version of the WHO-5. The findings indicate that the scale has good internal

consistency, concurrent validity, factorial validity, and construct validity. The results suggest that the Chinese version of the WHO-5 is a valid measure of the mental wellbeing of Chinese university students. The findings may encourage researchers and practitioners to use this scale in epidemiological research. However, additional work is needed to confirm the psychometric properties of the WHO-5 with more generalizable samples in other contexts.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee of the Guangzhou Huashang College. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

S-ff has worked in the conception and design of the study. Y-mL, QH, ZX, ZJ, FZ, ZC, KS, HZ, and PY have worked on data collection. S-ff and CK have performed statistical data analyses, interpretation, and have written the article. All authors have critically reviewed the manuscript and approved its last version for publication.

## REFERENCES

- De Wit M, Pouwer F, Gemke R, Delemarre-Van De Waal HA, Snoek FJ. Validation of the WHO-5 well-being index in adolescents with type 1 diabetes. *Diabetes Care*. (2007) 30:2003–6. doi: 10.2337/dc07-0447
- Topp CW, Ostergaard SD, Sondergaard S, Bech P. The WHO-5 well-being index: a systematic review of the literature. *Psychother Psychosom*. (2015) 84:10. doi: 10.1159/000376585
- Bradley C, Lewis KS. Measures of psychological well-being and treatment satisfaction developed from the responses of people with tablet-treated diabetes. *Diab Med*. (1990) 7:445–51. doi: 10.1111/j.1464-5491.1990.tb01421.x
- Awata S, Bech P, Koizum Y, Seki T, Kuriyama S, Hozawa A, et al. Validity and utility of the Japanese version of the WHO-Five Well-Being Index in the context of detecting suicidal ideation in elderly community residents. *Int Psychoger*. (2007) 19:77–88. doi: 10.1017/S1041610206004212
- Bech P. *Clinical Psychometrics*. Chichester: Wiley-Blackwell (2012).
- Love J, Andersson L, Moore CD, Hensing G. Psychometric analysis of the Swedish translation of the WHO well-being index. *Qual Life Res*. (2014) 23:293–7. doi: 10.1007/s11136-013-0447-0
- Bonsignore M, Barkow K, Jessen F, Heun R. Validity of the five-item WHO Well-Being Index (WHO-5) in an elderly population. *Eur Arch Psychiatry Clin Neurosci*. (2001) 251:27–31. doi: 10.1007/BF03035123
- Omani-Samani R, Maroufizadeh S, Almasi-Hashiani A, Sepidarkish M, Amini P. The WHO-5 well-being index: a validation study in people with infertility. *Iran J Public Health*. (2019) 48:2058–64. doi: 10.18502/ijph.v48i11.3525
- Cichon E, Kiejna A, Kokoszka A, Gondek T, Rajba B, Lloyd CE, et al. Validation of the Polish version of WHO-5 as a screening instrument for depression in adults with diabetes. *Diabetes Res Clin Pract*. (2020) 159:10. doi: 10.1016/j.diabres.2019.107970
- Diener E, Suh EM. *Culture and Subjective Well-being*. London: MIT Press (2000).
- Eser E, Cevik C, Baydur H, Gunes S, Esgin TA, Oztekin CS, et al. Reliability and validity of the Turkish version of the WHO-5, in adults and older adults for its use in primary care settings. *Primary Health Care Res Dev*. (2019) 20:7. doi: 10.1017/S1463423619000343
- Bonnin CM, Yatham LN, Michalak EE, Martinez-Aran A, Dhanoa T, Torres I, et al. Psychometric properties of the well-being index (WHO-5) spanish version in a sample of euthymic patients with bipolar disorder. *J Affect Disord*. (2018) 228:153–9. doi: 10.1016/j.jad.2017.12.006
- Schougaard LMV, De Thurah A, Bech P, Hjollund NH, Christiansen DH. Test-retest reliability and measurement error of the Danish WHO-5 Well-being Index in outpatients with epilepsy. *Health Qual Life Outcomes*. (2018) 16:6. doi: 10.1186/s12955-018-1001-0
- Tennant R, Hiller L, Fishwick R, Platt S, Joseph S, Weich S, et al. The warwick-edinburgh mental well-being scale (WEMWBS): development and UK validation. *Health Qual Life Outcomes*. (2007) 5:63. doi: 10.1186/1477-7525-5-63
- Gudmundsdottir HB, Olason DP, Gudmundsdottir DG, Sigurdsson JF. A psychometric evaluation of the Icelandic version of the WHO-5. *Scand J Psychol*. (2014) 55:567–72. doi: 10.1111/sjop.12156
- Bech P, Olsen LR, Kjoller M, Rasmussen NK. Measuring well-being rather than the absence of distress symptoms: a comparison of the SF-36 Mental Health subscale and the WHO-Five Well-Being Scale. *Int J Methods Psychiatr Res*. (2003) 12:85–91. doi: 10.1002/mpr.145

17. Hochberg G, Pucheu S, Kleinebreil L, Halimi S, Fructuoso-Voisin C. WHO-5, a tool focusing on psychological needs in patients with diabetes: the French contribution to the DAWN study. *Diab Metab.* (2012) 38:515–22. doi: 10.1016/j.diabet.2012.06.002
18. Loewenthal KM. *An Introduction to Psychological Tests and Scales.* Philadelphia, PA: Psychology Press (2001).
19. Allgaier AK, Pietsch K, Fruhe B, Prast E, Sigl-Glockner J, Schulte-Körne G. Depression in pediatric care: is the WHO-Five Well-Being Index a valid screening instrument for children and adolescents? *Gen Hosp Psychiatry.* (2012) 34:234–41. doi: 10.1016/j.genhosppsych.2012.01.007
20. Carrozzino D, Costabile A, Patierno C, Settineri S, Fulcheri M. Clinical psychology in school and educational settings: emerging trends. *Mediterr J Clin Psychol.* (2019) 7:10. doi: 10.6092/2282-1619/2019.7.2138
21. Clarke R, Farina N, Chen HL, Rusted JM, Team IP. Quality of life and well-being of carers of people with dementia: are there differences between working and nonworking carers? Results from the IDEAL program. *J Appl Gerontol.* (2021) 40:752–62. doi: 10.1177/0733464820917861
22. Maccallum RC, Browne MW, Sugawara HM. Power analysis and determination of sample size for covariance structure modeling. *Psychol Methods.* (1996) 1:130–49. doi: 10.1037/1082-989X.1.2.130
23. Bech P. Measuring the dimensions of psychological general well-being by the WHO-5. *QoL Newsletter.* (2004) 32:15–6. Available online at: <https://ogg.osu.edu/media/documents/MB%20Stream/who5.pdf>
24. Brislin RW. Back-translation for cross-cultural research. *J Cross Cult Psychol.* (1970) 1:185–216. doi: 10.1177/135910457000100301
25. Chang AM, Chau JPC, Holroyd E. Translation of questionnaires and issues of equivalence. *J Adv Nurs.* (1999) 29:316–22. doi: 10.1046/j.1365-2648.1999.00891.x
26. Cha ES, Kim KH, Erlen JA. Translation of scales in cross-cultural research: issues and techniques. *J Adv Nurs.* (2007) 58:386–95. doi: 10.1111/j.1365-2648.2007.04242.x
27. Diener E, Emmons RA, Larsen RJ, Griffin S. The satisfaction with life scale. *J Pers Assess.* (1985) 49:71–5. doi: 10.1207/s15327752jpa4901\_13
28. Pavot W, Diener E, Colvin CR, Sandvik E. Further validation of the Satisfaction with Life Scale: evidence for the cross-method convergence of well-being measures. *J Pers Assess.* (1991) 57:149–61. doi: 10.1207/s15327752jpa5701\_17
29. Pavot W, Diener E. Review of the satisfaction with life scale. *Psychol Assess.* (1993) 5:164–72. doi: 10.1037/1040-3590.5.2.164
30. Pavot W, Diener E. The satisfaction with life scale and the emerging construct of life satisfaction. *J Posit Psychol.* (2008) 3:137–52. doi: 10.1080/17439760701756946
31. Bai XW, Wu CH, Zheng R, Ren XP. The psychometric evaluation of the satisfaction with life scale using a nationally representative sample of China. *J Happiness Stud.* (2011) 12:183–97. doi: 10.1007/s10902-010-9186-x
32. The International Wellbeing Group. *Personal Wellbeing Index. 5th ed.* Melbourne, VIC: Australia Center on Quality of Life, Deakin University (2013).
33. Rosenberg M, Schooler C, Schoenbach C. Self-esteem and adolescent problems: modeling reciprocal effects. *Am Sociol Rev.* (1989) 54:1004–18. doi: 10.2307/2095720
34. Wu Y, Zuo B, Wen FF, Yan L. Rosenberg self-esteem scale: method effects, factorial structure and scale invariance across migrant child and urban child populations in China. *J Pers Assess.* (2017) 99:83–93. doi: 10.1080/00223891.2016.1217420
35. Bandura A. Self-efficacy mechanism in human agency. *Am Psychol.* (1982) 37:122–47. doi: 10.1037/0003-066X.37.2.122
36. Schwarzer R, Bäßler J, Kwiatek P, Schröder K, Zhang JX. The assessment of optimistic self-beliefs: comparison of the German, Spanish, and Chinese versions of the general self-efficacy scale. *Appl Psychol.* (1997) 46:69–88. doi: 10.1111/j.1464-0597.1997.tb01096.x
37. Scholz U, Dona BG, Sud S, Schwarzer R. Is general self-efficacy a universal construct? Psychometric findings from 25 countries. *Eur J Psychol Assess.* (2002) 18:242–51. doi: 10.1027//1015-5759.18.3.242
38. Zeng G, Fung S, Li JW, Hussain N, Yu P. Evaluating the psychometric properties and factor structure of the general self-efficacy scale in China. *Curr Psychol.* (2020) 11. doi: 10.1007/s12144-020-00924-9. [Epub ahead of print].
39. Stewart-Brown S, Tennant A, Tennant R, Platt S, Parkinson J, Weich S. Internal construct validity of the Warwick-Edinburgh Mental Well-being Scale (WEMWBS): a Rasch analysis using data from the Scottish Health Education Population Survey. *Health Qual Life Outcomes.* (2009) 7:15. doi: 10.1186/1477-7525-7-15
40. Dong A, Chen X, Zhu L, Shi L, Cai Y, Shi B, et al. Translation and validation of a Chinese version of the Warwick-Edinburgh Mental Well-being Scale with undergraduate nursing trainees. *J Psychiatr Ment Health Nurs.* (2016) 23:554–60. doi: 10.1111/jpm.12344
41. Dong A, Zhang XX, Zhou HT, Chen SY, Zhao W, Wu MM, et al. Applicability and cross-cultural validation of the Chinese version of the Warwick-Edinburgh mental well-being scale in patients with chronic heart failure. *Health Qual Life Outcomes.* (2019) 17:11. doi: 10.1186/s12955-019-1120-2
42. Fung S. Psychometric evaluation of the Warwick-Edinburgh mental well-being scale (WEMWBS) with Chinese University Students. *Health Qual Life Outcomes.* (2019) 17:46. doi: 10.1186/s12955-019-1113-1
43. Sun YY, Luk TT, Wang MP, Shen C, Ho SY, Viswanath K, et al. The reliability and validity of the Chinese Short Warwick-Edinburgh Mental Well-being Scale in the general population of Hong Kong. *Qual Life Res.* (2019) 28:2813–20. doi: 10.1007/s1136-019-02218-5
44. Goldberg DP, Williams P. *A User's Guide to the General Health Questionnaire.* Windsor: NFER-Nelson (1988).
45. Ye SQ. Factor structure of the general health questionnaire (GHQ-12): the role of wording effects. *Pers Individ Dif.* (2009) 46:197–201. doi: 10.1016/j.paid.2008.09.027
46. Liang Y, Wang L, Yin XC. The factor structure of the 12-item general health questionnaire (GHQ-12) in young Chinese civil servants. *Health Qual Life Outcomes.* (2016) 14:9. doi: 10.1186/s12955-016-0539-y
47. Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika.* (1951) 16:297–334. doi: 10.1007/BF02310555
48. McDonald RP. *Test Theory: A Unified Treatment.* London: L. Erlbaum Associates (1999).
49. Zinbarg RE, Revelle W, Yovel I, Li W. Cronbach's alpha, Revelle's beta, and McDonald's (omega H): their relations with each other and two alternative conceptualizations of reliability. *Psychometrika.* (2005) 70:123–33. doi: 10.1007/s11336-003-0974-7
50. Revelle W, Zinbarg RE. Coefficients alpha, beta, omega, and the glb: comments on Sijtsma. *Psychometrika.* (2009) 74:145–54. doi: 10.1007/s11336-008-9102-z
51. Hair JF. *Multivariate Data Analysis.* Upper Saddle River, NJ: Prentice Hall (2010).
52. Tabachnick BG. *Using Multivariate Statistics.* Boston: Pearson Education (2013).
53. Jennrich RI, Sampson PF. Rotation for simple loadings. *Psychometrika.* (1966) 31:313–23. doi: 10.1007/BF02289465
54. Fokkema M, Greiff S. How performing PCA and CFA on the same data equals trouble overfitting in the assessment of internal structure and some editorial thoughts on it. *Eur J Psychol Assess.* (2017) 33:399–402. doi: 10.1027/1015-5759/a000460
55. Field AP. *Discovering Statistics Using IBM SPSS Statistics.* Los Angeles, CA: SAGE Publications (2018).
56. Jöreskog KG. A general approach to confirmatory maximum likelihood factor analysis. *Psychometrika.* (1969) 34:183–202. doi: 10.1007/BF02289343
57. Lionetti F, Keijsers L, Dellagiulia A, Pastore M. Evidence of factorial validity of parental knowledge, control and solicitation, and adolescent disclosure scales: When the ordered nature of Likert scales matters. *Front Psychol.* (2016) 7:941. doi: 10.3389/fpsyg.2016.00941
58. Distefano C, Morgan GB. A comparison of diagonal weighted least squares robust estimation techniques for ordinal data. *Struct Eq Model A Multidiscip J.* (2014) 21:425–38. doi: 10.1080/10705511.2014.915373
59. Li C-H. Confirmatory factor analysis with ordinal data: comparing robust maximum likelihood and diagonally weighted least squares. *Behav Res Methods.* (2016) 48:936–49. doi: 10.3758/s13428-015-0619-7
60. Wong DSW, Fung S. Development of the cybercrime rapid identification tool for adolescents. *Int J Environ Res Public Health.* (2020) 17:13. doi: 10.3390/ijerph17134691

61. Maydeu-Olivares A. Maximum likelihood estimation of structural equation models for continuous data: standard errors and goodness of fit. *Struct Eq Model Multidiscip J.* (2017) 24:383–94. doi: 10.1080/10705511.2016.1269606
62. Gao CJ, Shi DX, Maydeu-Olivares A. Estimating the maximum likelihood root mean square error of approximation (RMSEA) with non-normal data: a monte-carlo study. *Struct Eq Model Multidiscip J.* (2020) 27:192–201. doi: 10.1080/10705511.2019.1637741
63. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Eq Model Multidiscip J.* (1999) 6:1–55. doi: 10.1080/10705519909540118
64. Schreiber JB, Nora A, Stage FK, Barlow EA, King J. Reporting structural equation modeling and confirmatory factor analysis results: a review. *J Educ Res.* (2006) 99:323–38. doi: 10.3200/JOER.99.6.323-338
65. Brown TA. *Confirmatory Factor Analysis for Applied Research. 2nd Ed.* New York, NY: Guilford Publications (2014).
66. Bentler PM, Bonett DG. Significance tests and goodness of fit in the analysis of covariance structures. *Psychol Bull.* (1980) 88:588–606. doi: 10.1037/0033-2909.88.3.588
67. Byrne BM. *Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basic Concepts, Applications, and Programming.* Mahwah, NJ: L. Erlbaum Associates (1998).
68. Satorra A, Bentler PM. A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika.* (2001) 66:507–14. doi: 10.1007/BF02296192
69. Kline RB. *Principles and Practice of Structural Equation Modeling.* New York, NY: Guilford Press (2005).
70. Muthén LK, Muthén BO. *Mplus User's Guide.* Los Angeles, CA: Muthén and Muthén (2017).
71. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine.* (2000) 25:3186–91. doi: 10.1097/00007632-200012150-00014
72. Rosseel Y. lavaan: an R package for structural equation modeling. *J Stat Softw.* (2012) 48:36. doi: 10.18637/jss.v048.i02
73. Perera BPR, Jayasuriya R, Caldera A, Wickremasinghe AR. Assessing mental well-being in a Sinhala speaking Sri Lankan population: validation of the WHO-5 well-being index. *Health Qual Life Outcomes.* (2020) 18:9. doi: 10.1186/s12955-020-01532-8
74. Chow KM, Tang WKF, Chan WHC, Sit WHJ, Choi KC, Chan S. Resilience and well-being of university nursing students in Hong Kong: a cross-sectional study. *BMC Med Educ.* (2018) 18:8. doi: 10.1186/s12909-018-1119-0
75. Liu L, Li SP, Zhao Y, Zhang JL, Chen G. Health state utilities and subjective well-being among psoriasis vulgaris patients in mainland China. *Qual Life Res.* (2018) 27:1323–33. doi: 10.1007/s11136-018-1819-2
76. Li Z, Dai JM, Wu N, Gao JL, Fu H. The mental health and depression of rural-to-urban migrant workers compared to non-migrant workers in Shanghai: a cross-sectional study. *Int Health.* (2019) 11:S55–63. doi: 10.1093/inthealth/ihz081
77. Gao JL, Zheng PP, Jia YN, Chen H, Mao YM, Chen SH, et al. Mental health problems and social media exposure during COVID-19 outbreak. *PLoS ONE.* (2020) 15:10. doi: 10.2139/ssrn.3541120
78. Liu SY, Huang J, Dong QL, Li B, Zhao X, Xu R, et al. Diabetes distress, happiness, and its associated factors among type 2 diabetes mellitus patients with different therapies. *Medicine.* (2020) 99:8. doi: 10.1097/MD.00000000000018831
79. Li X, Li Y, Xia B, Han Y. Pathways between neighbourhood walkability and mental wellbeing: a case from Hankow, China. *J Trans Health.* (2021) 20:18. doi: 10.1016/j.jth.2021.101012
80. Wang CP, Lu YC, Hung WC, Tsai IT, Chang YH, Hu DW, et al. Inter-relationship of risk factors and pathways associated with chronic kidney disease in patients with type 2 diabetes mellitus: a structural equation modelling analysis. *Public Health.* (2021) 190:135–44. doi: 10.1016/j.puhe.2020.02.007
81. Fung S, Fung ALC. Development and evaluation of the psychometric properties of a brief parenting scale (PS-7) for the parents of adolescents. *PLoS ONE.* (2020) 15:15. doi: 10.1371/journal.pone.0228287
82. Fung S, Chow EOW, Cheung CK. Development and validation of a brief self-assessed wisdom scale. *BMC Geriatr.* (2020) 20:8. doi: 10.1186/s12877-020-1456-9
83. Leeman TM, Knight BG, Fein EC, Winterbotham S, Webster JD. An evaluation of the factor structure of the Self-Assessed Wisdom Scale (SAWS) and the creation of the SAWS-15 as a short measure for personal wisdom. *Int Psychoger.* (2021) 1–11. doi: 10.1017/S1041610220004202. [Epub ahead of print].
84. Hermida R. The problem of allowing correlated errors in structural equation modeling: concerns and considerations. *Comput Methods Soc Sci.* (2015) 3:5–17. Available online at: <https://econpapers.repec.org/article/ntutcmss/vol3-iss1-15-005.htm>
85. Van Den Eijnden RJJM, Lemmens JS, Valkenburg PM. The social media disorder scale. *Comput Human Behav.* (2016) 61:478–87. doi: 10.1016/j.chb.2016.03.038
86. Shah R, Goldstein SM. Use of structural equation modeling in operations management research: looking back and forward. *J Operat Manag.* (2006) 24:148–69. doi: 10.1016/j.jom.2005.05.001
87. Cole DA, Ciesla J, Steiger J. The insidious effects of failing to include design-driven residuals in latent-variable covariance structure analysis. *Psychol Methods.* (2008) 12:381–98. doi: 10.1037/1082-989X.12.4.381
88. Fung S. Revisiting the dimensionality of the Brief Sensation Seeking Scale in Mainland China. *Soc Behav Pers.* (2020) 48:12. doi: 10.2224/sbp.8619
89. Fung S, Chow EOW, Cheung CK. Development and evaluation of the psychometric properties of a brief wisdom development scale. *Int J Environ Res Public Health.* (2020) 17:14. doi: 10.3390/ijerph17082717
90. Fung S, Kong CYW, Huang Q. Evaluating the dimensionality and psychometric properties of the brief self-control scale amongst Chinese University Students. *Front Psychol.* (2020) 10:10. doi: 10.3389/fpsyg.2019.02903

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Fung, Kong, Liu, Huang, Xiong, Jiang, Zhu, Chen, Sun, Zhao and Yu. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Regional Internet Access and Mental Stress Among University Students: A Representative Nationwide Study of China

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Ruimin Ma,  
King's College London,  
United Kingdom  
Wei Wang,  
Xuzhou Medical University, China  
Jun Qing Wu,  
Fudan University, China  
Xiao Zheng,  
Southern Medical University, China

### \*Correspondence:

Tingzhong Yang  
Tingzhongyang@zju.edu.cn

### †ORCID:

Shuhan Jiang  
orcid.org/0000-0003-3370-3565  
Weifang Zhang  
orcid.org/0000-0002-0769-3749  
Tingzhong Yang  
orcid.org/0000-0001-8234-0938  
Dan Wu  
orcid.org/0000-0003-0849-0297  
Lingwei Yu  
orcid.org/0000-0001-9182-1055  
Randall R. Cottrell  
orcid.org/0000-0001-9182-1055

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

Received: 30 December 2021

Accepted: 04 March 2022

Published: 08 April 2022

### Citation:

Jiang S, Zhang W, Yang T, Wu D, Yu L  
and Cottrell RR (2022) Regional  
Internet Access and Mental Stress  
Among University Students: A  
Representative Nationwide Study of  
China.  
Front. Public Health 10:845978.  
doi: 10.3389/fpubh.2022.845978

Shuhan Jiang<sup>1†</sup>, Weifang Zhang<sup>2†</sup>, Tingzhong Yang<sup>3,4\*†</sup>, Dan Wu<sup>5†</sup>, Lingwei Yu<sup>6†</sup> and Randall R. Cottrell<sup>7†</sup>

<sup>1</sup> School of Humanities and Management, Zhejiang Chinese Medical University, Hangzhou, China, <sup>2</sup> Key Laboratory of Oral Biomedical Research of Zhejiang Province, The Affiliated Stomatology Hospital, Zhejiang University School of Medicine, Hangzhou, China, <sup>3</sup> Women's Hospital/Center for Tobacco Control Research, Zhejiang University, School of Medicine, Hangzhou, China, <sup>4</sup> Injury Control Research Center, West Virginia University, Morgantown, WV, United States, <sup>5</sup> School of Psychology/Center for Mental Health, Shenzhen University, Shenzhen, China, <sup>6</sup> Center for Tobacco Control Research, Zhejiang University, School of Medicine, Hangzhou, China, <sup>7</sup> Public Health Studies Program, University of North Carolina, Wilmington, NC, United States

**Background:** The Internet changed the lives of average citizens in the early part of the twenty-first century, and it has now become an essential part of daily life. Many studies reported that accessibility of Internet use is associated with mental health. However, previous studies examining this association were confined to local and community subpopulations and limited at the individual level, which increases the potential bias from the selection effect at a different level. Regional variables would be a stable estimate of people's socioeconomic and cultural environments and how these variables affect mental health needed to be studied. The objective of this study was to evaluate the association between regional Internet access, and mental stress among university students.

**Methods:** Participants were 11,954 students, who were identified through a multistage survey sampling process conducted in 50 Chinese universities. Regional Internet access was retrieved from a national database, and mental stress was measured using the Perceived Stress Scale (Chinese Version) (CPSS). Both unadjusted and adjusted methods were considered in the analyses.

**Results:** More than one-third 36.9% (95% CI: 24.4–49.5%) of university students in this study suffered from severe mental stress (SMR). The multilevel logistic regression model found that university students studied in low-level universities had 2.52 (95% C.I. 1.17 to 6.37) times the prevalence of SMR than those in high-level universities. Compared with small cities, students in a large city had a lower prevalence of SMR (OR 0.25; 95% C.I. 0.06 to 0.77). Most importantly, regional Internet access was negatively associated with students' SMR (OR 0.25; 95% C.I. 0.08 to 0.76).

**Conclusions:** This study indicated that regional Internet access and other environmental factors including city size and type of universities contribute to students' mental health. The findings underscore that efforts to control excessive mental stress among students in China should pay greater attention to environmental determinants of stress and particularly to improve internet access.

**Keywords:** Internet use, mental health, mental stress, university students, China



## BACKGROUND

The number of Internet users has increased. An estimated 4.4 billion of the world's 7.7 billion people connected to the Internet in March 2019 (1). By 2008, China had outpaced the U.S. to become the world's largest Internet user (2). There are 1.01 billion Chinese Internet users and the Internet penetration rate reached 71.6% by June 2021 (3). The Internet changed the lives of average citizens in the early part of the twenty-first century, and it has now become an essential part of daily life. It is often used for such activities as shopping, obtaining health information, working, and communicating with each other. In the context of the global spread of Covid-19, the value and function of the Internet have once again been fully demonstrated.

The rapid growth of Internet uses around the world and in China—combined with the use of other Information and Communication Technologies (ICTs) such as personal computers and mobile devices—may have a significant impact on individual psychological well being (4). Many studies reported that fewer accessibility of Internet use is correlated with more psychological and mental problems, including depression, loneliness, and stress (5–7). And, Internet use would in fact buffer the mental and physical impact of stressful life events (8). Some studies, however, have found the opposite result: depression and psychosocial distress were positively related to Internet use (9–11). Regardless, the Internet has become an essential part of daily life and its impact on psychological and mental health needs to be closely studied. There is a rapidly growing public awareness of mental stress as an important factor that may lead to psychopathology (12).

According to the Stimulus, Cognition, and Response (SCR) model, various stimuli (S) affect internal states of people through cognition (C), which in turn elicits mental and behavioral responses (R). Classic S elicit different physical or mental outcomes due to personal cognition (13). In this context, maladaptive coping or cognitive styles may result in greater distress, while more positive personal lifestyles and access to social resources are associated with a more favorable psychological well being (14). Ecological models have emphasized that mental stress is influenced by both individual and environmental variables (15, 16). Access to and being able to use the Internet is a basic and important resource for people. Personal devices and behaviors affect access to the Internet, which in turn may affect people's mental stress (6). Regional variables are a widely accepted and stable estimate of people's behaviors (17). However, in reviewing the literature, previous studies examining Internet use and mental stress were confined to local and community subpopulations and limited at the individual level, which increases a potential selection effect bias (8, 10). Regional variables have been shown to be stable estimates of people's socioeconomic and cultural environments, so analysis results obtained from these variables are more reliable.

Mainland China is a vast territory with much cultural diversity and large differences in economic and social development. This

creates a situation where different regions have vastly different levels of Internet access. Given China's regional differences in Internet access, it would seem that region of residence might also be related to mental stress, but no studies have directly examined this association. By utilizing a large-scale, national population sample in this study, it will be possible to expand and further clarify the relationship between regional Internet access and mental stress.

Numerous studies have reported that negative academic, emotional, and health outcomes may appear because of university students' high-stress levels (18–20). College students face multiple stressors including financial burdens, academic overload, constant pressure to succeed, competition with peers, and social pressure as well as concerns about the future (21). Besides, the majority of Chinese college students are the only child in their family. Lack of siblings, being spoiled and poorly developed psychological coping skills make them more vulnerable to mental problems (22).

A large-scale, national population sample will provide more representative information on the impact of regional factors including regional internet access on the mental stress of college students. This study hypothesized that higher regional Internet access will be associated with lower mental stress levels. The information from this study could be helpful to inform Internet development and access in China as well as mental health policy and intervention strategies for college students.

## METHODS

This is a population study, the method used has been adopted by many researchers and proved to be reasonable and valid (23, 24).

### Study Area and Participants

This study employed a multistage sampling design. In Stage 1, 180 potential universities were identified in 45 China cities. These universities were part of the Bloomberg Global Initiative Project entitled "Facilitate MOH Endorsement of Tobacco Control Curriculum Implementation through Promoting Tobacco Control Curricula in Medical Schools." Using a stratified random sampling procedure based on regional location, 60 universities were selected (25). All these universities were asked to participate and students from 50 of the 60 universities completed the study survey between March to September 2013. Among these 50 universities, 22 were medical universities offering only medical programs, and 28 were comprehensive universities offering medical and non-medical programs (26). Stage 2, of the sampling strategy, involved the selection of classes within each university. All classes with certain medical courses were selected in each university, and several non-medical classes (matched for academic level) were selected in each designated comprehensive university (25). A total of 11,954 valid questionnaires were completed in 50 universities including 10,507 completed by medical students and 1,447 completed by non-medical students. The study was approved by the Ethics Committee at the Zhejiang University Medical Center (ZM, 14201), and verbal consent was obtained from all participants before data collection.

**Abbreviations:** CPSS, the Chinese version of the perceived stress scale; GDP, gross domestic product; SMS, severe mental stress.



## Measures

### Dependent Variable

Mental stress was measured by the Chinese version of the Perceived Stress Scale (CPSS) (26–28). This scale comprised 14 items that addressed perceptions of stress during the month prior to the survey. Items were rated on a 5-point Likert-type scale that ranged from 0 (never) to 4 (very often). Item scores were summed to yield a total stress score, with higher scores indicating higher perceived levels of stress. This scale has been widely used to assess stress in China and has been shown to be an appropriate indicator of mental health status (28–31). Following previous practice, severe stress was operationalized as a score  $>25$ , which was classified by ROC (Receiver Operating Characteristic Curve) performance using mental disorders gold standard. This classification has demonstrated acceptable sensitivity and specificity (27). The dependent variable in this study was severe mental stress (SMS) and was coded dichotomously as 1 = no severe mental stress and 2 = severe mental stress.

### Individual-Level Independent Variables

Sociodemographic questions were included to determine age, gender, grade level, ethnicity, paternal and maternal occupations, family location, and income.

### Covariates

Injuries are one of the most common and prominent negative events among university students and questions regarding injuries were included in the questionnaire. Students were asked to identify any unintentional injuries which required medical attention during the past 12 months. Injuries were divided into the following four groups: traffic injuries, home injuries, sports or exercise injuries, and other injuries (32, 33). For the purpose of this study, a reportable injury was defined as any injury satisfying at least one of the following criteria: the injury required (1) a doctor's treatment (2) an emergency room visit or other emergency care, or (3) the victim to rest for a minimum of one-half day (32, 33). As a covariate, injury was a categorical variable coded dichotomously as 1 = yes and 0 = no.

### University-Level Independent Variables

High levels of student stress may also reflect the type of institution where they are studying. University type was determined using the China university ranking system ("high level," "middle level," and "low level") as established by the National Ministry of Education (34). Different level universities have different courses and opportunities, and levels of stress experienced by students were expected to vary in response to different learning environments (19). Due to the intense competition to enter elite universities, their higher tuition/fees, and elevated pressures to succeed, it was expected that stress levels would be highest at such institutions (35).

### City-Level Independent Variable

Forty-five cities were included in this study. Several independent variables reflected potential regional variation. The first regional variable included in this study was the level of economic

development, as measured by per capita Gross Domestic Product (GDP) in Yuan. Categories were  $<40,000$ , from 40,000 to  $<50,000$ , and 50,000 and more. Both the GDP of the original province where the students came from and of the province where the university was located were measured. Former research found that home region GDP was significantly associated with uncertainty stress (but not life stress) (23). Whether living in a college city different from the home city would affect mental stress was examined in this research. The above data were obtained from the National Bureau of Statistics (36). The second regional variable was regional Internet access status in cities where the university was located. This was measured by the number of subscribers to the broadband Internet per 10,000 persons, which was obtained from the National Bureau of Statistics (37). Categories were  $<40$  subscribers of internet in 10,000 persons, from 40 to  $<70$  subscribers of internet in 10,000 persons, and 70 and more subscribers of internet in 10,000 persons. Regional Internet access status reflected the extent of Internet use in each region.

## Data Analysis

All data were entered into a database using Microsoft Excel. The dataset was then imported into SAS (9.3 version) for statistical analyses. Descriptive statistics were calculated to determine the prevalence of severe mental stress. A logistic model was utilized to assess the association between the dependent variable and Internet access as well as several other key co-variables. Both unadjusted and adjusted methods were considered in the data analyses. SAS survey logistic procedures were applied in the unadjusted analysis, using the university as the clustering unit, to account for a within-clustering correlation attributable to the complex sample for unadjusted analysis. Associations were confirmed through the application of a multilevel logistic regression model using the SAS Nlmixed procedure (38). Series models were built for each primary predictor, with adjustment for the influence of potentially confounding sociodemographic characteristics. We started with the Null Model, a three-level (individual, universities, and cities) model with random intercepts. It did not include any predictors except a constant in assessing variation in the likelihood of an individual experiencing severe mental stress levels. From this model, we entered demographic and regional socioeconomic variables as fixed main effects with severe mental stress to form a base Model (Model 1). From the base Model, we entered Internet access status to form the full model to assess the impact of Regional Internet access on severe mental stress (Model 2). The association between system variables and mental stress was expressed in terms of their odds ratios, and 95% CI (Confidence Interval) was computed. Model fitting was assessed by the likelihood of a change in the  $-2\log$ . We assessed the significance of the random parameter variance estimates using the Wald joint  $X^2$  test statistic (39). Model fit was assessed by the likelihood of a change in the  $-2\log$  among different models.

All analysis was weighted. Weights included: (1) sampling weights, as the inverse of the probability of selection, calculated at university and (2) post-stratification weights, calculated in relation to sex, based on estimated distributions of

this characteristic from a national survey (40). The final overall weights were computed as the product of the above two weights (41). Using a non-response weight was not considered because non-response rates were very low in this study.

Unadjusted logistic regression analyses were weighted using the overall participant-level weights, and the multilevel analysis was weighted using sampling weight and subject-level weights with post-stratification weights, respectively (42).

## RESULTS

Valid questionnaires were completed by 11,954 out of 12,260 (97.5%) of the potential university students, who come from 50 different universities in the 42 cities.

### Demographics

Of those completing surveys, 12.8% were <20 years of age, 77.3% were between 20 and 23 years of age and 9.8% were over 23 years of age. Gender was split between 44.2 male and 55.8% female. The majority of responders (60.7%) were in their first or second years of study and, 38.5% were in their third or fourth years of study. Eighty-eight percent of respondents were medical students and 12% were from other majors (Table 1).

### Association Between Regional Internet and Mental Stress

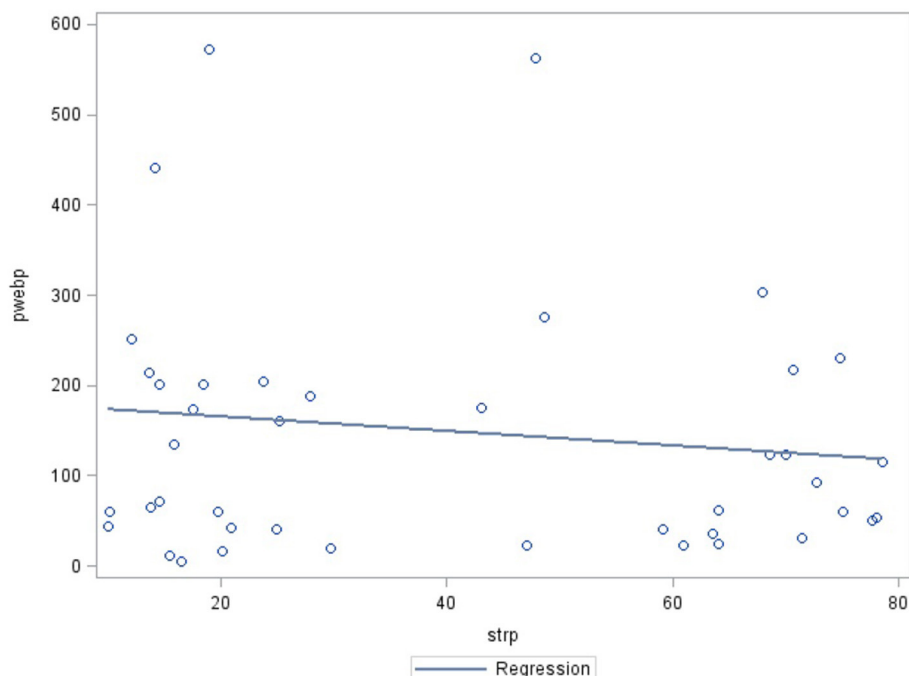
The prevalence of severe mental stress among the study population was 36.9% (95% CI: 24.4–49.5%). To be considered having severe mental stress one had to score >25 on the stress scale. Lower Internet access was associated with higher mental stress prevalence. Scatter plot showing significant correlations between the city-level number of subscribers of the Internet and severe mental stress prevalence ( $R: -1.1296$ ,  $P < 0.001$ ). The lower the city-level number of Internet subscribers, the higher was the severe mental stress prevalence (Figure 1).

The results of two multiple-level regression models were listed in Table 2. The  $-2\log$ s Likelihood of base model (model 1) is 32,849.3 and the  $-2\log$ s Likelihood of full model (model 2) is 31,835.3. The comparison LRX2 is 14 ( $df = 1$ ,  $P > 0.01$ ) between them, suggesting that the effect of the full model fitting was well improved. In detail, the base model showed that grades, university type, and university city populations were significantly related to students' mental stress. The full model showed that regional variables, including types of universities, university city populations, and the number of website subscribers were significantly associated with the students' mental stress levels. Those studied in low-level universities had 2.52 (95% C.I. 1.17 to 6.37) times the prevalence of severe mental stress than the reference group. Small city students studying in a large city had a featured lower prevalence of severe mental stress (OR 0.25; 95% C.I. 0.06 to 0.77). Students in the regions with higher Internet access had less likelihood of having severe mental stress (OR 0.25; 95% C.I. 0.08 to 0.76) than those in the regions with lower Internet access (see Table 2).

**TABLE 1 |** Demographic characteristics of sample and mental stress prevalence.

Group	N	% of sample	Prevalence	Unadjusted OR
<b>Age (years)</b>				
<20	1,894	12.8	36.3	1.00
20–	2,392	32.3	34.9	0.91 (0.53, 1.56)
21–	2,762	30.6	44.5	1.38 (0.62, 3.01)
22–	2,450	14.4	34.4	0.93 (0.47, 1.82)
23–	2,456	9.8	26.7	0.64 (0.28, 1.45)
<b>Gender</b>				
Male	4,253	44.2	35.6	1.00
Female	7,701	55.8	38.1	1.12 (0.58, 2.16)
<b>Grade</b>				
1–2	4,945	60.7	36.0	1.00
3–4	6,717	38.5	39.5	1.16 (0.49, 2.74)
5–	292	0.8	17.0	0.39 (0.16, 0.90)*
<b>Ethnicity</b>				
Han	11,148	94.4	37.3	1.00
Minority	806	4.2	35.1	0.90 (0.44, 1.85)
<b>Major</b>				
Medical	10,507	87.9	32.7	1.00
Others	1,447	12.1	38.1	1.26 (0.66, 2.41)
<b>Family home location</b>				
Rural or township	3,357	59.6	40.5	1.00
County town	769	17.2	35.6	0.81 (0.71, 1.16)
City	898	23.2	32.3	0.70 (0.47, 1.04)
<b>Income in each person in family (RMB)</b>				
<10,000	1,813	34.3	38.4	1.00
10,000	1,277	21.7	43.0	1.66 (0.85, 1.59)
20,000+	1,935	44.0	34.2	0.81 (0.64, 0.97)*
<b>Injure</b>				
No	6,889	51.5	36.0	1.00
Yes	5,065	48.5	38.4	1.11 (0.84, 1.45)
<b>University variables</b>				
<b>Universities types</b>				
High level	4,295	58.9	36.8	1.00
Middle level	6,961	39.5	36.1	0.93 (0.31, 2.82)
Low level	698	2.5	64.1	3.05 (1.45, 6.44)**
<b>Regional variables</b>				
<b>University city GDP</b>				
<50,000	4,055	16.1	31.4	1.00
50,000	6,378	61.1	38.0	1.31 (0.48, 3.59)
100,000	1,521	22.8	39.0	1.38 (0.29, 6.67)
<b>City population (million)</b>				
<1	3,084	12.2	46.2	1.00
1–	5,982	57.3	42.4	0.85 (0.29, 2.45)
4–	2,888	30.5	23.7	0.35 (0.16, 0.77)**
<b>Number of subscribers of Internet/10,000 persons in university city</b>				
<40	4,394	53.5	57.9	1.00
40–	5,015	22.6	40.8	0.98 (0.27, 2.15)
70–	2,485	23.8	22.6	0.35 (0.14, 0.85)**

\* $P < 0.05$ ; \*\* $P < 0.01$ .



**FIGURE 1 |** Relevant scatter plot between city-level number of subscribers of internet and severe mental health prevalence.

## DISCUSSION

Based on the results of this study, 36.9% (95% CI: 24.4 to 49.5) of university students were severely stressed, which is very similar to urban residents in general (36.8%) (95% CI: 33.5 to 40.2) (28). These results indicate that one-third of urban residents and one-third of university students are severely stressed. This mirrors findings from other countries. At Griffith University in Australia, fifty-three percent of first-year students were suffering from stress (41). In France, the mean perceived stress score among 1,876 students was 15.9. Scores between 16 and 20 were indicated stressed students (42). Mental stress is indeed a serious social and public issue that needs attention. Numerous studies have shown an escalation in the number of stress-related health problems in China (29, 43, 44). These high-stress levels have been attributed to massive social challenges such as an imbalance between urban and rural development, rampant corruption, and a widening chasm between rich and poor (14, 43, 45). The results of this study strongly suggest the importance of combating persistent and relatively high-stress levels among university students. The Central Government and local health authorities need to collaborate on policies for stress reduction and the prevention of mental disorders. Prevention needs to target those students who are at risk of severe stress. A nationwide media campaign should be planned and implemented to educate the populace about the adverse health effects of stress. Support groups should be established in urban community centers to provide a forum where residents can express mental health concerns, talk with others having similar concerns, and learn stress-reduction and management skills. Worksite programs should be established to

help students manage their stress. University health authorities should offer stress management programs and concurrently offer mental health treatment as needed. Special university-based clinics should be established to provide high-risk individuals with no or low-cost psychological counseling on an as needed basis and in-patient care if required. Although traditional face to face cognitive behavioral therapy and stress management program are generally recognized as great sets of stress reduction (46, 47), the obvious characteristics of those approaches are rigorous, time-consuming, and costly, which may not be ideal for college students (48). Previous studies reported that internet-based and mobile-based programs focusing on mindfulness meditation and positive psychology interventions can be effective in improving students' stress outcomes (48–50).

Addressing a gap in the literature, our study found regional Internet access was associated with students' mental stress. Based on running full analysis models, people in the regions with lower Internet access had 4 times the likelihood of having severe mental stress than those in the regions with higher Internet access, and this result was consistent with the analyses using the mental stress score as continuous or categorical data. The mean mental stress scores in the three different city-level internet access groups which can be seen in **Table 1**. There were significant differences among the three groups. When the variables listed in **Table 1** were controlled by multivariate stepwise regression, the regression coefficient of the relationship between city-level Internet access and psychological stress scores was 0.03 ( $P < 0.001$ ). Internet access reflected the number of Internet subscribers among residents in these regions (2). For this study, Internet access was considered as an essential regional

**TABLE 2 |** Results of multiple level models.

Group	Base model			Full model	
	OR	95% C.I.	P	OR	95% C.I.
<b>Grade</b>					
1–2	1.00			1.00	
3–4	1.23	0.52, 2.89	0.82	1.18	0.55, 2.54
5–	0.37	0.16, 0.86	0.02	0.41	0.19, 0.90**
<b>Type of universities</b>					
High level	1.00			1.00	
Middle level	0.93	0.31, 2.74	0.93	0.96	0.12, 2.44
Low level	3.21	1.61, 6.42	0.00	2.52	1.17, 6.37**
<b>University city population (million)</b>					
<1	1.00			1.00	
1–	0.85	0.31, 2.33	0.73	0.87	0.25, 3.05
4–	0.35	0.15, 0.77	0.01	0.25	0.06, 0.77**
<b>Number of subscribers of Internet/10,000 persons</b>					
<40				1.00	
40–				0.73	0.24, 2.21
70–				0.25	0.08, 0.76**
Fixed parameters	–0.18*			–0.27	
Random parameters between universities	0.63*			0.58*	
Random parameters between universities cities	0.57**			0.56**	

\* $P < 0.05$ ; \*\* $P < 0.01$ .

variable separate from general socioeconomic characteristics. It has been noted that “inequalities in access to and use of Internet has become one of the most prominent forms of social inequality with a major influence on life opportunities” (48, 51). Several studies have linked such a “digital divide” to poor health and well being (52–54). College students who live in a city with lower Internet access could be considered at a disadvantage in terms of their overall learning and their competitiveness in the job market.

Moreover, in modern society, the Internet has become an essential part of daily life, for shopping, obtaining information, working, and communicating. On the one hand, Internet access is the basis for the everyday social life of long-distance communication and social participation. Involvement in varied kinds of online social networking, on the one hand, can contribute to feelings of self-worth and, on the other hand, can provide more solutions for distressed people, especially when traditional resources are not available or affordable (55). People who cannot conduct these activities due to lack of Internet access could feel severe psychological discomfort which may lead to mental disorders. Besides, it should be noted that the negative impacts of the Internet, digital products, and mobile devices emerged among university students with the rapid development of internet technology (56–58). Further research into the relationship between individual Internet use patterns and physical and mental development among young adults is necessary.

Regional Internet access status is dependent on urban economic progress; the survey showed that higher Internet access regions were in economically developed regions, especially the eastern coastal areas of China (59). At the same time, socioeconomic status is also associated with mental stress (60). It is possible that regional social and economic variables may play a confounding role in the association between regional Internet access and students’ mental stress. Our study controlled for the potential interference of regional social and economic variables.

Unlike other studies (61, 62), this study found other environmental and regional variables were also associated with severe mental stress. Firstly, the city size where universities were located was associated with students’ mental stress. Large cities in China usually have more financial resources and technology available to students. They also have better social services (37). This reality may mean that students in large cities have less mental stress than students in small cities. This study also revealed that students attending higher-level universities have lower mental stress prevalence than students attending lower-level universities. It is plausible that higher-level universities attract more outstanding students. Students attending higher-level universities have access to better facilities and learning resources and may face less employment pressure as they are more likely to be employed upon graduation than students attending lower-level universities (19). Ultimately the advantages of attending a higher-level university may relieve some of the stressors associated with being a college student.

The results of this study indicate that environmental conditions are important contributors to university students’ mental health. To promote students’ mental health, it is important to address negative environmental conditions and develop programs to help students manage their stress levels.

## Study Limitations

Several limitations to this study must be considered when interpreting the results. The cross-sectional study design is an important limitation of our study; therefore, a causal link between regional Internet access and mental stress cannot be established through this work. On the other hand, we employed a large sample, and our findings met several criteria for inferring causality, including the strength of some associations, their consistency, and plausibility of effect. Future studies need to collect longitudinal surveillance data on the mental health of college students, especially focusing on the relationship between individual Internet use patterns and mental stress in the context of the influence of regional variables. Another important limitation is that our participants were confined to university students, particularly medical students. Thus, our results cannot be generalized to the wider Chinese population.

## CONCLUSION

This study indicated that regional Internet access and other environmental factors including city size and type of universities contribute to students’ mental stress. The findings underscore that efforts to control excessive mental stress among college students in China should pay greater attention



to environmental determinants of stress and particularly to improve internet access.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

## REFERENCES

- Internet World Stats. *Internet Users in the World by Regions-March*. (2019). Available online at: <https://www.internetworldstats.com/stats.htm> (accessed February 6, 2022).
- Wang Q, Li M. Home computer ownership and Internet use in China: trends, disparities, socioeconomic impacts, and policy implications. *First Monday*. (2012) 17:3767. doi: 10.5210/fm.v17i2.3767
- China Internet Network Information Center. *Statistical Reports on Internet Development in China, the forty-eighth version*. (2021). Available online at: <http://www.cnnic.net.cn/hlwfzyj/hlwzxbg/hlwtjbg/202109/P020210915523670981527.pdf> (accessed February 6, 2022).
- Nie P, Nimrod G, Sousa-Poza A. Internet use and subjective well being in China. *Hohenheim Discuss Pap Bus Econ Soc Sci*. (2015) 11:1–28. doi: 10.1007/s11205-015-1227-8
- Shapira NA, Goldsmith TD, Keck PE, Khosla UM, McElroy SL. Psychiatric features of individuals with problematic internet use. *J Affect Disord*. (2000) 57:267–72. doi: 10.1016/S0165-0327(99)00107-X
- Tandoc EC, Ferrucci P, Duffy M. Facebook use, envy, and depression among college students: is facebook depressing? *Comput Human Behav*. (2015) 43:139–46. doi: 10.1016/j.chb.2014.10.053
- Whang SM, Lee S, Chang G. Internet over-users' psychological profiles: a behavior sampling analysis on internet addiction. *Cyber Psychol Behav*. (2003) 6:143–50. doi: 10.1089/109493103321640338
- Leung L. Stressful life events, motives for internet use, and social support among digital kids. *Cyber Psychol Behav*. (2007) 10:204–14. doi: 10.1089/cpb.2006.9967
- Nguyen DT, Dedding C, Pham TT, Wright P, Bunders J. Depression, anxiety, and suicidal ideation among Vietnamese secondary school students and proposed solutions: a cross-sectional study. *BMC Public Health*. (2013) 13:119. doi: 10.1186/1471-2458-13-1195
- Sun P, Unger JB, Palmer PH, Gallaher P, Chou CP, Baezconde-Garbanati L, et al. Internet accessibility and usage among urban adolescents in Southern California: implications for web-based health research. *Cyber Psychol Behav*. (2005) 8:441–53. doi: 10.1089/cpb.2005.8.441
- Müller KW, Dreier M, Beutel ME, Duven E, Giral S, Wölfling K. A hidden type of internet addiction? intense and addictive use of social networking sites in adolescents. *Comput Human Behav*. (2016) 55:172–7. doi: 10.1016/j.chb.2015.09.007
- McMahon SD, Grant KE, Compas BE, Thurm AE, Ey S. Stress and psychopathology in children and adolescents: is there evidence of specificity? *J Child Psychol Psychiatr Allied Discipl*. (2010) 44:107–33. doi: 10.1111/1469-7610.00105
- Beck AT, Haigh EAP. Advances in cognitive theory and therapy: the generic cognitive model. *Annu Rev Clin Psychol*. (2014) 10:1. doi: 10.1146/annurev-clinpsy-032813-153734
- Vollrath M, Torgersen S. Personality types and coping. *Pers Individ Dif*. (2000) 29:367–78. doi: 10.1016/S0191-8869(99)00199-3

## AUTHOR CONTRIBUTIONS

TY conceived the study. SJ drafted the first versions of the manuscript. WZ and RC revised the manuscript. DW and LY collected the data. All authors contributed to the article and approved the submitted version.

## FUNDING

This study was partly funded by the National Nature Science Foundation of China (71490733) and the Nature Science Foundation of Zhejiang Province (LQ20G030014).

- Sallis JF, Owen N, Fisher EB. Ecological models of health behavior. *Health Educ Behav*. (2008) 4:8. doi: 10.1111/j.1442-9993.2008.01952.x
- Yang XY, Barnett R, Yang T. "Geographical context and cultural practices affecting smoking." In: editors Barnett R, Yang T, Yang X. *Smoking Environments in China. Global Perspectives on Health Geography*. (Cham: Springer), p. 5.
- Yang T. *Health Research: Social and Behavioral Theory and Methods*. Beijing: People's Medical Publishing House (2018), p. 72–132.
- Dahlin M, Joneborg N, Runeson B. Stress and depression among medical students: a cross-sectional study. *Med Educ*. (2010) 39:594–604. doi: 10.1111/j.1365-2929.2005.02176.x
- Yang T, Wang H, Zhang W, Fu J, Cottrell RR. Violent injuries among college students in China: an exploration of gender mental stress model. *Am J Men's Health*. (2020) 14:1106568750. doi: 10.1177/1557988320936503
- Wu D, Yu L, Yang T, Cottrell R, Jiang S. The impacts of uncertainty stress on mental disorders of Chinese college students: evidence from a nationwide study. *Front Psychol*. (2020) 11:243. doi: 10.3389/fpsyg.2020.00243
- Yang T, Jiang S, Yu L, Cottrell RR, Si Q. Life stress, uncertainty stress and self-reported illness: a representative nationwide study of Chinese students. *J Public Health*. (2018) 26:205–9. doi: 10.1007/s10389-017-0837-9
- Jiang S, Peng S, Yang T, Cottrell RR, Li L. Overweight and obesity among Chinese college students: an exploration of gender as related to external environmental influences. *Am J Men's Health*. (2018) 12:1557988317750990. doi: 10.1177/1557988317750990
- Yang T, Barnett R, Fan Y, Li L. The effect of urban green space on uncertainty stress and life stress: A nationwide study of university students in China. *Health Place*. (2019) 59:102199. doi: 10.1016/j.healthplace.2019.102199
- Yang T, Yu L, Oliffe JL, Jiang S, Si Q. Regional contextual determinants of internet addiction among college students: a representative nationwide study of China. *Euro J Public Health*. (2017) 27:1032–7. doi: 10.1093/eurpub/ckx141
- Yang T, Yu L, Bottorff JL, Wu D, Jiang S, Peng S, et al. Global health professions student survey (ghps) in tobacco control in China. *Am J Health Behav*. (2015) 39:732–41. doi: 10.5993/AJHB.39.5.14
- Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. (1983) 24:385–96. doi: 10.2307/2136404
- Yang TZ, Huang HT. An epidemiological study on stress among urban residents in social transition period. *Chinese J Epidemiol*. (2003) 24:760. doi: 10.3760/j.issn:0254-6450.2002.06.017
- Yang T, Rockett I, Lv Q, Cottrell RR, Marianna M. Stress status and related characteristics among urban residents: a six-province capital cities study in China. *PLoS One*. (2012) 7:e30521. doi: 10.1371/journal.pone.0030521
- Chen WQ, Yu TS, Wong TW. Impact of occupational stress and other psychosocial factors on musculoskeletal pain among Chinese offshore oil installation workers. *Occup Environ Med*. (2005) 62:251–6. doi: 10.1136/oem.2004.013680
- Li L, Feng L, Wu L, Yang Y. Association between stress and health in radiology physicians. *J Environ Occup Med*. (2001) 28, 156–8. doi: 10.13213/j.cnki.jeom.2011.03.006



31. Ng SM. Validation of the 10-item Chinese Perceived Stress Scale in elderly service workers: one-factor versus two-factor structure. *BMC Psychol.* (2013) 1:9. doi: 10.1186/2050-7283-1-9
32. Dan W, Yang T, Cottrell RR, Zhou H, Feng X. Prevalence and behavioral associations of unintentional injuries among Chinese college students: A 50-University population-based study. *Injury Prevent.* (2018) 25:10–1136. doi: 10.1136/injuryprev-2018-042751
33. Korniloff KH, Kkinen A, Koponen HJ, Kautiainen HJ, et al. Relationships between depressive symptoms and self-reported unintentional injuries: the cross-sectional population-based FIN-D2D survey. *BMC Public Health.* (2012) 12:516. doi: 10.1186/1471-2458-12-516
34. Website of Gaokao. 2014 College Entrance Examination Inquire. (2020). Available online at: <http://www.gaokao.com/baokao/lqfsx/ybfsx/> (accessed November 10, 2020).
35. Yang T, Barnett R, Peng S, Yu L, Zhang C, Zhang W. Individual and regional factors affecting stress and problem alcohol use: A representative nationwide study of China. *Health and Place.* (2018) 51:19–27. doi: 10.1016/j.healthplace.2018.02.008
36. Department of Comprehensive Statistics of National Bureau of Statistics. *China City Statistical Yearbook.* Beijing: China Statistics Press (2014).
37. Department of Urban Social Economic Survey of the National Bureau of Statistics. *China City Statistical Yearbook.* Beijing: China Statistics Press (2014).
38. Wang J. *Multilevel Models Methods and Application.* London: Higher education Press (2008).
39. National Ministry of Education. *Annual Report on University Graduates' Employment in 2015.* (2015). Available online at: <http://news.sohu.com/20131107/n389748218.shtml> (accessed November 10, 2020).
40. Grilli LM. Weighted estimation in multilevel ordinal and binary models in the presence of informative sampling designs. *Survey Methodol.* (2004) 30:93–103. Available online at: <https://www150.statcan.gc.ca/n1/pub/12-001-x/2004001/article/6997-eng.pdf>
41. Papier K, Ahmed F, Lee P, Wiseman J. Stress and dietary behavior among first-year university students in Australia: sex differences. *Nutrition.* (2015) 31:324–30. doi: 10.1016/j.nut.2014.08.004
42. Tavolacci, M, Pierre L, Joel G, Sebastien RL, Villet T. Prevalence and association of perceived stress, substance use and behavioral addictions: a cross-sectional study among university students in France, 2009–2011. *BMC Public Health.* (2013) 13:1–8. doi: 10.1186/1471-2458-13-724
43. Phillips MR, Liu H, Zhang Y, Phillips MR, Liu H, Zhang Y. Suicide and social change in China. *Cult Med Psychiatry.* (1999) 23:25–50. doi: 10.1023/A:1005462530658
44. Zhou X. Economic transformation and income inequality in urban China: evidence from panel data. *Am J Sociol.* (2000) 105:1135. doi: 10.1086/210401
45. Chen H. Development of financial intermediation and economic growth: The Chinese experience. *China Econ Rev.* (2006) 17:347–62. doi: 10.1016/j.chieco.2006.01.001
46. Dipndiped JHR, Ma DWJ, Jones MC, Johnston DW. Reducing distress in first level and student nurses: a review of the applied stress management literature. *J Adv Nurs.* (2010) 32:66–74. doi: 10.1046/j.1365-2648.2000.01421.x
47. Hofmann SG, Asnaani A, Vonk IJJ, Sawyer AT, Fang A. The Efficacy of Cognitive Behavioral Therapy: A Review of Meta-analyses. *Cognit Ther Res.* (2012) 36:427–40. doi: 10.1007/s10608-012-9476-1
48. Huberty J, Green J, Glissmann C, Larkey L, Chong L. Efficacy of the Mindfulness Meditation Mobile App “Calm” to Reduce Stress Among College Students: Randomized Controlled Trial. *JMIR mHealth and uHealth.* (2019) 7:e14273. doi: 10.2196/14273
49. Bendtsen M, Müssener U, Linderöth C, Thomas K. A Mobile Health Intervention for Mental Health Promotion Among University Students: Randomized Controlled Trial. *JMIR mHealth and uHealth.* (2020) 8:e17208. doi: 10.2196/17208
50. Ritvo P, Ahmad F, Morr CE, Pirbaglou M, Moineddin R. Correction: A Mindfulness-Based Intervention for Student Depression, Anxiety, and Stress: Randomized Controlled Trial (Preprint). *JMIR Mental Health.* (2021) 8:e27160. doi: 10.2196/preprints.27160
51. Robinson L, Cotten SR, Ono H, Quan-Haase A, Mesch G, Chen W, et al. Digital inequalities and why they matter. *Inform Commun. Soc.* (2015) 18:569–82. doi: 10.1080/1369118X.2015.1012532
52. Hong YA, Zi Z, Fang Y, Shi L. The Digital Divide and Health Disparities in China: Evidence From a National Survey and Policy Implications. *J Med Internet Res.* (2017) 19:e317. doi: 10.2196/jmir.7786
53. Ihm J, Hsieh YP. The implications of information and communication technology use for the social well being of older adults. *Inform Commun Soc.* (2015) 18:1123–38. doi: 10.1080/1369118X.2015.1019912
54. Shapira N, Barak A, Gal I. Promoting older adults' well being through Internet training and use. *Aging Ment Health.* (2007) 11:477–84. doi: 10.1080/13607860601086546
55. Sherina MS, Rampal L, Kaneson N. Psychological stress among undergraduate medical students. *Med J Malaysia.* (2004) 59:207–11. Available online at: [http://www.e-mjm.org/2004/v59n2/Psychological\\_Stress.pdf](http://www.e-mjm.org/2004/v59n2/Psychological_Stress.pdf)
56. Long J, Liu TQ, Liao YH, Qi C, He HY, Chen SB, et al. Prevalence and correlates of problematic smartphone use in a large random sample of Chinese undergraduates. *BMC Psychiatry.* (2016) 16:408. doi: 10.1186/s12888-016-1083-3
57. Wang HY, Leif S, Cheng C. Digital nativity and information technology addiction: age cohort versus individual difference approaches. *Comput Hum Behav.* (2018) 18:S1609368516. doi: 10.1016/j.chb.2018.08.031
58. Wang Y, Zhao Y, Liu L, Chen Y, Jin Y. The current situation of internet addiction and its impact on sleep quality and self-injury behavior in Chinese medical students. *Psychiatr Investigat.* (2020) 17:3. doi: 10.30773/pi.2019.0131e
59. China Internet Network Information Center. *Statistical Report on Internet Development in China, the Thirty-Five Version.* (2015). Available online at: <http://www.cnnic.net.cn/hlwzzyj/hlwzbg/201502/P020150203551802054676.pdf> (accessed March 20, 2021).
60. Wang H, Yang XY, Yang T, Cottrell RR, Yu L, Feng X, et al. Socioeconomic inequalities and mental stress in individual and regional level: a twenty one cities study in China. *Int J Equity Health.* (2015) 14:4. doi: 10.1186/s12939-015-0152-4
61. Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among US and Canadian medical students. *Acad Med J Assoc Am Med Coll.* (2006) 81:354–73. doi: 10.1097/00001888-200604000-00009
62. Pidgeon AM, Coast G, Coast G, Coast G. Psychosocial moderators of perceived stress, anxiety and depression in university students: an international study. *Open J Soc Sci.* (2014) 2:23. doi: 10.4236/jss.2014.211004

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Jiang, Zhang, Yang, Wu, Yu and Cottrell. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# The Prevalence of Irritable Bowel Syndrome Among Chinese University Students: A Systematic Review and Meta-Analysis

Weixin Yang<sup>1</sup>, Xiao Yang<sup>1</sup>, Xianghao Cai<sup>1</sup>, Zhuoren Zhou<sup>1</sup>, Huan Yao<sup>1</sup>, Xingrong Song<sup>2</sup>, Tianyun Zhao<sup>2\*</sup> and Peng Xiong<sup>1\*</sup>

<sup>1</sup> Department of Public Health and Preventive Medicine, School of Medicine, Jinan University, Guangzhou, China,

<sup>2</sup> Department of Anesthesiology, Guangzhou Women and Children's Medical Center, Guangzhou Medical University, Guangzhou, China

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Zhaoyu Gan,  
Third Affiliated Hospital of Sun Yat-sen  
University, China  
Liping Duan,  
Peking University Third Hospital, China

### \*Correspondence:

Tianyun Zhao  
wenyan\_404@tom.com  
Peng Xiong  
paulxiongwhu@gmail.com;  
pengxiong@jnu.edu.cn

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 28 January 2022

**Accepted:** 14 March 2022

**Published:** 15 April 2022

### Citation:

Yang W, Yang X, Cai X, Zhou Z, Yao H,  
Song X, Zhao T and Xiong P (2022)  
The Prevalence of Irritable Bowel  
Syndrome Among Chinese University  
Students: A Systematic Review and  
Meta-Analysis.  
Front. Public Health 10:864721.  
doi: 10.3389/fpubh.2022.864721

**Background:** Irritable bowel syndrome (IBS) has become a common public health issue among university students, impairing their physical and mental health. This meta-analysis aimed to examine the pooled prevalence of IBS and its associated factors among Chinese university students.

**Methods:** Databases of PubMed, EMBASE, MEDLINE (via EBSCO), CINAHL (via EBSCO), Wan Fang, CNKI and Weipu (via VIP) were systematically searched from inception date to May 31, 2021. Meta-analysis was performed using random-effects models. Meta-regression and subgroup analysis were used to detect the potential source of heterogeneity.

**Key Results:** A total of 22 cross-sectional studies (14 were in Chinese and 8 were in English) with 33,166 Chinese university students were included. The pooled prevalence of IBS was estimated as 11.89% (95% CI = 8.06%, 16.35%). The prevalence was 10.50% (95% CI = 6.80%, 15.87%) in Rome II criteria, 12.00% (95% CI = 8.23%, 17.17%) in Rome III criteria, and 3.66% (95% CI = 2.01%, 6.60%) in Rome IV criteria. The highest prevalence of IBS was 17.66% (95% CI = 7.37%, 36.64%) in North China, and the lowest was 3.18% (95% CI = 1.28%, 7.68%) in South China. Subgroup analyses indicated that gender, major, anxiety and depression symptoms, drinking and smoking behaviors were significantly associated with the prevalence of IBS. Meta-regression analyses suggested that region influenced prevalence estimates for IBS.

**Conclusions and Inferences:** This meta-analysis illustrated that IBS is very common in Chinese university students. Regular screening, effective prevention, and appropriate treatments should be implemented to reduce the risk of IBS in this population. More future studies should be conducted in Northeastern and Southwestern parts of China.

**Keywords:** irritable bowel syndrome, prevalence, associated factors, Chinese university students, meta-analysis

## INTRODUCTION

Irritable bowel syndrome (IBS) is a chronic functional gastrointestinal disease characterized by altered bowel habits, abdominal discomfort or pain, and abdominal distension, without obvious structural or biochemical abnormalities (1) or organic etiology (2). A meta-analysis with 23 studies ( $n = 74,763$ ) revealed that the prevalence of IBS was 6.5% in the general population in China (3). Though the pathophysiology is still unclear, IBS has been proved to be associated with multiple factors including abnormal gastrointestinal motility, visceral sensory abnormality, abnormal brain-gut regulation, inflammation, gastrointestinal infection, and stressful life events, etc. (4–6). Furthermore, recent evidences supported the negative psycho-influences to be the key role of the biopsychosocial model of IBS (4, 7–9). For instance, a meta-analysis showed the high rates of anxiety symptoms (39.1%) and disorders (23%), depression symptoms (28.8%) and disorders (23.3%) in IBS patients (10). Throughout the years, various criteria including the Manning criteria, the Rome I, Rome II, Rome III and Rome IV criteria, have been applied for diagnosis of IBS. Amongst them, the Rome III criteria (11) and Rome IV criteria (12) are the most commonly used currently.

University students are more likely to experience IBS—varied from 1.18% (13) to 33.3% (14) in China, might due to the psychological problems, unhealthy lifestyles, and a low level of health literacy (15). For instance, they are more prone to suffer from anxiety and depression symptoms, because of difficulties in terms of academic pressures, occupational choices, interpersonal conflict, and life goal decisions (16), which could cause gastrointestinal disorders through the brain-gut axis mechanism (17). A lack of physical exercise, irregular eating habits (i.e., not having breakfast), smoking, and drinking behaviors have also been found common in university students (18), which may contribute to the risk of IBS in this population. Moreover, due to various clinical examinations and constant medical treatment, IBS has been proved to be linked to physical problems like headache, chronic back or neck pain and diabetes (19), mental disorders like anxiety and depression (20) and obsessive-compulsiveness (21), sleep disorder (22), poorer academic achievements (23), lower quality of life (24, 25), social embarrassment due to diarrhea (a symptom of IBS) which restricts the patients being near a bathroom (26), and higher economic cost (24).

There has been a growing number of studies on IBS in Chinese university students, but the prevalence of IBS varied widely in existing studies. Precise epidemiological figures related to IBS prevalence are fundamental to inform preventive strategies in an evidence-based way. This study aimed to quantitatively evaluate the prevalence of IBS and its associated factors among Chinese university students *via* systematic review and meta-analysis.

## MATERIALS AND METHODS

### Search Strategy and Selection Criteria

This study was performed according to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA)

Statement (27) and Meta-analyses Observational Studies in Epidemiology (MOOSE) guidelines (28). A systematic search was conducted in both English (PubMed, EMBASE, MEDLINE *via* EBSCO, CINAHL *via* EBSCO) and Chinese databases (Wan Fang, CNKI, Weipu *via* VIP) from their inception date to May 31, 2021. The searching terms were followed: (((Irritable OR spastic OR Mucous) AND (bowel OR colon OR colonic OR gastrointestinal)) OR IBS) AND (China OR Chinese OR mainland China OR Hong Kong OR Macau OR Macao OR Taiwan) AND (College OR University OR undergrad\*). The search strategies in different databases were provided in **Supplementary Table 1**. The cited references of the identified publications were also searched manually to ascertain additional studies that may have been missed. The corresponding author would be contacted to get the essential information if needed.

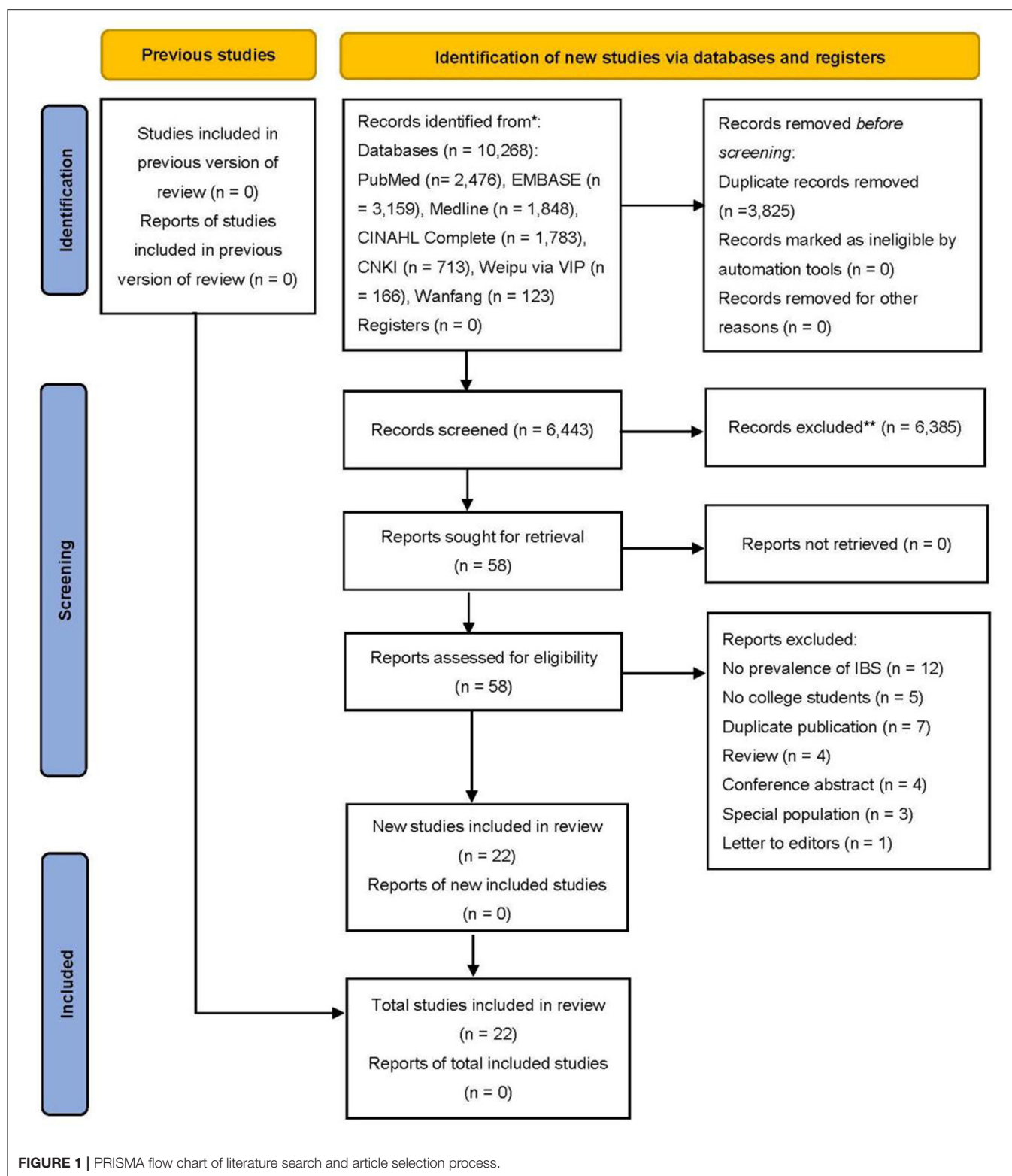
The titles and abstracts were initially screened and those that were obviously irrelevant were excluded. The full texts of the remaining articles were reviewed to find relevant studies that were finally included. The selection above was performed by two researchers (WX Yang and X Yang) independently and any discrepancies were resolved by discussing with the senior researcher (XH Cai). **Figure 1** detailed the process of screening articles.

Studies were included if they met the following criteria: (1) original studies including cross-sectional and cohort studies; (2) participants should be full-time undergraduate students, junior college students, or postgraduates in China (including Hong Kong, Macao, and Taiwan); (3) reporting the prevalence of IBS with diagnostic criteria based on validated questionnaires or scales according to Manning or Rome criteria or International Classification of Diseases codes; (4) studies recruiting at least 50 subjects; (5) accessible full texts in English or Chinese. We excluded studies if they met the following criteria: (1) studies focused on special populations with medical conditions like gastritis or hepatitis; (2) studies without the prevalence of IBS reported; (3) full-texts not being available. If two or more papers were published based on the same dataset, only the one with the most complete information was included.

### Data Analysis

We used the “Checklist for Prevalence Studies” developed by the Joanna Briggs Institute for quality assessment (29, 30). The checklist consists of nine items, including (1) appropriate sampling frame, (2) appropriate sampling design, (3) adequate sample size, (4) detailed description of study subjects and setting, (5) sufficient coverage of sample, (6) valid methods for identifying the condition, (7) standard and reliable measurement of the condition (8) appropriate statistical analysis, and (9) adequate response rate. Each item was rated as either “yes”, “no”, “unclear”, or “not applicable”. Only the “yes” answer for each item receives a score of 1. Thus, final scores for each study could range from 0 to 9. Study quality was assessed by two researchers (WX Yang and X Yang) independently and any discrepancies were resolved by discussing with a third researcher (XH Cai).

Two researchers (WX Yang and X Yang) independently conducted data extraction, and any inconsistencies in the process were checked and resolved by involving a third



investigator (XH Cai). The following information was extracted and tabulated: author, year of publication, sample characteristics {gender[Male/Female (M/F)], age [Mean  $\pm$  Standard Deviation(SD)], grade, majors, educational level},

survey year, survey province, survey region, sampling method, total subjects, subjects with IBS, the prevalence of IBS, diagnostic criteria of IBS, subgroups, risk factors, and other significant results. Seven regions were identified in China, as shown in



**Supplementary Data 1.** Majors were classified into “medicine” (clinical medicine, nursing, and health-related specialties set in the medical university), “non-medicine” or “mixed”. “Mixed” was defined as a mixture of different majors, which could not extract the specific major data in the paper. Only Rome III prevalence data was extracted if the study contained both Rome II and Rome III criteria.

The pooled prevalence of IBS was calculated as effect size (ES). Given the prevalence of IBS in most included studies (ranging from 0 to 20%) was close to the margins, the variance-stabilizing Freeman-Tukey double arcsine transformation was used to combine rates (31). Raw prevalence estimation was transformed and then multiple meta-analyses were performed with the transformed proportions using the random-effects model. These were then back-transformed to prevalence rates to facilitate interpretation of the outcomes and confidence interval (CI) (32). The  $I^2$  statistic was used to assess heterogeneity between the studies (low:  $I^2 < 25\%$ , moderate: 25–50%, high:  $I^2 > 50\%$ ) (33, 34). The funnel plot and Begg’s test (35) were conducted to explore publication bias when there were at least 10 studies in the meta-analysis (36). The “metaninf” command was used for sensitivity analysis *via* evaluating the effect of each study on overall estimates.

Subgroup analyses were conducted to examine the possible sources of heterogeneity according to the following categorical variables: (1) educational level: junior college vs. undergraduate vs. postgraduate; (2) gender: female vs. male; (3) majors: medicine vs. non-medicine vs. mixed; (4) regions: Central China vs. East China vs. North China vs. Northwest China vs. South China; (5) survey year: 2005–2010 vs. > 2010; (6) criteria: Rome II vs. Rome III vs. Rome IV; (7) anxiety: yes vs. no; (8) depression: yes vs. no; (9) drinking: yes vs. no; and (10) smoking: yes vs. no. To identify the factors associated with the prevalence of IBS in Chinese university students, pooled odd ratios (ORs) for potential influencing factors were calculated with a random-effects model.

Univariate meta-regression was performed to identify sources of between-study heterogeneity according to the following variables: educational level, gender ratio (M/F), major, region, survey year, criteria, anxiety proportion, depression proportion, drinking proportion, smoking proportion, and quality score. The significance level was set at  $p < 0.05$  (two-tailed) for all analyses.

The Stata 14.0 (Stata Corporation, College Station, TX, USA) and Comprehensive Meta-Analysis Version 2.0 (Biostat, Inc., Englewood, New Jersey, USA) were administered to synthesize data.

## RESULTS

### Study Characteristics

A total of 10,268 citations were initially searched in the databases, with 6,443 remaining after the removal of duplicates. After evaluating the title and/or abstract, 6,385 citations were removed for non-compliance with inclusion criteria. The full text of the remaining 58 citations was evaluated, and a total of 22 citations that met the criteria were included. Two citations with the same data were both included due to the different

content in subgroup analyses and significant results, and the sample size of one citation was included when calculating the number of participants in this review. Finally, a total of 22 citations (14 in Chinese and 8 in English) with 33,166 Chinese university students were included in the analysis (**Figure 1**). All 22 studies reported the prevalence of IBS in university students, 20 reported risk factors for IBS, and 21 reported other significant results. A list of all included studies was presented in **Supplementary Data 2**. The characteristics of the study were summarized in **Table 1**.

### Quality Assessment and Publication Bias

The scores of study quality assessment ranged from 6 to 9 with a mean score of 7.8. The most common missing items in the studies included the reports of detailed information about the study subjects and the detailed descriptions of the process of collecting data or the professionalism of the person collecting the data (**Supplementary Table 2**).

No significant publication bias was found by the funnel plot (**Supplementary Figure 1**) in the 21 studies. Begg’s test ( $z = 1.48$ ,  $p = 0.139$ ) also did not detect significant bias.

### Prevalence of IBS

The pooled prevalence of IBS in Chinese university students was estimated to be 11.89% (95% CI = 8.06%, 16.35%) based on the random-effects model (**Figure 2**). The sensitivity analysis indicated that no study affected the prevalence estimate by more than 1%, suggesting that the overall prevalence estimate was powered to the methodological quality of each research study included.

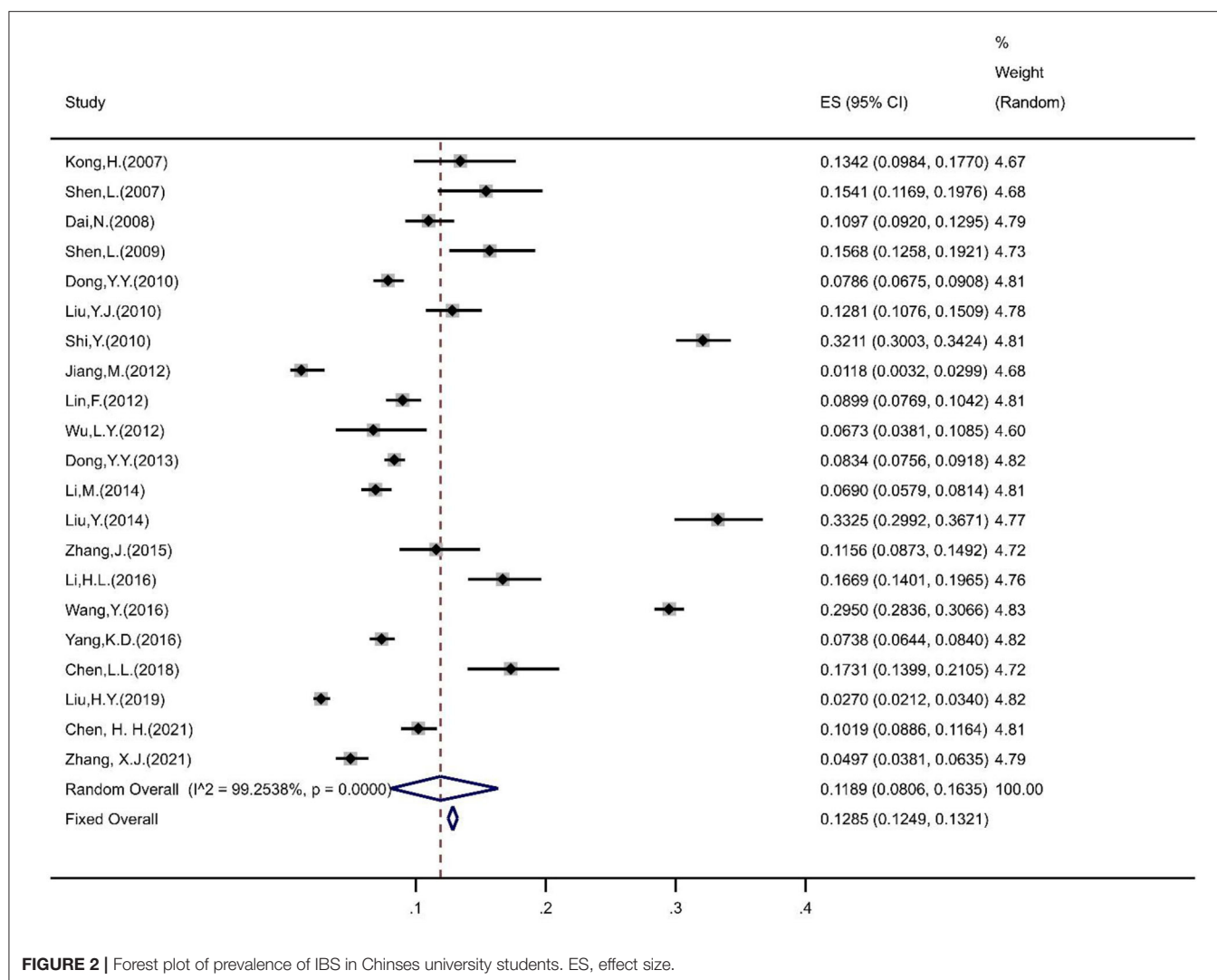
Among them, the prevalence of IBS was 8.18% (95% CI = 3.66%, 17.26%) for junior college students, 12.14% (95% CI = 8.02%, 17.96%) for undergraduate students, and 12.74% (95% CI = 10.10%, 15.94%) for postgraduate students. The prevalence of IBS was 13.14% (95% CI = 9.22%, 18.39%) in females and 10.17% (95% CI = 6.39%, 15.80%) in males. The prevalence of IBS in medical, non-medical, and mixed majors were 11.91% (95% CI = 8.13%, 17.12%), 11.35% (95% CI = 8.90%, 14.37%), and 6.48% (95% CI = 2.13%, 18.05%), respectively. In terms of regions, the prevalence of IBS among university students was 15.93% (95% CI = 8.28%, 28.47%) in Central China, 10.50% (95% CI = 8.40%, 13.06%) in East China, 17.66% (95% CI = 7.37%, 36.64%) in North China, 19.10% (95% CI = 7.02%, 42.46%) in Northwest China, and 3.18% (95% CI = 1.28%, 7.68%) in South China. Under different diagnostic criteria, the prevalence of IBS was 10.50% (95% CI = 6.80%, 15.87%) in Rome II, 12.00% (95% CI = 8.23%, 17.17%) in Rome III, and 3.66% (95% CI = 2.01%, 6.60%) in Rome IV.

The prevalence of IBS in people with anxiety and depression symptoms was 17.31% (95% CI = 8.36%, 32.44%) and 17.34% (95% CI = 8.32%, 32.68%), respectively. The prevalence of IBS was 11.11% (95% CI = 6.40%, 18.60%) in people who drank, 18.10% (95% CI = 5.59%, 45.18%) in people who smoke.

### Associated Factors With IBS

Subgroup analysis found that a higher prevalence of IBS was significantly associated with postgraduate students,





females, medical majors, anxiety, and depression symptoms, drinking and smoking behaviors (all  $P < 0.001$ ) (Table 2, Supplementary Table 3). The survey region, survey year, diagnostic criteria were also significantly associated with the prevalence of IBS (all  $P < 0.001$ ) (Table 2, Supplementary Table 3).

In the univariate meta-regression, region ( $p = 0.01$ ) was identified as a significant moderator that contributed to heterogeneity between the studies. However, educational level ( $p = 0.66$ ), gender ratio ( $p = 0.19$ ), major ( $p = 0.05$ ), survey year ( $p = 0.57$ ) criteria ( $p = 0.41$ ), anxiety proportion ( $p = 0.29$ ), depression proportion ( $p = 0.14$ ), drinking proportion ( $p = 0.64$ ), smoking proportion ( $p = 0.71$ ) and quality score ( $p = 0.48$ ) were non-significant moderators (Table 3).

Items of sleep disorders (OR = 1.48, 95% CI = 1.02, 2.15), anxiety (OR = 2.35, 95% CI = 2.03, 2.72), depression (OR = 2.15, 95% CI = 1.88, 2.47), and gender (OR = 1.36, 95% CI = 1.08, 1.69) were statistically associated with the development of IBS in

Chinese university students (Supplementary Table 4), which was also found in the corresponding subgroup analyses.

## DISCUSSION

To the best of our knowledge, this is the first systematic review and meta-analysis to estimate the pooled prevalence of IBS among Chinese university students, including 22 studies with 33,166 subjects. The major findings are: (1) the pooled prevalence of IBS among Chinese university students was 11.89% (95% CI = 8.06%, 16.35%); (2) the prevalence of IBS was significantly associated with educational level, gender, major, region, survey year, diagnostic criteria, anxiety, depression, drinking, smoking, and sleep disorders.

The prevalence of IBS in our study was approximate to that of 10.9% in American university students (56) and 10.7% in Japanese university students (57), but higher than that in Korean college students (5.7%) (58), lower than that in Pakistan

**TABLE 1** | Characteristics of included studies.

References	Survey year	Region, province	Sampling method	Quality score	Criteria of IBS	Gender (M/F)	Age (mean $\pm$ SD)	Major	Educational level and grade	Total subjects	Prevalence (%)	Other significant results
Kong (37)	2006	East China, Shanghai	Random, stratified	8	Rome II	155/158	23.48 $\pm$ 2.46	Medicine	Undergraduate, postgraduate	313	13.42	<ul style="list-style-type: none"> <li>With the Rome II criteria, 8 cases were IBS-C (19.05%), 24 cases were IBS-D (57.14%), and 10 cases were IBS-M (23.81%).</li> <li>Compared with the non-IBS group, scores of anxiety and depression were higher in the IBS group (<math>p &lt; 0.001</math>).</li> </ul>
Shen (38)	2006	Central China, Hubei	Stratified	9	Rome II	166/165	24.69 $\pm$ 2.10	Mixed	Undergraduate year 1, postgraduate year 1–2	331	15.4	<ul style="list-style-type: none"> <li>IBS was detected in 19.7% of the non-medical professional group, and 10.5% of the medical professional group, with significant differences seen between groups (<math>p = 0.022</math>).</li> <li>Compared with the non-IBS group, scores of anxiety and depression were higher in the IBS group.</li> </ul>
Dai (39)	2007	East China, Zhejiang	Cluster	9	Rome II, Rome III	517/604	21.8 $\pm$ 3.2	Mixed	Undergraduate	1,121	4.7 (Rome II), 10.4 (Rome III)	<ul style="list-style-type: none"> <li>With the Rome II criteria, 8 cases were c-IBS (14.81%), 12 cases were d-IBS (22.22%), and 34 cases were a-IBS (62.96%). With the Rome III criteria, 18 cases were IBS-C (14.63%), 30 cases were IBS-D (24.39%), 59 cases were IBS-M (47.97%), and 16 cases were IBS-U (13.01%).</li> </ul>
Shen (5)	2006	Central China, Hubei	Stratified	9	Rome II	241/250	24.13 $\pm$ 2.069	Mixed	Undergraduate year 1	491	15.7	<ul style="list-style-type: none"> <li>IBS was associated with anxiety (<math>p &lt; 0.001</math>) and depression (<math>p &lt; 0.001</math>).</li> </ul>
Dong (40)	2009	East China, Shandong	Random	9	Rome II	917/1209	20.64 $\pm$ 1.593	Mixed	Undergraduate	2,126	7.85	<ul style="list-style-type: none"> <li>The IBS group scored higher in anxiety (<math>p &lt; 0.001</math>), depression (<math>p &lt; 0.001</math>) and lower in exercise frequency (<math>p = 0.007</math>) compared to the non-IBS group.</li> <li>With the Rome III criteria, 61 cases were IBS-C (36.5%), 51 cases were IBS-D (31.1%), 40 cases were IBS-M (23.9%), and 25 were non-IBS cases (8.5%).</li> </ul>

(Continued)

TABLE 1 | Continued

References	Survey year	Region, province	Sampling method	Quality score	Criteria of IBS	Gender (M/F)	Age (mean $\pm$ SD)	Major	Educational level and grade	Total subjects	Prevalence (%)	Other significant results
Liu (41)	2009	East China, Jiangxi	Cluster	8	Rome III	392/568	19.68 $\pm$ 2.14	Mixed	Junior college year 1–2	960	12.81	<ul style="list-style-type: none"> <li>With the Rome III criteria, 58 cases were IBS-C (47.51%), 23 cases were IBS-D (18.34%), and 42 cases were IBS-M (34.25%).</li> <li>IBS was associated with health-related majors (<math>p &lt; 0.01</math>) and higher grade (<math>p &lt; 0.01</math>).</li> <li>Compared with the non-IBS group, the IBS group has a higher prevalence of anxiety and depression.</li> </ul>
Shi (42)	2008	Central China, Henan	Cluster	8	Rome III	414/1,520	19.7 $\pm$ 1.4	Medicine	Undergraduate	1,934	32.1	<ul style="list-style-type: none"> <li>With the Rome III criteria, 203 cases were IBS-C (32.69%), 168 cases were IBS-D (27.05%), and 250 cases were IBS-M (40.26%).</li> <li>Higher height (<math>p = 0.018</math>), shorter sleep time (<math>p = 0.024</math>) and weight loss (<math>p &lt; 0.001</math>) were related to IBS in females.</li> </ul>
Jiang (13)	/	South China, Guangdong	Stratified	7	Rome III	161/178	20.12 $\pm$ 0.63	Mixed	Junior college, undergraduate	339	1.18	<ul style="list-style-type: none"> <li>Mental factors were related to functional gastroenteropathy (<math>p &lt; 0.05</math>).</li> </ul>
Lin (43)	/	North China, Hebei	Stratified	8	Rome III	388/1,370	18–24 (age range)	Medicine	Junior college, undergraduate	1,758	8.99	<ul style="list-style-type: none"> <li>IBS was associated with female (<math>p = 0.049</math>), educational level (<math>p &lt; 0.001</math>), major (<math>p = 0.026</math>).</li> </ul>
Wu (44)	2011	Central China, Hubei	Stratified	6	Rome III	86/137	20.26	Medicine	Undergraduate	223	6.7	<ul style="list-style-type: none"> <li>IBS was associated with lack of physical exercise (<math>p = 0.035</math>), spicy diet (<math>p = 0.009</math>), anxiety (<math>p = 0.049</math>), gastrointestinal infection (<math>p = 0.002</math>), antibiotics taking (<math>p = 0.046</math>), painkillers taking (<math>p = 0.009</math>), lack of amusement (<math>p = 0.017</math>) and parents having the same symptoms (<math>p = 0.012</math>).</li> </ul>
Dong (45)	2012	East China, Shandong	Random	9	Rome III	2,215/2,423	20.768 $\pm$ 1.509	Mixed	Undergraduate	4,638	8.34	<ul style="list-style-type: none"> <li>IBS was associated with anxiety (<math>p = 0.002</math>) and depression (<math>p = 0.045</math>).</li> <li>With the Rome III criteria, 150 cases were IBS-C (38.76%), 189 cases were IBS-D (48.84%), and 48 cases were IBS-M (12.40%).</li> </ul>
Li (46)	2010–2011	East China, Zhejiang	/	8	Rome III	967/903	21.34 $\pm$ 2.56	Mixed	Undergraduate year 1–4, postgraduate year 1	1,870	6.9	/

(Continued)

TABLE 1 | Continued

References	Survey year	Region, province	Sampling method	Quality score	Criteria of IBS	Gender (M/F)	Age (mean $\pm$ SD)	Major	Educational level and grade	Total subjects	Prevalence (%)	Other significant results
Liu (14)	2014	North China, Beijing	Stratified	8	Rome III	196/571	23.26 $\pm$ 2.88	Medicine	Undergraduate and postgraduate, year 1–7	767	33.3	<ul style="list-style-type: none"> <li>• For females, the IBS participants scored higher in anxiety (<math>p = 0.015</math>).</li> <li>• The IBS group scored higher in emotional neglect than the non-IBS group (<math>p = 0.045</math>).</li> <li>• Medical students with IBS scored higher on the PSQI than those without IBS (<math>p &lt; 0.001</math> in females, <math>p = 0.014</math> in males).</li> <li>• With the Rome III criteria, 15 cases were IBS-C (5.88%), 79 cases were IBS-D (30.98%), 112 cases were IBS-M (43.92%), and 49 cases were IBS-U (19.22%).</li> </ul>
Yang (47)	2014	North China, Beijing	Stratified, cluster	7	Rome III	196/571	23.26 $\pm$ 2.88	Medicine	Undergraduate and postgraduate, year 1–7	767	33.3	<ul style="list-style-type: none"> <li>• With the Rome III criteria, 15 cases were IBS-C (5.88%), 79 cases were IBS-D (30.98%), 112 cases were IBS-M (43.92%), and 49 cases were IBS-U (19.22%).</li> <li>• Compared with the non-IBS group, the score of the life stress questionnaire was higher in the IBS group (<math>p &lt; 0.05</math>).</li> </ul>
Zhang (48)	2012–2013	Northwest China, Xinjiang	Stratified	9	Rome III	248/193	24.57 $\pm$ 2.02	Mixed	Postgraduate year 1–3	441	11.56	<ul style="list-style-type: none"> <li>• IBS prevalence was higher in groups of females (<math>p = 0.021</math>), eating cold food frequency <math>\geq 3</math> times a week (<math>p &lt; 0.001</math>), eating dairy product frequency <math>\geq 3</math> times a week (<math>p = 0.001</math>), eating high-fiber foods frequency <math>&lt; 4</math> times a week (<math>p = 0.011</math>), physical activity time <math>&lt; 4</math> h a week (<math>p = 0.029</math>), insomnia frequency <math>\geq 3</math> times a week (<math>p &lt; 0.001</math>), anxiety (<math>p = 0.013</math>) and depression (<math>p = 0.002</math>).</li> </ul>

(Continued)

TABLE 1 | Continued

References	Survey year	Region, province	Sampling method	Quality score	Criteria of IBS	Gender (M/F)	Age (mean $\pm$ SD)	Major	Educational level and grade	Total subjects	Prevalence (%)	Other significant results
Li (49)	2015	North China, Beijing	Stratified	8	Rome III	425/282	20.28 $\pm$ 1.46	Mixed	Undergraduate year 1–4	707	16.7	<ul style="list-style-type: none"> <li>• With the Rome III criteria, 16 cases were IBS-C (13.6%), 40 cases were IBS-D (33.9%), 54 cases were IBS-M (45.8%), and 8 cases were IBS-U (6.8%).</li> <li>• IBS was detected differently in females (20.2%) and males (14.4%, <math>p = 0.041</math>).</li> <li>• Compared to the healthy control group, participants in the IBS group reported higher scores of somatization symptom (<math>p &lt; 0.001</math>), test anxiety (<math>p = 0.026</math>), negative life events (<math>p = 0.002</math>), and lower scores of physical symptoms and organ function (<math>p &lt; 0.001</math>), psychological symptoms and negative emotions (<math>p = 0.036</math>), role activities and social adaptation (<math>p = 0.008</math>), social resources and social contact (<math>p = 0.027</math>) of SRHMS.</li> <li>• Gender, smoking, eating chillies, high physical-sensitive independently related to IBS.</li> </ul>
Wang (50)	2013	Northwest China, Inner Mongolia	Stratified	7	Rome III	1,667/4,438	21 $\pm$ 1.5	Mixed mixed	Undergraduate year 1–3	6,105	29.5	<ul style="list-style-type: none"> <li>• With the Rome III criteria, 364 cases were IBS-C (20.22%), 866 cases were IBS-D (48.11%), 322 cases were IBS-M (17.89%), and 248 cases were IBS-U (13.78%).</li> <li>• IBS was detected differently in females (31.3%) and males (24.8%, <math>p &lt; 0.001</math>).</li> <li>• IBS was associated with lose weight (<math>p &lt; 0.001</math>), anxiety (<math>p &lt; 0.001</math>) and depression (<math>p = 0.026</math>).</li> </ul>
Yang (51)	2014–2015	South China, Guangdong	Stratified	7	Rome III	/	/	Mixed	Undergraduate year 1–3	2,847	7.38	<ul style="list-style-type: none"> <li>• With the Rome III criteria, 76 cases were IBS-C (36.19%), 101 cases were IBS-D (48.10%), and 33 cases were IBS-M (15.71%).</li> </ul>

(Continued)



TABLE 1 | Continued

References	Survey year	Region, province	Sampling method	Quality score	Criteria of IBS	Gender (M/F)	Age (mean $\pm$ SD)	Major	Educational level and grade	Total subjects	Prevalence (%)	Other significant results
Chen (52)	2016	East China, Shanghai	Stratified, cluster	7	Rome III	0/468	19.60 $\pm$ 1.20	Nursing	Junior college year 1–3	468	17.31	<ul style="list-style-type: none"> <li>With the Rome III criteria, 43 cases were IBS-C (53.09%), 19 cases were IBS-D (23.46%), 14 cases were IBS-M (17.28%), and 5 cases were IBS-U (6.17%).</li> <li>IBS was associated with spicy diet (<math>p = 0.014</math>), sleep disorder (<math>p = 0.047</math>) and lower grade (<math>p = 0.008</math>).</li> </ul>
Liu (53)	2019	South China, Guangxi	Cluster	8	Rome IV	593/2,033	19.22 $\pm$ 1.03	Health related	Junior college year 1	2,626	2.7	<ul style="list-style-type: none"> <li>IBS was associated with alcohol consumption (<math>p = 0.021</math>), dairy intake (<math>p = 0.001</math>), fatigue (<math>p = 0.003</math>), poor mood situation (<math>p &lt; 0.001</math>) in healthy freshmen.</li> </ul>
Chen (54)	2016	East China, Taiwan	Convenience	7	Rome III	0/1,894	21.59 $\pm$ 1.40	Medicine, non-medicine	Undergraduate year 2–4	1,894	10.1	<ul style="list-style-type: none"> <li>Compared with the non-IBS female students, IBS female students had higher levels of stress and lower QoL.</li> <li>IBS in females was associated with dysmenorrhea (<math>p &lt; 0.001</math>), food avoidance (<math>p &lt; 0.001</math>), class absenteeism (<math>p &lt; 0.001</math>), and the lower physical domain of QoL (<math>p &lt; 0.001</math>).</li> </ul>
Zhang (55)	2018–2019	East China, Jiangsu	Cluster	8	Rome IV	533/674	/	Medicine, non-medicine	Undergraduate year 1–4	1,207	5.1	<ul style="list-style-type: none"> <li>IBS was associated with irregular menstruation (<math>p &lt; 0.05</math>) and previous history of gastroenteritis (<math>p &lt; 0.05</math>).</li> </ul>

Gender (M/F), Gender (Male/Female); Junior college students, students studying in 3-year college degree; Undergraduate students, students studying in 4-year or 5-year bachelor degree; Postgraduate students, students studying in master degree; Under Rome II criteria, IBS-C, irritable bowel syndrome with constipation; IBS-D, irritable bowel syndrome with diarrhea; IBS-M, irritable bowel syndrome mixed; IBS-U, irritable bowel syndrome un-subtyped; Under Rome III criteria: c-IBS, constipation predominant irritable bowel syndrome; d-IBS, diarrhea predominant irritable bowel syndrome; a-IBS, alternative irritable bowel syndrome; SRHMS, self-rated health measurement scale; PSQI, Pittsburgh sleep quality index; QoL, The World Health Organization Quality of Life-BREF Questionnaire.

**TABLE 2 |** Subgroup analyses of the pooled prevalence of IBS.

Subgroup analysis	Studies (n)	Sample size (n)	Pooled prevalence (%)	95% CI		<i>I</i> <sup>2</sup> (%) within subgroup	<i>p</i> -value across subgroups
				Lower	Upper		
Educational level							<b>&lt;0.001</b>
Junior college	4	5,063	8.18	3.66	17.26	98.24	
Undergraduate	13	24,202	12.14	8.02	17.96	99.27	
Postgraduate	3	925	12.74	10.10	15.94	40.36	
Gender							<b>&lt;0.001</b>
Female	16	18,252	13.14	9.22	18.39	98.72	
Male	14	9,279	10.17	6.39	15.80	98.02	
Major							<b>&lt;0.001</b>
Medicine	15	10,046	11.91	8.13	17.12	98.02	
Non-medicine	10	11,077	11.35	8.90	14.37	93.49	
Mixed	5	12,061	6.48	2.13	18.05	99.55	
Region							<b>&lt;0.001</b>
Central China	4	2,979	15.93	8.28	28.47	97.39	
East China	7	14,597	10.50	8.40	13.06	92.56	
North China	3	3,232	17.66	7.37	36.64	99.03	
Northwest China	2	6,546	19.10	7.02	42.46	98.30	
South China	3	5,812	3.18	1.28	7.68	97.00	
Survey year							<b>&lt;0.001</b>
2005–2010	7	7,276	14.42	8.48	23.46	98.65	
2010–2021	12	23,793	10.60	6.42	17.00	99.38	
Criteria							<b>&lt;0.001</b>
Rome II	5	4,382	10.50	6.80	15.87	94.58	
Rome III	15	26,072	12.00	8.23	17.17	99.21	
Rome IV	2	3,833	3.66	2.01	6.60	92.00	
Anxiety							<b>&lt;0.001</b>
No	6	11,058	8.61	3.72	18.66	99.31	
Yes	6	2,640	17.31	8.36	32.44	98.02	
Depression							<b>&lt;0.001</b>
No	5	10,743	9.11	3.60	21.19	99.43	
Yes	5	2,798	17.34	8.32	32.68	98.10	
Drinking							<b>&lt;0.001</b>
No	4	3,570	10.78	3.51	28.62	99.05	
Yes	4	970	11.11	6.40	18.60	85.58	
Smoking							<b>&lt;0.001</b>
No	4	2,815	14.70	6.09	31.43	98.65	
Yes	4	307	18.10	5.59	45.18	87.47	

Boldface indicates statistical significance ( $p < 0.05$ ).

CI, confidence interval.

college students (34%) (59). The possible explanations might be the difference in culture, diet habits, physical characteristics, academic and socioeconomic stress across countries.

Students with psychological disorders such as anxiety and depression had an increased likelihood of IBS comorbidity compared to those without. The link between psychosocial factors and gastrointestinal function (motility, sensation, inflammation) could be explained by the brain-gut axis (17). Specifically, this implies a bidirectional connection system between the gastrointestinal tract and the brain, through neural, neuroimmune and neuroendocrine pathways. In this model,

individuals with increased central nervous system (CNS) arousal such as those with anxiety and depression, could experience gastrointestinal distress and increased gastrointestinal motility *via* CNS-mediated sympathetic outflow (60), leading to the destruction in the intestinal mucosal barrier (61) and the change of transport in the small intestine and even the entire gastrointestinal tract (62) and, resulting in gastrointestinal symptoms (cramping and pain, etc.) of IBS.

Our study found that the prevalence of IBS was higher among female students. This discrepancy could be attributed to several factors. First, the difference in the secretion of sex hormones

**TABLE 3 |** Univariate meta-regression analyses of prevalence of IBS.

	Variable	Coefficient	SE	T	P >  t	95%CI	
						Lower	Upper
Univariate analysis	Educational level	0.02	0.04	0.45	0.66	-0.07	0.11
	Gender ratio (M/F)	-0.09	0.06	-1.36	0.19	-0.23	0.05
	Major	-0.09	0.04	-2.06	0.05	-0.18	0.00
	Region	0.03	0.01	2.84	<b>0.01</b>	0.01	0.06
	Survey year	-0.03	0.05	-0.58	0.57	-0.12	0.07
	Criteria	-0.03	0.04	-0.84	0.41	-0.01	0.05
	Anxiety proportion	-0.21	0.17	-1.23	0.29	-0.68	0.26
	Depression proportion	-0.35	0.18	-1.96	0.14	-0.92	0.22
	Drinking proportion	-0.16	0.32	-0.51	0.64	-1.17	0.84
	Smoking proportion	-0.15	0.33	-0.43	0.71	-1.59	1.30
	Quality score	0.02	0.02	0.72	0.48	-0.03	0.06

Boldface indicates statistical significance ( $p < 0.05$ ). CI, confidence interval; M/F, male/female.

contributes to the gender difference in the modulation of IBS. For example, androgens, higher in males, possibly could reduce visceral pain through enhancing TRPM8 expression and/or activity (63). TRPM8 is suggested to possess anti-nociceptive roles in the intestine (64) and ligands of TRPM8 such as peppermint are believed to possess analgesic effects in IBS patients (65, 66). As for females, the higher level of hormones like estrogen contributes to the development of IBS. It is reported that estrogens inhibit colonic smooth muscle contraction *via* a non-genomic mechanism involving cell membrane coupling (67), leading to the higher occurrence of IBS-related symptoms including abdominal distension, bloating, infrequent stools and hard stools (68). Estrogens promote activation of mast cells (68), which are found to be associated with IBS through increasing intestinal nerve sensitization (69). Second, for females, increased prostaglandins during the menstrual cycle could induce diarrhea syndrome, one of the IBS symptoms, through enhanced intestinal secretion and altered electrolyte absorption (70). Third, women are more vulnerable to experience life stress, anxiety, and depression symptoms (71, 72), which are associated with a higher incidence of IBS.

In terms of majors, a higher prevalence of IBS was estimated in the medical students. This might be due to the long length of schooling, high load from the academy and clinical practice, high level of psychological stress exposure like severe anxiety and depression (73) and sleep disturbances (74). It was proved that the stress was associated with the development of IBS through stimulating the hypothalamic-pituitary-adrenal (HPA) axis and triggering the release of some substances including corticotrophin-releasing factor (CRF), adreno-corticotrophic-hormone (ACTH), and cortisol, which affect gut function

through the composition and the growth of microbiota, and stimulate the sympathetic nervous system (SNS) (75). Sleep disorder, such as insomnia, was associated with a 24-h increase of ACTH and cortisol secretion (76). Furthermore, the symptoms of IBS, such as abdominal pain, might activate the SNS and then reduce sleep efficiency (76, 77).

Our results revealed that the prevalence of IBS in university students was higher in Northwest China (19.10%, 95% CI: 7.02–42.46%), North China (17.66%, 95% CI: 7.37–36.64%) and Central China (15.93%, 95% CI: 8.28–28.47%), followed by East China (10.50%, 95% CI: 8.40–13.06%) and South China (3.18%, 95% CI: 1.28–7.68%). This might be due to the varied territory, climate, diet, traditional customs, the development of socioeconomic and employment prospects across China (48). In the coastal regions—East China and South China, the relatively more moderate climate might benefit people's health and the superior socioeconomic conditions effectively alleviate the psychological stress for university students there (78), leading to a lower prevalence of IBS.

Be consistent with the results of previous studies (79, 80), the prevalence estimation in the Rome III criteria group (12.00%) was higher than groups of Rome II (10.50%) and Rome IV criteria (3.66%). Diagnosis of IBS can be challenging. Compared to Rome III, Rome II criteria examine a 12-week period duration in the past 12 months, less than a continuous 6-month period, thus expanding the scope of diagnosis and being more stringent (81). Rome IV criteria requires that abdominal pain occurs on average at least 1 day per week while only 3 days a month were required in Rome III criteria. This might be the most important factor accounting for a reduction in the estimated prevalence of IBS from Rome III to Rome IV (82). Dai et al. (39) suggested that the choice between Rome II and Rome III criteria may affect the IBS diagnosis in females more than males. Another diagnosis of IBS—Manning criteria was regarded to be applied to the private housing group rather than the public housing group (83). Studies showed that Manning criteria was more appropriate for females (84), but less sensitive for males (85, 86). The applicable diagnostic criteria seem different according to the research population.

Furthermore, university students with drinking and smoking behaviors were more likely to report IBS. It was explained that alcohol could decrease muscle movements, which helps retain the food for further digestion in the small intestine and reduce the frequency and strength of muscle contractions in a segment of the rectum. This could further reduce the transit time and the compaction of the intestinal content. In addition, alcohol interferes with the activity of lactase, which breaks down the milk sugar lactose, resulting in lactose intolerance. Thus, diarrhea was frequently observed in alcoholics. Alcohol also inhibits some enzymes that participate in the metabolism of foreign organic substances in the gut. It directly disturbs the integrity of the mucosal epithelium and induces the release of noxious signaling molecules, which could damage the small blood vessels of capillaries in the intestinal mucosa and induce blood clotting. The resulting lesions allow large molecules, such as endotoxins and other bacterial toxins, to enter the bloodstream and the lymph. Therefore, alcohol-induced digestive disorders

and mucosal damage in the gastrointestinal (GI) tract cause the change in the frequency and appearance of the stool, abdominal pain and bloating (87), which were the symptoms of IBS. For smokers, nicotine stimulates the sympathetic nerve to inhibit the movement of the disinfected tract and the secretion of the gland, resulting in gastrointestinal emptying delay and absorption dysfunction. Another explanation could be that oxygen-free radicals from smoking could enhance lipid peroxidation, implicated with gastrointestinal dysfunction (88).

The results of this meta-analysis have implications for future research. The prevalence of IBS among university students in certain regions such as Northeast and Southwest China, needs further study for the overall estimation with greater precision. More population-based studies using Rome IV criteria are required to explore the appropriateness of this criteria on Chinese university students. Future longitudinal studies are needed to be adopted to establish the causal relationships between IBS and potential influencing factors, which are greatly warranted for intervention development.

The findings of this meta-analysis should be interpreted with caution due to several limitations. First, the 22 included studies involved only 14 of 34 provincial-level administrative regions in China, which limited the generalizability of the findings to all university students in China. Second, although subgroup analyses somewhat mitigated this limitation (89), heterogeneity was impossible to avoid in the meta-analysis of epidemiological studies. Third, the potential association between IBS and some factors, such as frequency of exercise, could not be examined in the subgroup analyses due to incomplete data or inconsistent reporting forms in most included studies. The miss of studies only exploring the associated factors without the prevalence of IBS might lead to the insufficiency of data on the analyses of associated factors of IBS. Therefore, our results of associated factors of IBS needed to be treated with caution. Finally, the causal inference between IBS and other factors was not allowed because of the cross-sectional design in all included studies.

## CONCLUSIONS

This systematic review and meta-analysis showed that IBS was common (11.89%) in Chinese university students. The prevalence varied considerably in some instances, according to educational levels, geographic region, criteria used to define IBS. There are many associated factors of IBS, including female gender, majoring in medicine, anxiety, depression, drinking and smoking behavior. Further research should build on our findings

and develop effective strategies for preventing and treating IBS in this population.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

## AUTHOR CONTRIBUTIONS

PX: conceptualization, methodology, software, resources, writing-original draft, writing-review and editing, supervision, project administration, and funding acquisition. TZ: conceptualization, methodology, and funding acquisition. WY: methodology, validation, formal analysis, investigation, data curation, and writing-original. XY: validation, formal analysis, investigation, data curation, writing-original draft, and visualization. XC: methodology, investigation, draft, and visualization. ZZ and HY: methodology, investigation, and visualization. XS: review and revision. All authors contributed to the article and approved the submitted version.

## FUNDING

PX was supported by grants Moral Education Research Project for Teaching Science of Education Department of Guangdong Province (NO. 2019JKDY005) and National Natural Science Foundation of China (NO. 31970990). TZ was supported by grants Guangzhou Institute of Pediatrics/Guangzhou Women and Children's Medical Center funds (NO. GCP-2018-001) and Program of Guangzhou Municipal Science and Technology Bureau (NO. 201803010025). The funding body had no role in the study design, data collection, data analysis, data interpretation, the writing of the manuscript and the decision to submit the paper for publication. The research presented in this paper is that of the authors and does not reflect the official policy of Department of Public Health and Preventive Medicine, School of Medicine, Jinan University, Guangzhou, China. PX has full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.864721/full#supplementary-material>

## REFERENCES

1. Saha L. Irritable bowel syndrome: pathogenesis, diagnosis, treatment, and evidence-based medicine. *World J Gastroenterol*. (2014) 20:6759–73. doi: 10.3748/wjg.v20.i22.6759
2. Schoenfeld PS. Advances in IBS 2016: A Review of Current and Emerging Data. *Gastroenterol Hepatol*. (2016) 12:1–11. Available online at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5210026/>
3. Zhang L, Duan LP, Liu YX, Leng YX, Zhang H, Liu ZJ, et al. Meta analysis of prevalence and related risk factors of irritable bowel syndrome in Chinese population [In Chinese]. *Zhonghua Nei Ke Za Zhi*. (2014) 53:969–75. doi: 10.3760/cma.j.issn.0578-1426.2014.12.011
4. Choung RS, Locke GR 3rd, Zinsmeister AR, Schleck CD, Talley NJ. Psychosocial distress and somatic symptoms in community subjects with irritable bowel syndrome: a psychological component is the rule. *Am J Gastroenterol*. (2009) 104:1772–9. doi: 10.1038/ajg.2009.239

5. Shen L, Kong H, Hou X. Prevalence of irritable bowel syndrome and its relationship with psychological stress status in Chinese university students. *J Gastroenterol Hepatol.* (2009) 24:1885–90. doi: 10.1111/j.1440-1746.2009.05943.x
6. Enck P, Aziz Q, Barbara G, Farmer AD, Fukudo S, Mayer EA, et al. Irritable bowel syndrome. *Nat Rev Dis Primers.* (2016) 2:16014. doi: 10.1038/nrdp.2016.14
7. Fadgyas-Stanculete M, Buga AM, Popa-Wagner A, Dumitrascu DL. The relationship between irritable bowel syndrome and psychiatric disorders: from molecular changes to clinical manifestations. *J Mol Psychiatry.* (2014) 2:4. doi: 10.1186/2049-9256-2-4
8. Jang SH, Ryu HS, Choi SC, Lee SY. Psychological factors influence the irritable bowel syndrome and their effect on quality of life among firefighters in South Korea. *Psychiatry Investig.* (2017) 14:434–40. doi: 10.4306/pi.2017.14.4.434
9. Midenford I, Polster A, Sjövall H, Törnblom H, Simrén M. Anxiety and depression in irritable bowel syndrome: Exploring the interaction with other symptoms and pathophysiology using multivariate analyses. *Neurogastroenterol Motil.* (2019) 31:e13619. doi: 10.1111/nmo.13619
10. Zamani M, Alizadeh-Tabari S, Zamani V. Systematic review with meta-analysis: the prevalence of anxiety and depression in patients with irritable bowel syndrome. *Aliment Pharmacol Ther.* (2019) 50:132–43. doi: 10.1111/apt.15325
11. Drossman DA. Rome III: the new criteria. *Chin J Dig Dis.* (2006) 7:181–5. doi: 10.1111/j.1443-9573.2006.00265.x
12. Fau DD, Hasler WL. Rome IV-functional GI disorders: disorders of gut-brain interaction. *Gastroenterology.* (2016) 150:1257–61. doi: 10.1053/j.gastro.2016.03.035
13. Jiang M, Wang L, Liu X, Hu HX, Liang ZX, Zhang JA. The distribution and influencing factors of functional gastrointestinal diseases in college students [In Chinese]. *Chin J Clinicians.* (2012) 6:5281–2. doi: 10.3877/cma.j.issn.1674-0785.2012.17.069
14. Liu Y, Liu L, Yang Y, He Y, Zhang Y, Wang M, et al. A school-based study of irritable bowel syndrome in medical students in Beijing, China: prevalence and some related factors. *Gastroenterol Res Pract.* (2014) 2014:124261. doi: 10.1155/2014/124261
15. Zhou WW, Luo CH, Fan CX, Li YF, Ma SB. A study on the status and influential factors of health literacy among undergraduate students in Guangzhou City [In Chinese]. *Chinese Journal of Disease Control & Prevention.* (2014) 18:654–8. Available online at: <http://zhjbkz.ahmu.edu.cn/article/id/JBKZ201407021>
16. Jiang CX, Li ZZ, Chen P, Chen LZ. Prevalence of depression among college-goers in mainland China: a methodical evaluation and meta-analysis. *Medicine.* (2015) 94:e2071. doi: 10.1097/MD.00000000000002071
17. Surdea-Blaga T, Fau BA, Dumitrascu DL. Psychosocial determinants of irritable bowel syndrome. *World J Gastroenterol.* (2012) 18:616–26. doi: 10.3748/wjg.v18.i7.616
18. Mao CF, Zhou WJ, Ma HY, Wang XP, Weng XY, Zhuo YN, et al. A survey on cognitive attitude and behavior of chronic diseases among college students in Hangzhou [In Chinese]. *Zhongguo jian kang jiao yu.* (2015) 31:15–9. doi: 10.16168/j.cnki.issn.1002-9982.2015.01.04
19. Grover M, Kolla BP, Pamarthy R, Mansukhani M, Breen-Lyles M, He JP, et al. Psychological, physical, and sleep comorbidities and functional impairment in irritable bowel syndrome: Results from a national survey of US adults. *PLoS ONE.* (2021) 16:e0245323. doi: 10.1371/journal.pone.0245323
20. Frändemark Å, Törnblom H, Jakobsson S, Simrén M. Work productivity and activity impairment in irritable bowel syndrome (IBS): a multifaceted problem. *Am J Gastroenterol.* (2018) 113:1540–9. doi: 10.1038/s41395-018-0262-x
21. Sertbas Y, Fau BH, Fau PN, Fau UC, Fau AM, Fau SM, et al. Assessment of psychiatric symptoms and co-morbidities in patients with irritable bowel syndrome. *West Indian Med J.* (2012) 61:544–8. doi: 10.7727/wimj.2012.166
22. Wang B, Duan R, Duan L. Prevalence of sleep disorder in irritable bowel syndrome: a systematic review with meta-analysis. *Saudi J Gastroenterol.* (2018) 24:141–50. doi: 10.4103/sjg.SJG\_603\_17
23. Gralnek IM. Health care utilization and economic issues in irritable bowel syndrome. *Eur J Surg.* (1998) 164:73–6. doi: 10.1080/11024159850191283
24. Gulewitsch MD, Fau EP, Fau HM, Schlarb AA. Irritable bowel syndrome symptoms among German students: prevalence, characteristics, and associations to somatic complaints, sleep, quality of life, and childhood abdominal pain. *Eur J Gastroenterol Hepatol.* (2011) 23:311–6. doi: 10.1097/MEG.0b013e3283457b1e
25. Tan YM, Goh KL, Muhidayah R, Ooi CL, Salem O. Prevalence of irritable bowel syndrome in young adult Malaysians: a survey among medical students. *J Gastroenterol Hepatol.* (2003) 18:1412–6. doi: 10.1046/j.1440-1746.2003.03212.x
26. Drossman DA, Fau CL, Fau SS, Fau BC, Fau NW, Norton NJ, et al. A focus group assessment of patient perspectives on irritable bowel syndrome and illness severity. *Dig Dis Sci.* (2009) 54:1532–41. doi: 10.1007/s10620-009-0792-6
27. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ.* (2021) 372:n71. doi: 10.1136/bmj.n71
28. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. *JAMA.* (2000) 283:2008–12. doi: 10.1001/jama.283.15.2008
29. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and incidence data. *Int J Evid Based Healthc.* (2015) 13:147–53. doi: 10.1097/XEB.0000000000000054
30. Santoso AMM, Jansen F, de Vries R, Leemans CR, van Straten A, Verdonck-de Leeuw IM. Prevalence of sleep disturbances among head and neck cancer patients: a systematic review and meta-analysis. *Sleep Med Rev.* (2019) 47:62–73. doi: 10.1016/j.smrv.2019.06.003
31. Barendregt JJ, Doi SA, Lee YY, Norman RE, Vos T. Meta-analysis of prevalence. *J Epidemiol Community Health.* (2013) 67:974–8. doi: 10.1136/jech-2013-203104
32. Freeman MF, Tukey JW. Transformations related to the angular and the square root. *Ann Math Statist.* (1950) 21:607–11. doi: 10.1214/aoms/1177729756
33. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ.* (2003) 327:557–60. doi: 10.1136/bmj.327.7414.557
34. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med.* (2002) 21:1539–58. doi: 10.1002/sim.1186
35. Lin L, Chu H. Quantifying publication bias in meta-analysis. *Biometrics.* (2018) 74:785–94. doi: 10.1111/biom.12817
36. Dalton JE, Fau BS, Mascha EJ. Publication bias: the elephant in the review. *Anesth Analg.* (2016) 123:812–3. doi: 10.1213/ANE.0000000000001596
37. Kong H, Shen L, Hou XH. Prevalence of irritable bowel syndrome among medical students in different grades: the effect of anxiety and depression. *J Clin Intern Med.* (2007) 24:825–7. doi: 10.3969/j.issn.1001-9057.2007.12.011
38. Shen L, Kong H, Hou X. An epidemiologic study of irritable bowel syndrome in graduates of different specialties. *Chin J Gastroenterol.* (2007) 12:14–8. doi: 10.3969/j.issn.1008-7125.2007.01.004
39. Dai N, Cong Y, Yuan H. Prevalence of irritable bowel syndrome among undergraduates in Southeast China. *Dig Liver Dis.* (2008) 40:418–24. doi: 10.1016/j.dld.2008.01.019
40. Dong YY, Zuo XL, Li CQ, Yu YB, Zhao QJ, Li YQ. Prevalence of irritable bowel syndrome in Chinese college and university students assessed using Rome III criteria. *World J Gastroenterol.* (2010) 16:4221–6. doi: 10.3748/wjg.v16.i33.4221
41. Liu Y, Xiong L, Cui M. The prevalence and influencing factors of irritable bowel syndrome among students in a vocational college in Jiangxi Province. *Chin J Sch Health.* (2010) 31:1393–4. doi: 10.16835/j.cnki.1000-9817.2010.11.049
42. Shi Y, Liu L, Zhang Z. Current situation of irritable bowel syndrome in nursing and clinical medicine undergraduates. *J Zhengzhou Univers.* (2010) 45:829–31. doi: 10.13705/j.issn.1671-6825.2010.05.025
43. Lin F, Li Z. Investigation of functional gastrointestinal diseases among students of Tangshan Medical College. *Seek Medical and Ask The Medicine* (2012) 10:281. Available online at: <http://www.cnki.com.cn/Article/CJFDTotol-QYWA201211302.htm>
44. Wu L, Xu X, Ma H. Investigation and analysis of influencing factors of irritable bowel syndrome among internal medical students in Wuhan City. *Chin Med Herald.* (2012) 9:125–7. doi: 10.3969/j.issn.1673-7210.2012.33.048



45. Dong YY, Chen FX, Yu YB, Du C, Qi QQ, Liu H, et al. A school-based study with rome iii criteria on the prevalence of functional gastrointestinal disorders in chinese college and university students. *PLoS ONE* (2013) 8:e54183. doi: 10.1371/journal.pone.0054183
46. Li M, Lu B, Chu L, Zhou H, Chen MY. Prevalence and characteristics of dyspepsia among college students in Zhejiang province. *World J Gastroenterol*. (2014) 20:3649–54. doi: 10.3748/wjg.v20.i13.3649
47. Yang Y, Liu L, He Y, Zhao H, Yao S, Zhang Y. Gender differences in the prevalence of irritable bowel syndrome and related factors in medical students. *J China-Japan Friendship Hosp*. (2015) 29:177–9. doi: 10.3969/j.issn.1001-0025.2015.03.015
48. Zhang J, Zhang GL, Liu H, Liu F, Chen WG, Zheng Y. Morbidity of IBS and its related factors in different major postgraduates [In Chinese]. *Chin J Gastroenterol Hepatol*. (2015) 24:291–5. doi: 10.3969/j.issn.1006-5709.2015.03.016
49. Li H, Liu L, Ren W, Li Y, Liu Y, Zhang Y, et al. A school-based study of irritable bowel syndrome in college students in Beijing: prevalence and some relative factors. *Chin J Gastroenterol Hepatol*. (2016) 25:448–51. doi: 10.3969/j.issn.1006-5709.2016.04.025
50. Wang Y, Jin F, Chi B, Duan S, Zhang Q, Liu Y, et al. Gender differences in irritable bowel syndrome among medical students at Inner Mongolia Medical University, China: a cross-sectional study. *Psychol Health Med*. (2016) 21:964–74. doi: 10.1080/13548506.2016.1144890
51. Yang K, Jin Y, Yang T. Investigation and syndrome differentiation of Irritable bowel syndrome among students in a university in Guangzhou [In Chinese]. *J New Chin Med*. (2016) 48:74–5. doi: 10.13457/j.cnki.jncm.2016.08.032
52. Chen L, Shen F, Hong L, Jin Q, Jin Y, Zhu D, et al. The association of sleep quality with prevalence of irritable bowel syndrome in female college students from the faculty of nursing. *Nurs. Integr. Trad. Chin West Med*. (2018) 4:23–6. doi: 10.11997/nitcwm.201805007
53. Liu H, Jiang L, Wei X, Liang H, Chen Y, Long S, et al. Investigation analysis of the prevalence situation and risk factors for irritable bowel syndrome of students in a higher vocational college in Guangxi based on the Rome IV standard. *Intern Med Chin*. (2019) 14:16–8. doi: 10.16121/j.cnki.cn45-1347/r.2019.05.02
54. Chen HH, Hung CH, Kao AW, Hsieh HF. Exploring quality of life, stress, and risk factors associated with irritable bowel syndrome for female university students in Taiwan. *Int J Environ Res Public Health*. (2021) 18:3888. doi: 10.3390/ijerph18083888
55. Zhang X, Ma S, Li R. Prevalence of irritable bowel syndrome and analysis of related factors in Soochow University. *Contemp Med*. (2021) 27:120–3. doi: 10.3969/j.issn.1009-4393.2021.08.048
56. Hazlett-Stevens H, Craske MG, Mayer EA, Chang L, Naliboff BD. Prevalence of irritable bowel syndrome among university students: the roles of worry, neuroticism, anxiety sensitivity and visceral anxiety. *J Psychosom Res*. (2003) 55:501–5. doi: 10.1016/S0022-3999(03)00019-9
57. Shiotani A, Miyanishi T, Takahashi T. Sex differences in irritable bowel syndrome in Japanese university students. *J Gastroenterol*. (2006) 41:562–8. doi: 10.1007/s00535-006-1805-2
58. Kim YJ, Ban DJ. Prevalence of irritable bowel syndrome, influence of lifestyle factors and bowel habits in Korean college students. *Int J Nurs Stud*. (2005) 42:247–54. doi: 10.1016/j.ijnurstu.2004.06.015
59. Jafri W, Yakoob J, Jafri N, Islam M, Ali QM. Frequency of irritable bowel syndrome in college students. *J Ayub Med Coll Abbottabad*. (2005) 17:9–11. Available online at: [https://ecommons.aku.edu/pakistan\\_fhs\\_mc\\_med\\_gastroenterol/56/](https://ecommons.aku.edu/pakistan_fhs_mc_med_gastroenterol/56/)
60. Lydiard RB. Irritable bowel syndrome, anxiety, and depression: what are the links? *J Clin Psychiatry*. (2001) 62:38–45. Available online at: <https://www.psychiatrist.com/jcp/medical/comorbidity/irritable-bowel-syndrome-anxiety-depression-are-links/>
61. Konturek PC, Brzozowski T, Konturek SJ. Stress and the gut: pathophysiology, clinical consequences, diagnostic approach and treatment options. *J Physiol Pharmacol*. (2011) 62:591–9. Available online at: [http://www.jpp.krakow.pl/journal/archive/12\\_11/pdf/591\\_12\\_11\\_article.pdf](http://www.jpp.krakow.pl/journal/archive/12_11/pdf/591_12_11_article.pdf)
62. Pellissier S, Bonaz B. The place of stress and emotions in the irritable bowel syndrome. *Vitam Horm*. (2017) 103:327–54. doi: 10.1016/bs.vh.2016.09.005
63. So SY, Savidge TC. Sex-bias in irritable bowel syndrome: linking steroids to the gut-brain axis. *Front Endocrinol*. (2021) 12:684096. doi: 10.3389/fendo.2021.684096
64. Harrington AM, Fau HP, Fau MC, Fau YJ, Fau CJ, Fau IN, et al. A novel role for TRPM8 in visceral afferent function. *Pain*. (2011) 152:1459–68. doi: 10.1016/j.pain.2011.01.027
65. Cappello G, Spezzaferro M, Fau-Grossi L, Grossi L, Fau-Manzoli L, Manzoli L, et al. Peppermint oil (Mintoil) in the treatment of irritable bowel syndrome: a prospective double blind placebo-controlled randomized trial. *Dig Liver Dis*. (2007) 39:530–6. doi: 10.1016/j.dld.2007.02.006
66. Ford AC, Fau TN, Fau SB, Fau F-OA, Fau SL, Fau QE, et al. Effect of fibre, antispasmodics, and peppermint oil in the treatment of irritable bowel syndrome: systematic review and meta-analysis. *BMJ*. (2008) 337:a2313. doi: 10.1136/bmj.a2313
67. Hogan AM, Fau KR, Fau CD, Fau BA, Winter DC. Oestrogen inhibits human colonic motility by a non-genomic cell membrane receptor-dependent mechanism. *Br J Surg*. (2009) 96:817–22. doi: 10.1002/bjs.6612
68. Meleine M, Matricon J. Gender-related differences in irritable bowel syndrome: potential mechanisms of sex hormones. *World J Gastroenterol*. (2014) 20:6725–43. doi: 10.3748/wjg.v20.i22.6725
69. Uranga J, Martinez V, Abalo R. Mast cell regulation and irritable bowel syndrome: effects of food components with potential nutraceutical use. *Molecules*. (2020) 25:4314. doi: 10.3390/molecules25184314
70. Kane SV, Sable K, Hanauer SB. The menstrual cycle and its effect on inflammatory bowel disease and irritable bowel syndrome: a prevalence study. *Am J Gastroenterol*. (1998) 93:1867–72. doi: 10.1111/j.1572-0241.1998.540\_i.x
71. Young E, Korszun A. Sex, trauma, stress hormones and depression. *Mol Psychiatry*. (2010) 15:23–8. doi: 10.1038/mp.2009.94
72. Altemus M. Sex differences in depression and anxiety disorders: potential biological determinants. *Horm Behav*. (2006) 50:534–8. doi: 10.1016/j.yhbeh.2006.06.031
73. Mao Y, Zhang N, Liu J, Zhu B, He R, Wang X, et al. A systematic review of depression and anxiety in medical students in China. *BMC Med Educ*. (2019) 19:327. doi: 10.1186/s12909-019-1744-2
74. Azad MC, Fraser K, Rumana N, Abdullah AF, Shahana N, Hanly PJ, et al. Sleep disturbances among medical students: a global perspective. *J Clin Sleep Med*. (2015) 11:69–74. doi: 10.5664/jcsm.4370
75. Qin HY, Cheng CW, Tang XD, Bian ZX. Impact of psychological stress on irritable bowel syndrome. *World J Gastroenterol*. (2014) 20:14126–31. doi: 10.3748/wjg.v20.i39.14126
76. Vgontzas AN, Chrousos GP. Sleep, the hypothalamic-pituitary-adrenal axis, and cytokines: multiple interactions and disturbances in sleep disorders. *Endocrinol Metab Clin North Am*. (2002) 31:15–36. doi: 10.1016/S0889-8529(01)00005-6
77. Schlereth T, Birklein F. The sympathetic nervous system and pain. *Neuromolecular Med*. (2008) 10:141–7. doi: 10.1007/s12017-007-8018-6
78. Zhang L, Che WB, Li B, Zhang XD. An epidemiological survey of psychological stress among undergraduates in 13 Universities in China [In Chinese]. *Chinese Journal of Epidemiology*. (2006) 27:387–91. doi: 10.3760/j.issn.0254-6450.2006.05.006
79. Lovell RM, Ford AC. Global prevalence of and risk factors for irritable bowel syndrome: a meta-analysis. *Clin Gastroenterol Hepatol*. (2012) 10:712–21. doi: 10.1016/j.cgh.2012.02.029
80. Oka P, Parr H, Barberio B, Black CJ, Savarino EV, Ford AC. Global prevalence of irritable bowel syndrome according to Rome III or IV criteria: a systematic review and meta-analysis. *Lancet Gastroenterol Hepatol*. (2020) 5:908–17. doi: 10.1016/S2468-1253(20)30217-X
81. Sperber AD, Fau SR, Fau FM, Fich A. A comparative reappraisal of the Rome II and Rome III diagnostic criteria: are we getting closer to the 'true' prevalence of irritable bowel syndrome? *Eur J Gastroenterol Hepatol*. (2007) 19:441–7. doi: 10.1097/MEG.0b013e32801140e2
82. Whitehead WE, Palsson OS, Simrén M. Irritable bowel syndrome: what do the new Rome IV diagnostic guidelines mean for patient management? *Expert Rev Gastroenterol Hepatol*. (2017) 11:281–3. doi: 10.1080/17474124.2017.1292130

83. Gwee KA, Lu CL, Ghoshal UC. Epidemiology of irritable bowel syndrome in Asia: something old, something new, something borrowed. *J Gastroenterol Hepatol.* (2009) 24:1601–7. doi: 10.1111/j.1440-1746.2009.05984.x
84. Gwee KA, Wee S, Wong ML, Png DJ. The prevalence, symptom characteristics, and impact of irritable bowel syndrome in an asian urban community. *Am J Gastroenterol.* (2004) 99:924–31. doi: 10.1111/j.1572-0241.2004.04161.x
85. Talley NJ, Phillips SE, Melton LJ, Mulvihill C, Wiltgen C, Zinsmeister AR. Diagnostic value of the Manning criteria in irritable bowel syndrome. *Gut.* (1990) 31:77–81. doi: 10.1136/gut.31.1.77
86. Smith RC, Greenbaum DS, Vancouver JB, Henry RC, Reinhart MA, Greenbaum RB, et al. Gender differences in Manning criteria in the irritable bowel syndrome. *Gastroenterology.* (1991) 100:591–5. doi: 10.1016/0016-5085(91)80002-Q
87. Bode C, Bode JC. Effect of alcohol consumption on the gut. *Best Pract Res Clin Gastroenterol.* (2003) 17:575–92. doi: 10.1016/S1521-6918(03)00034-9
88. Kim YJ, Fau KE, Hahm KB. Oxidative stress in inflammation-based gastrointestinal tract diseases: challenges and opportunities. *J Gastroenterol Hepatol.* (2012) 27:1004–10. doi: 10.1111/j.1440-1746.2012.07108.x
89. Patsopoulos NA, Lau EE, Ioannidis JP. Sensitivity of between-study heterogeneity in meta-analysis: proposed metrics and empirical evaluation. *Int J Epidemiol.* (2008) 37:1148–57. doi: 10.1093/ije/dyn065

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Yang, Yang, Cai, Zhou, Yao, Song, Zhao and Xiong. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Adaptability Protects University Students From Anxiety, Depression, and Insomnia During Remote Learning: A Three-Wave Longitudinal Study From China

Keshun Zhang<sup>1\*†</sup>, Zhenhong Mi<sup>2†</sup>, Elizabeth J. Parks-Stamm<sup>3</sup>, Wanjun Cao<sup>1</sup>, Yaqi Ji<sup>4</sup> and Runjie Jiang<sup>1</sup>

<sup>1</sup> Department of Psychology, Normal College, Qingdao University, Qingdao, China, <sup>2</sup> Student Counselling and Mental Health Center, Qingdao University, Qingdao, China, <sup>3</sup> Department of Psychology, University of Southern Maine, Portland, ME, United States, <sup>4</sup> UCL Queen Square Institute of Neurology, University College London, London, United Kingdom

## OPEN ACCESS

### Edited by:

Agnes Lai,  
The University of Hong Kong,  
Hong Kong SAR, China

### Reviewed by:

Aurora Zanghi,  
Sant'Elia Hospital, Italy  
Habtem Gelaye,  
Wollo University, Ethiopia

### \*Correspondence:

Keshun Zhang  
keshun.zhang@qdu.edu.cn

<sup>†</sup>These authors share first authorship

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

**Received:** 02 February 2022

**Accepted:** 25 March 2022

**Published:** 18 April 2022

### Citation:

Zhang K, Mi Z, Parks-Stamm EJ,  
Cao W, Ji Y and Jiang R (2022)  
Adaptability Protects University  
Students From Anxiety, Depression,  
and Insomnia During Remote  
Learning: A Three-Wave Longitudinal  
Study From China.  
Front. Psychiatry 13:868072.  
doi: 10.3389/fpsy.2022.868072

The longitudinal relationship between students' pre-existing adaptability and subsequent sleep and mental health during the COVID-19 pandemic has not been studied. The present study examines the relationship between adaptability and students' anxiety, depression, and insomnia during and after the lockdown related to COVID-19. 5,235 university students participated in a longitudinal study with three time points. Students completed the Adaptability Scale before the outbreak (October 2019; Time 1), the Insomnia Severity Index (ISI) both during (April 2020; Time 2) and after lockdown (March 2021; Time 3), the Anxiety and Depression subscales of the SCL-90 (at Time 1 and 3), and the SAS/SDS (at Time 2). The results showed that self-reported adaptability is significantly negatively correlated with anxiety and depression, and that anxiety and depression are positively correlated with insomnia. Furthermore, adaptability protects from insomnia both directly and through its negative relationship with anxiety and depression. This study sheds light on the internal mechanisms mediating the relationship between students' adaptability and experience of insomnia in challenging circumstances. Implications for curtailing the negative effects of stressful events on students' sleep health by improving their adaptability and reducing their anxiety and depression are discussed.

**Keywords:** COVID-19, remote learning, adaptability, insomnia, anxiety, depression

## INTRODUCTION

Numerous studies have demonstrated the relationship between stressful events—like natural disasters—and negative outcomes like insomnia (1), anxiety (2), and depression (3). Unlike localized natural disasters (e.g., flooding, earthquakes), the COVID-19 pandemic was a natural disaster that impacted individuals around the world (4), with a disproportionate impact on university students (5).

As universities shut down and students suddenly were removed from their academic and social supports (6), university students reported declines in their physical and mental health (7–11). In line with previous research documenting sleep disturbances in response to traumatic events (12), insomnia has been identified as an important adverse outcome of the COVID-19 pandemic (13, 14), particularly for university students (5). Insomnia is defined as a difficulty with sleep onset and sleep maintenance resulting in impairment and distress (15). Adaptability has emerged as an important protective factor for individuals in the pandemic (16–19). The present study therefore examines the long-term impact of adaptability—measured before the pandemic—on the development of insomnia in university students both during and after lockdown, along with potential mediators of this relationship (i.e., anxiety and depression; see **Figure 1**).

Adaptability is defined as the ability to adjust one's cognition, emotion, and behavior in response to changing, new, or uncertain conditions (20, 21). During the COVID-19 pandemic, students needed to adjust to vast changes to their daily lives associated with the closure of universities, confinement to one's home, and the shift to remote learning. Individuals with greater adaptability showed more positive academic emotions and greater academic engagement in remote learning (19). In addition, adaptability predicted their distress and mood during COVID-19, controlling for personality, mattering, and automatic thoughts (16).

Adaptability thus appears to be a beneficial predispositional factor for students. The 3P model of insomnia (also known as the Spielman model) is a widely used theoretical framework for explaining insomnia (22–24). According to the 3P model of insomnia, persistent insomnia can be explained by a combination of three factors, namely predisposing factors, precipitating factors, and perpetuating factors (25). Predisposing factors include characteristics that predispose an individual to insomnia, such as genetics, cognitive style, awakening ability, or the tendency to ruminate or worry (26, 27). However, predisposing factors can also be beneficial factors, such as adaptability or mindfulness, that negatively predict insomnia. Precipitating factors include factors and events that trigger sudden insomnia, such as stressful events, or environmental or psychological stressors (25). Perpetuating factors include maladaptive emotions, such as sleep-related anxiety (28) or coping behaviors, such as going to bed early, that the individual enacts to cope with sleep disturbances. Predisposing factors and precipitating factors interact to cause temporary sleep disturbances, whereas maintenance factors make the individual's insomnia symptoms persist (26). The present study examines the predisposing factor of adaptability (and its effect on other predisposing factors like anxiety and depression) in the context of the precipitating factors of the pandemic and the shift to remote learning.

Past research on the key role of adaptability as a protective factor for insomnia following natural disasters suggests that adaptability may play a beneficial role as a predisposing factor in individuals' sleep health during the COVID-19 pandemic. Varela et al. (29), for example, found adaptability was the only significant predictor of insomnia following an earthquake

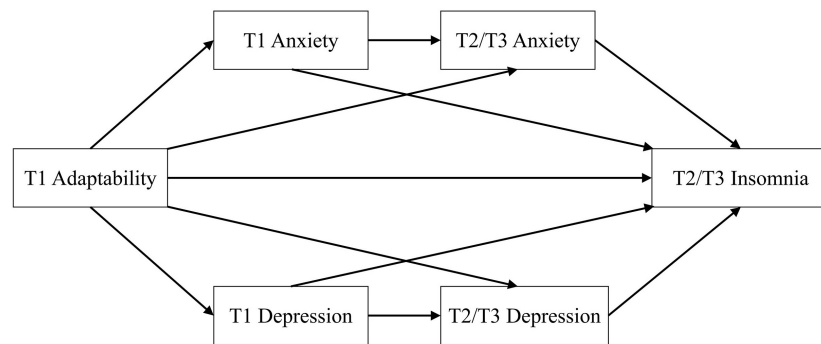
in Greece. Liu et al. (30) found that the hardiness factor of psychological resilience (i.e., the ability to adapt to adversity) was a protective factor for insomnia among medical professionals working in the COVID-19 response in China.

Given the relationship between stressful events and insomnia (31, 32), it not surprising that insomnia and other sleep complaints increased during the precipitating event of the COVID-19 pandemic. According to the NHS (33), insomnia refers to difficulty in going to sleep, waking up during the night, waking up early, feeling irritable during the day, and feeling tired after waking up on a regular basis. In France, the prevalence of sleep problems increased from 49% before the pandemic to 74% during the lockdown (34). Similarly, Lin et al. (35) reported a 37% increase in clinical insomnia in China from before to during the pandemic. However, individual variability in sleep responses to the pandemic are striking. In one study, whereas approximately 29% of participants showed a decrease in their sleep quality over the first weeks of the pandemic, approximately 47% showed an improvement in their sleep (36). We propose that individuals' adaptability—and the effect of adaptability on their psychological well-being—may explain this variability in sleep outcomes across individuals in the year following the outbreak of COVID-19.

How does adaptability impact individuals' sleep in times of crisis? We propose that adaptability impacts individuals' levels of anxiety and depression, which then impacts their sleep (see **Figure 1**). Previous researchers have proposed that stress—like that experienced during the COVID-19 pandemic—induces maladaptive responses like anxiety, which in turn affect sleep quality (26, 37). The pandemic has been associated with a significant increase in anxiety and depression around the world [e.g., a meta-analysis from (38) estimated an increase of 31.9 and 33.7%, respectively] and among university students in China in particular (39). Adaptability, on the other hand, plays a protective role by buffering individuals from these negative emotional responses to challenging circumstances. University students high in adaptability, for example, reported fewer negative emotions during the pandemic, including anxiety, hopelessness, and boredom (19).

Concerning the second step of this model (see **Figure 1**), many studies have demonstrated the relationship between both the predisposing factors of depression and anxiety and insomnia (40–42). Further, both anxiety and depression have been found to mediate the relationship between other factors and insomnia; for example, anxiety and depression mediate the relationship between conscientiousness/stability and insomnia (43), and anxiety mediated the relationship between perfectionism and insomnia in a longitudinal study (44). This research suggests that anxiety and depression play a proximal role in insomnia.

However, a good deal of research has indicated reciprocal relationships between anxiety, depression, and insomnia (42, 45), indicating the need to measure changes over time. Previous studies have mostly relied on cross-sectional designs to examine insomnia during the COVID-19 pandemic [e.g., (8, 46–48)], which are unable to examine relationships between pre-pandemic individual characteristics and subsequent mental and sleep health over time during the pandemic. Our longitudinal design addresses this gap in the research.



**FIGURE 1** | Conceptual model of adaptability, anxiety, depression, and insomnia.

In sum, our study has two aims. The first aim is to explore the relationship between adaptability as a predisposing individual difference and insomnia both during and after the lockdowns associated with COVID-19. The second aim is to understand the mediating role of anxiety and depression in this relationship. Using a longitudinal design, we first examine if adaptability measured before the pandemic influences insomnia during and after the lockdown. Second, we examine whether anxiety and depression (measured at Time 2 and 3) influence sleep quality both during and after the lockdown, that is, the possible mediating role of anxiety and depression in the relationship between adaptability and insomnia.

## MATERIALS AND METHODS

### Ethics Statement

This study was approved by our university's Research Ethics Committee. All procedures complied with the ethical standards of the latest version of the Helsinki Declaration. All participants willingly gave their informed consent digitally after being informed about the purpose of the study. All analyses were based on anonymous data.

### Participants and Design

Longitudinal data was collected via a Chinese online research panel, Wenjuanxing<sup>1</sup>, which is functionally equivalent to Amazon Mechanical Turk. 8,547 university students participated in the Time 1 (T1) assessment. Of these, 5,408 took part in the Time 2 (T2) assessment and 5,235 took part in the Time 3 (T3) assessment (2,747 females, 2,488 males), with a 38.75% attrition rate. There were no sample differences among the three waves in age ( $F = 1.11$ ,  $p = 0.33$ ) or gender (Kruskal–Wallis test;  $\chi^2 = 2.20$ ,  $p = 0.33$ ) (49). The final sample size was 5,235, with mean age = 19.00 years,  $SD = 0.89$ .

T1 took place in October 2019 (before the COVID-related restrictions) and measured adaptability, anxiety, and depression. T2 took place in April 2020 (during the COVID-related restrictions and remote learning) and measured anxiety,

depression, and insomnia. T3 took place in March 2021 (after the COVID-related restrictions were lifted) and measured anxiety, depression, and insomnia.

## Measures

### Adaptability Scale

Students' adaptability was assessed using the nine-item Adaptability Scale [(50); Chinese version: (19)] in T1. This scale comprises six items referring to cognitive-behavioral adaptability (e.g., "I am able to think through a number of possible options to assist me in a new situation") and three items referring to affective adaptability (e.g., "When uncertainty arises, I am able to minimize frustration or irritability so that I can deal with it best"). The items were assessed on a 7-point scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). The scale showed good internal consistency ( $\alpha_{t1} = 0.91$ ).

### Anxiety and Depression Subscales of the Symptom Checklist 90

We applied the anxiety and depression subscales of the SCL-90 (51) to assess anxiety and depression at both T1 and T3. The anxiety and depression subscales include 10 items and 13 items, respectively. The items were rated along a 5-point response scale with 1–5 representing the severity as follows: "1 = none," "2 = light," "3 = moderate," "4 = quite heavy," and "5 = severe." The SCL-90 uses a standardized scoring algorithm to define anxiety symptoms, with a total score range of 10–50. Individuals were categorized as experiencing anxiety symptoms if the anxiety subscale score was  $>20$ . A standardized scoring algorithm is also used to define depression symptoms, with a total score range of 13–65. Individuals were categorized as experiencing depression symptoms if the anxiety subscale score was  $>26$ . The anxiety and depression subscales were internally consistent ( $\alpha_{t1} = 0.85$  and  $0.89$ , respectively;  $\alpha_{t3} = 0.89$  and  $0.92$ , respectively).

### Zung Self-Rating Anxiety Scale

Anxiety at T2 was measured by the SAS [(52); Chinese version: (53)], which contains 20 items. The scale covers both psychological symptoms (e.g., "I feel afraid for no reason at all") and somatic symptoms (e.g., "My arms and legs shake

<sup>1</sup><https://www.wjx.cn/>



and tremble”). The items were rated along a 4-point response scale ranging from 1 (A little of the time) to 4 (Most of the time). The SAS uses a standardized scoring algorithm to define anxiety symptoms, with a total score range of 25–100. Individuals were categorized as experiencing anxiety symptoms if the SAS score was greater than or equal to 50. The scale was internally consistent ( $\alpha_{t2} = 0.76$ ).

### Zung Self-Rating Depression Scale

Depression at T2 was evaluated by the SDS [(54); Chinese version: (55)]. The scale contains 20 items, of which 10 items indicate negative experience (e.g., “I feel unhappy and depressed”) and 10 items indicate positive experience (e.g., “I am hopeful for the future”; reverse coded). Participants responded using a 4-point Likert scale ranging from 1 (A little of the time) to 4 (Most of the time). The SDS uses a standardized scoring algorithm to define depression symptoms, with a total score range of 25–100. Individuals were categorized as experiencing depression symptoms if the SDS score was greater than or equal to 50. The scale was internally consistent ( $\alpha_{t2} = 0.86$ ).

### Insomnia Severity Index

The ISI (15) was used to measure the severity of insomnia during COVID-19 at both T2 and T3. This scale includes 7 items that are rated on a 0–4 scale. The total score ranges from 0 to 28, with a higher score indicating a greater number of insomnia symptoms (0–7 = No clinically significant insomnia; 8–14 = Subthreshold insomnia; 15–21 = Moderate severity clinical insomnia; 22–28 = Severe clinical insomnia). The scale was internally consistent ( $\alpha_{t2} = 0.88$ ;  $\alpha_{t3} = 0.88$ ).

### Data Analysis

The statistical analyses were performed using SPSS Version 25.0, with the PROCESS macro for SPSS utilized for the multiple mediation model (56). PROCESS Model 82 was used to test the mediating role of anxiety and depression (mediators) in the relationship between adaptability at T1 (independent variable) and insomnia at T2 (dependent variable Model 1) and T3 (dependent variable in Model 2). 5,000 bootstrap samples and the 95% bias-corrected confidence interval (95% CI) were set to examine the significance of the two mediation effects (56). As different scales for anxiety and insomnia were used at different time points, scores were standardized to allow comparison. The statistical significance level was set at  $p < 0.05$ .

### Common Method Biases

The Harman single-factor test was used to diagnose the common method bias (57). The results of principal component factor analysis without rotation showed that there were 17 factors whose eigenvalues were greater than 1. The variance explained by the first factor was 19.73%, which falls below the threshold of 40%. The results showed that there is no serious common method bias in this study.

**TABLE 1 |** Descriptive statistics of all study variables ( $n = 5235$ ).

	<i>M</i>	<i>SD</i>	<i>Skewness</i>	<i>Kurtosis</i>	$\alpha$
1. T1 Adaptability	5.95	0.82	−1.20	2.90	0.91
2. T1 Anxiety	1.44	0.49	1.94	5.14	0.85
3. T1 Depression	1.44	0.52	1.86	4.38	0.89
4. T2 Anxiety	1.44	0.30	1.06	2.14	0.76
5. T2 Depression	1.69	0.43	0.66	−0.24	0.86
6. T3 Anxiety	1.26	0.42	2.85	11.15	0.89
7. T3 Depression	1.38	0.51	1.88	3.93	0.92
8. T2 Insomnia	1.36	0.48	2.16	6.48	0.88
9. T3 Insomnia	1.44	0.50	1.91	5.25	0.88

*T1 Adaptability (range from 1 to 7), T2 Anxiety and T2 Depression (range from 1 to 4), T1 Anxiety, T1 Depression, T3 Anxiety, and T3 Depression (range from 1 to 5), T2 Insomnia and T3 Insomnia (range from 0 to 4).*

**TABLE 2 |** Pearson correlation of all study variables ( $n = 5235$ ).

	1	2	3	4	5	6	7	8	9
1. T1 Adaptability	–								
2. T1 Anxiety	−0.32**	–							
3. T1 Depression	−0.36**	0.83**	–						
4. T2 Anxiety	−0.15**	0.27**	0.30**	–					
5. T2 Depression	−0.19**	0.26**	0.32**	0.74**	–				
6. T3 Anxiety	−0.14**	0.37**	0.35**	0.33**	0.30**	–			
7. T3 Depression	−0.16**	0.35**	0.41**	0.34**	0.35**	0.76**	–		
8. T2 Insomnia	−0.13**	0.28**	0.30**	0.49**	0.40**	0.30**	0.31**	–	
9. T3 Insomnia	−0.14**	0.27**	0.28**	0.31**	0.28**	0.56**	0.56**	0.38**	–

\*\* $p < 0.01$ .

## RESULTS

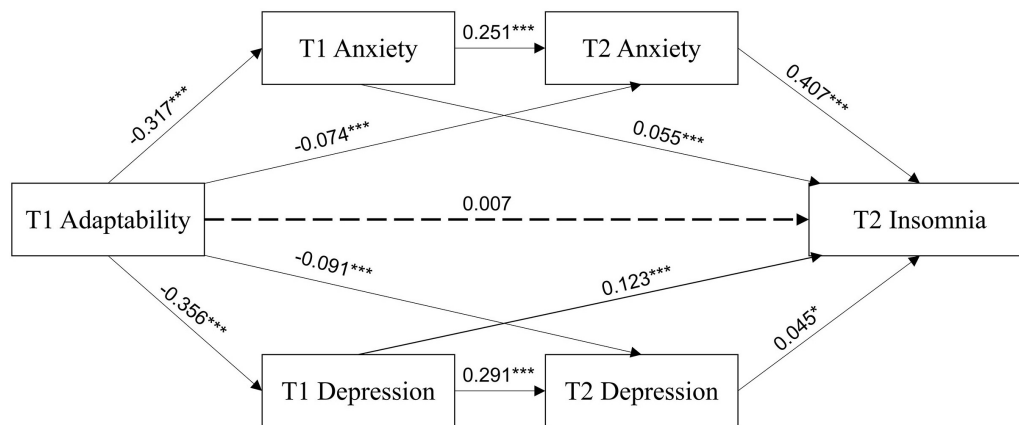
### Descriptive Statistics and Correlations

The means (*M*), standard deviations (*SD*), skewness, and kurtosis, and reliabilities for all variables across the two-time points are displayed in **Table 1**. All the measures had acceptable reliabilities (ranging from 0.76 to 0.92).

Pearson correlations for the relations between the variables are displayed in **Table 2**. T1 adaptability was negatively correlated with T1, T2, and T3 anxiety ( $r_s = -0.32, -0.15$ , and  $-0.14$ , respectively;  $p_s < 0.01$ ); T1, T2, and T3 depression ( $r_s = -0.36, -0.19$ , and  $-0.16$ , respectively;  $p_s < 0.01$ ); and T2 and T3 insomnia ( $r_s = -0.13, -0.14$ , respectively;  $p_s < 0.01$ ). Moreover, T2 insomnia was positively correlated with T1, T2, and T3 anxiety ( $r_s = 0.28, 0.49$ , and  $0.30$ , respectively;  $p_s < 0.01$ ), and T1, T2, and T3 depression ( $r_s = 0.30, 0.40$ , and  $0.31$ , respectively;  $p_s < 0.01$ ). In addition, T3 insomnia was positively correlated with T1, T2, and T3 anxiety ( $r_s = 0.27, 0.31$ , and  $0.56$ , respectively;  $p_s < 0.01$ ), and T1, T2, and T3 depression ( $r_s = 0.28, 0.28$ , and  $0.56$ , respectively;  $p_s < 0.01$ ).

### The Multiple Mediation Effects of Adaptability, Anxiety, Depression, and Insomnia at T1 and T2

The results of the regression analysis are shown in **Figure 2** and **Table 3**. To first review the role of T1 adaptability: T1 adaptability



**FIGURE 2 |** Multiple-mediating test of adaptability, anxiety, depression, and insomnia at T1 and T2. \* $p < 0.05$ , \*\*\* $p < 0.001$ .

**TABLE 3 |** Regression analysis of variable relationships at T1 and T2 ( $n = 5235$ ).

Dependent variables	Predictors	Model summary				
		<i>F</i>	<i>R</i> <sup>2</sup>	$\beta$	<i>SE</i>	<i>t</i>
T1 Anxiety	T1 Adaptability	584.13***	0.10	-0.317	0.016	-24.17
T2 Anxiety	T1 Adaptability	228.07***	0.08	-0.074	0.017	-5.29
	T1 Anxiety			0.251	0.014	17.95
T1 Depression	T1 Adaptability	758.14***	0.13	-0.356	0.016	-27.53
T2 Depression	T1 Adaptability	328.68***	0.11	-0.091	0.017	-6.50
	T1 Depression			0.291	0.014	20.87
T2 Insomnia	T1 Adaptability	386.26***	0.27	0.007	0.007	0.59
	T1 Anxiety			0.055	0.010	2.59
	T2 Anxiety			0.407	0.009	22.94
	T1 Depression			0.123	0.010	5.67
	T2 Depression			0.045	0.009	2.50

\*\*\* $p < 0.001$ .

significantly negatively predicted T1 anxiety ( $\beta = -0.317$ ,  $p < 0.001$ ), T2 anxiety ( $\beta = -0.074$ ,  $p < 0.001$ ), T1 depression ( $\beta = -0.356$ ,  $p < 0.001$ ), and T2 depression ( $\beta = -0.091$ ,  $p < 0.001$ ). However, T1 adaptability did not significantly predict T2 insomnia ( $\beta = 0.007$ ,  $p = 0.558$ ).

T1 anxiety and depression also had significant effects. T1 anxiety positively predicted T2 anxiety ( $\beta = 0.251$ ,  $p < 0.001$ ) and T2 insomnia ( $\beta = 0.055$ ,  $p < 0.001$ ). T1 depression positively predicted T2 depression ( $\beta = 0.291$ ,  $p < 0.001$ ) and T2 insomnia ( $\beta = 0.123$ ,  $p < 0.001$ ). T2 depression positively predicted T2 insomnia ( $\beta = 0.045$ ,  $p < 0.05$ ). A strong regressive path was shown between T2 anxiety and T2 insomnia ( $\beta = 0.407$ ,  $p < 0.001$ ).

The final regression model for insomnia, which included T1 adaptability, T1 anxiety, T2 anxiety, T1 depression, and T2 depression, was highly significant and accounted for 27% of the variability in T2 insomnia.

The bootstrap method was used to sample 5,000 times and build a 95% unbiased correction confidence interval for our multiple-mediating model for T1 and T2. The direct path from T1 adaptability to T2 insomnia was not significant ( $\beta = 0.007$ , 95% CI [-0.010, 0.019]). The chain intermediary effect of T1 and T2 anxiety ( $\beta = -0.032$ , 95% CI [-0.039, -0.026]) was significant, as well as the chain intermediary effect of T1 and T2 depression ( $\beta = -0.005$ , 95% CI [-0.009, -0.000]), indicating a significant mediation by both anxiety and depression at two time points. These two paths accounted for 23.02 and 3.60% of the total effect, respectively. T1 adaptability also had indirect effects on T2 insomnia through T1 anxiety ( $\beta = -0.017$ , 95% CI [-0.033, -0.002]), T2 anxiety ( $\beta = -0.030$ , 95% CI [-0.043, -0.018]), T1 depression ( $\beta = -0.044$ , 95% CI [-0.063, -0.026]), and T2 depression ( $\beta = -0.004$ , 95% CI [-0.009, -0.000]), which accounted for 12.23, 21.58, 31.65, and 2.88% of the total effect, respectively (see Table 4).

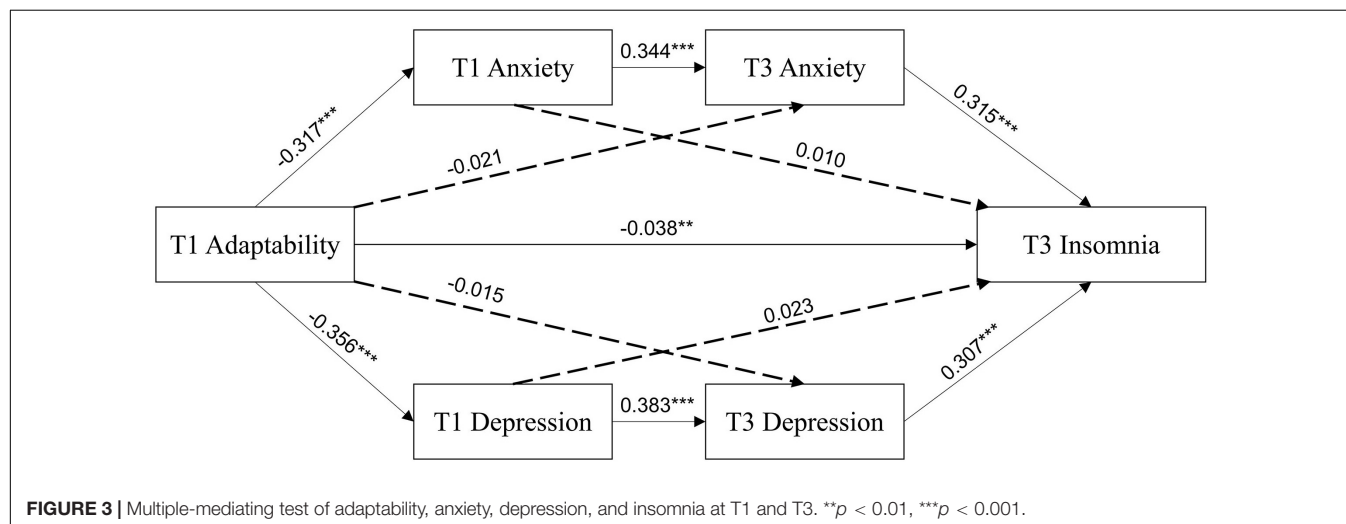
### The Multiple Mediation Effects of Adaptability, Anxiety, Depression, and Insomnia at T1 and T3

The results of the regression analysis examining variables from T1 and T3 are shown in Figure 3 and Table 5. T1 adaptability significantly negatively predicted T1 anxiety ( $\beta = -0.317$ ,  $p < 0.001$ ), T1 depression ( $\beta = -0.356$ ,  $p < 0.001$ ), and T3 insomnia ( $\beta = -0.038$ ,  $p < 0.01$ ). T1 adaptability did not significantly predict T3 anxiety ( $\beta = -0.021$ ,  $p = 0.119$ ) or T3 depression ( $\beta = -0.015$ ,  $p = 0.264$ ). T1 anxiety positively predicted T3 anxiety ( $\beta = 0.344$ ,  $p < 0.001$ ), but not T3 insomnia ( $\beta = 0.010$ ,  $p = 0.620$ ). T1 depression positively predicted T3 depression ( $\beta = 0.383$ ,  $p < 0.001$ ), but not T3 insomnia ( $\beta = 0.023$ ,  $p = 0.271$ ). A strong regressive path was shown between T3 anxiety and T3 insomnia ( $\beta = 0.315$ ,  $p < 0.001$ ) and between T3 depression and T3 insomnia ( $\beta = 0.307$ ,  $p < 0.001$ ). The final regression model for insomnia, which included T1 adaptability, T1 anxiety, T3 anxiety, T1 depression, and T3

**TABLE 4 |** Mediation effects test at T1 and T2.

Indirect paths (Ind)		Indirect effect			Percentage
		Effect	95% confidence interval		
			BootLLCI	BootULCI	
Ind 1	T1 Adaptability→T1 Anxiety→T2 Insomnia	−0.017	−0.033	−0.002	12.23%
Ind 2	T1 Adaptability→T2 Anxiety→T2 Insomnia	−0.030	−0.043	−0.018	21.58%
Ind 3	T1 Adaptability→T1 Depression→T2 Insomnia	−0.044	−0.063	−0.026	31.65%
Ind 4	T1 Adaptability→T2 Depression→T2 Insomnia	−0.004	−0.009	−0.000	2.88%
Ind 5	T1 Adaptability→T1 Anxiety→T2 Anxiety→T2 Insomnia	−0.032	−0.039	−0.026	23.02%
Ind 6	T1 Adaptability→T1 Depression→T2 Depression→T2 Insomnia	−0.005	−0.009	−0.000	3.60%
Sum		−0.132	−0.186	−0.138	94.96%

Percentage, Percentage of total effect explained.

**TABLE 5 |** Regression analysis of variable relationships at T1 and T3 ( $n = 5235$ ).

Dependent variables	Predictors	Model summary				
		<i>F</i>	<i>R</i> <sup>2</sup>	$\beta$	<i>SE</i>	<i>t</i>
T1 Anxiety	T1 Adaptability	584.13***	0.10	−0.317	0.016	−24.17
T3 Anxiety	T1 Adaptability	368.25***	0.12	−0.021	0.016	−1.56
	T1 Anxiety			0.344	0.013	25.20
T1 Depression	T1 Adaptability	758.14***	0.13	−0.356	0.016	−27.53
T3 Depression	T1 Adaptability	464.17***	0.15	−0.015	0.016	−1.12
	T1 Depression			0.383	0.013	28.06
T3 Insomnia	T1 Adaptability	599.36***	0.36	−0.038	0.007	−3.18
	T1 Anxiety			0.010	0.010	0.50
	T3 Anxiety			0.315	0.009	18.12
	T1 Depression			0.023	0.010	1.10
	T3 Depression			0.307	0.009	17.41

\*\*\* $p < 0.001$ .

depression, was highly significant and accounted for 36% of the variability in T3 insomnia.

For the multiple-mediating model of variables from T1 and T3, the direct path from T1 adaptability to T3 insomnia was significant ( $\beta = -0.038$ , 95% CI  $[-0.037, -0.009]$ ), accounting

for 27.74% of the total effect. The chain intermediary effect of T1 and T3 anxiety ( $\beta = -0.034$ , 95% CI  $[-0.043, -0.027]$ ) was significant, as well as the chain intermediary effect of T1 and T3 depression ( $\beta = -0.042$ , 95% CI  $[-0.050, -0.034]$ ), indicating a significant chain mediation by both anxiety and depression at two time points. These two paths accounted for 24.82 and 30.66% of the total effect, respectively (see Table 6). T1 adaptability did not indirect impact T3 insomnia via T1 anxiety, T3 anxiety, T1 depression, or T3 depression, as shown in Table 6.

## DISCUSSION

In the current study, we tested two multiple mediating models examining the role of adaptability, anxiety, and depression in predicting university students' insomnia both during the COVID-19 lockdown and a year after the lockdown had begun. Although past studies have shown the key role of adaptability in sleep responses to crises [e.g., as the only significant factor influencing sleep disturbance following an earthquake; (29)], the present study elucidates the mechanisms underlying these relationships and further

**TABLE 6 |** Mediation effects test at T1 and T3.

Indirect paths (Ind)		Indirect effect			Percentage
		Effect	95% confidence interval		
			BootLLCI	BootULCI	
Ind 1	T1 Adaptability→T1 Anxiety→T3 Insomnia	−0.003	−0.018	0.012	2.19%
Ind 2	T1 Adaptability→T3 Anxiety→T3 Insomnia	−0.007	−0.016	0.003	5.11%
Ind 3	T1 Adaptability→T1 Depression→T3 Insomnia	−0.008	−0.026	0.010	5.84%
Ind 4	T1 Adaptability→T3 Depression→T3 Insomnia	−0.005	−0.014	0.004	3.65%
Ind 5	T1 Adaptability→T1 Anxiety→T3 Anxiety→T3 Insomnia	−0.034	−0.043	−0.027	24.82%
Ind 6	T1 Adaptability→T1 Depression→T3 Depression→T3 Insomnia	−0.042	−0.050	−0.034	30.66%
Sum		−0.099	−0.120	−0.077	72.26%

Percentage, Percentage of total effect explained.

contributes longitudinal data to this issue. The results demonstrate that adaptability protects individuals from insomnia both directly and indirectly, by decreasing their anxiety and depression.

To examine how self-reported adaptability before a crisis predicts insomnia, we tested two models. Together, they provide consistent results concerning the role of pre-existing adaptability, anxiety, and depression for subsequent anxiety, depression, and insomnia both 6 and 17 months later. The only notable difference between the two models is the significant direct effect from T1 adaptability to T3 insomnia found in the second model. We suspect that students had to adapt to numerous changes over the year—from lockdown to return to school and numerous waves of infection risk—which led to an accentuated effect of this personality variable on insomnia (which, on average, increased from T2 to T3). Based on this intriguing finding, we suggest future research should explore how the impact of adaptability is moderated by the instability of the environment.

Overall, the present study breaks new ground in examining how adaptability—the ability to respond positively to challenging situations and changing demands in one's environment—impacts sleep disorders. We found that adaptability (as a predisposing factor measured before the onset of the precipitating event) directly affected insomnia 17 months after measurement, and indirectly through both anxiety and depression. This highlights the importance of measuring the impact of adaptability longitudinally, as its effects are subtle, continuous, and best seen over time, as individuals' adaptive changes in cognition, behavior, and affect in response to the environment produce favorable outcomes over time (58). For example, other research conducted during the pandemic found that students who were able to respond productively to the unexpected shift to remote learning and pandemic restrictions responded to their schoolwork with less anxiety, allowing them to engage more fully in their academic studies (19), and as a result, experience fewer sleeping problems (59). Similarly, positive adaptations to the impact of COVID-19 (e.g., living at home, learning remotely) may have allowed students to feel more hopeful and in control, generating less depression, and in turn, less insomnia (60). Importantly, adaptability continued

to impact students as they had to adapt – again—to post-lockdown pandemic life, as seen as its direct and indirect effect on T3 insomnia 17 months after the measurement of adaptability.

Anxiety and depression both appeared heightened during the COVID-19 pandemic, particularly among quarantined individuals (61) and those with greater exposure to the media (11, 62). Information highlighting the health risks for older loved ones (63, 64) and possible negative health consequences even for those who recover (65) stoked legitimate fear, with consequences for mental health and sleep health. Social media use related to the pandemic, for example, was found to be associated with fear of COVID-19 and both directly and indirectly related to insomnia (66). Along with anxiety, experiencing depression, loneliness, and feelings of isolation were also considered hallmarks of the COVID-19 pandemic (67), due to the need to self-isolate or quarantine (and for university students, to complete schoolwork remotely). Thus, anxiety and depression are relevant mediators for the COVID-19 context. The present findings illustrate the importance of examining such mediators when examining predictors of insomnia.

There are also important practical implications of the present work that could be applied by universities and mental health counselors. Fostering adaptability should benefit both students' mental health and sleep health. In times of upheaval, students need to look at their current cognitions, behaviors, and emotions, and then identify what changes they need to make given the changing circumstances to successfully adapt to the new environment. This greater adaptability should be associated with reduced depression and anxiety, and reduced sleep disturbances. The present study demonstrates that this effect lasts beyond the present moment to even a year following the lockdown.

According to the stress-buffering model (68), in times of significant stress, social connections mitigate the negative effects of stress on well-being. Loneliness and social isolation, on the other hand, are associated with anxiety, depression (69), poorer sleep quality (70, 71) and sleep fragmentation (72), and overall mortality risk (73). For the 30 million college students in China who were quarantined at home, the pandemic created a particularly challenging social context for students' physical and mental health.

In addition to university students, the COVID-19 pandemic and lockdown was particularly difficult for those with chronic health conditions. Research investigating patients with inflammatory rheumatic diseases (IRD), including rheumatoid arthritis, psoriatic arthritis, axial spondylarthritis, and others, showed a greater level of self-reported concerns and anxiety (74). Other research showed patients with relapsing-remitting multiple sclerosis (RRMS) were more susceptible to the detrimental neuropsychiatric effects of the pandemic and this condition was associated with a higher psychiatric concern, with a report of 48.6% moderate to severe anxiety, 22% moderate to severe depression and 29.6% insomnia by RRMS patients (75). Future research should move beyond the current population of university students to examine the predisposing and precipitating factors associated with insomnia in these populations.

One limitation of the present study was that the psychological assessments were obtained with self-report, which may limit the objectivity of the data. Secondly, to eliminate the possibility of participants remembering (and simply repeating) their responses to the earlier assessment [i.e., memory effects; (76)] as well as to avoid boredom effects during the second assessment, we used different anxiety and depression scales at the second time point (as compared to the first and third). Both the anxiety and depression scales of the SCL-90, as well as the SAS and SDS, are highly reliable and valid measurements used in previous research [e.g., (39, 77)]. As Marcoulides and Grimm (78) demonstrate, when using different measures, outcome variables must be calculated based on a common metric. For this reason, standardized values of these different measures were applied in our analyses [e.g., (79)]. Although this may be perceived a potential limitation for our conclusions, we found similar relationships with these different measures as were observed with identical measures (e.g., T1 anxiety and depression significantly predicted both T2 anxiety and depression and T3 anxiety and depression, respectively, and both contributed to a significant chain mediation of T1 adaptability on T3 insomnia). Third, although the university students came from more than 20 provinces, they all came from China. Future research should replicate this model in other regions of the world.

## CONCLUSION

The present longitudinal study examined the mechanisms underlying the relationship between adaptability and insomnia.

## REFERENCES

- Hall Brown TS, Akeeb A, Mellman TA. The role of trauma type in the risk for insomnia. *J Clin Sleep Med.* (2015) 11:735–9. doi: 10.5664/jcsm.4846
- Cook JD, Bickman L. Social support and psychological symptomatology following a natural disaster. *J Traumat Stress.* (1990) 3:541–56. doi: 10.1002/jts.2490030406
- Nolen-Hoeksema S, Morrow J. A prospective study of depression and posttraumatic stress symptoms after a natural disaster: the 1989 Loma Prieta Earthquake. *J Personal Soc Psychol.* (1991) 61:115–21. doi: 10.1037/0022-3514.61.1.115

We found that higher levels of pre-pandemic levels of adaptability protected students from insomnia both directly and indirectly, through its negative relationship with anxiety and depression. The present findings add to our understanding of how adaptability enables students to successfully navigate unexpected challenges like COVID-19, by protecting their mental health and sleep quality.

## DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: The data that support the findings of this study are openly available in ["OSF"] at [https://osf.io/vqe94/?view\\_only=3b5754af106d44f99807367471be7670](https://osf.io/vqe94/?view_only=3b5754af106d44f99807367471be7670).

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Department of Psychology, Qingdao University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

KZ and ZM conceived and designed the survey, performed the survey, and contributed to materials and analysis tools. KZ and WC analyzed the data. KZ, ZM, EP-S, WC, YJ, and RJ wrote the manuscript. KZ, EP-S, WC, YJ, and RJ contributed to literature research. All authors contributed to the article and approved the submitted version.

## FUNDING

This work was supported by the National Social Science Fund of China under Grant (21BSH098) and Shandong Social Science Foundation under Grant (21DSHJ03) awarded to KZ.

- Seddighi H. COVID-19 as a natural disaster: focusing on exposure and vulnerability for response. *Disaster Med Public Health Prepared.* (2020) 14:e42–3. doi: 10.1017/dmp.2020.279
- Marelli S, Castelnovo A, Somma A, Castronovo V, Mombelli S, Bottoni D, et al. Impact of COVID-19 lockdown on sleep quality in university students and administration staff. *J Neurol.* (2021) 268:8–15. doi: 10.1007/s00415-020-10056-6
- Eisenberg D, Gollust SE, Golberstein E, Hefner JL. Prevalence and correlates of depression, anxiety, and suicidality among university students. *Am J Orthopsychiat.* (2007) 77:534–42. doi: 10.1037/0002-9432.77.4.534



7. Peng M, Mo BR, Liu YS, Xu MM, Song XR, Liu LY, et al. Prevalence, risk factors and clinical correlates of depression in quarantined population during the COVID-19 outbreak [Article]. *J Affect Disord.* (2020) 275:119–24. doi: 10.1016/j.jad.2020.06.035
8. Shah SMA, Mohammad D, Qureshi MFH, Abbas MZ, Aleem S. Prevalence, psychological responses and associated correlates of depression, anxiety and stress in a global population, During the Coronavirus Disease (COVID-19) Pandemic. *Commun Mental Health J.* (2020) 57:101–10. doi: 10.1007/s10597-020-00728-y
9. Wang CY, Zhao H. The impact of COVID-19 on anxiety in Chinese university students. *Front Psychol.* (2020) 11:1168. doi: 10.3389/fpsyg.2020.01168
10. Wilson OWA, Holland KE, Elliott LD, Duffey M, Bopp M. The impact of the COVID-19 pandemic on US college students' physical activity and mental health. *J Phys Activ Health.* (2021) 18:272–8. doi: 10.1123/jpah.2020-0325
11. Xiong JQ, Lipsitz O, Nasri F, Lui LMW, Gill H, Phan L, et al. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord.* (2020) 277:55–64. doi: 10.1016/j.jad.2020.08.001
12. Lavie P. Current concepts: sleep disturbances in the wake of traumatic events. *N Engl J Med.* (2001) 345:1825–32. doi: 10.1056/NEJMr012893
13. Morin CM, Carrier J. The acute effects of the COVID-19 pandemic on insomnia and psychological symptoms. *Sleep Med.* (2021) 77:346–7. doi: 10.1016/j.sleep.2020.06.005
14. Pappa S, Ntella V, Giannakakis T, Giannakoulis VG, Papoutsis E, Katsaounou P. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis [Review]. *Brain Behav Immun.* (2020) 88:901–7. doi: 10.1016/j.bbi.2020.05.026
15. Bastien CH, Vallieres A, Morin CM. Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Med.* (2001) 2:297–307. doi: 10.1016/S1389-9457(00)00065-4
16. Besser A, Flett GL, Nepon T, Zeigler-Hill V. Personality, cognition, and adaptability to the COVID-19 pandemic: associations with loneliness, distress, and positive and negative mood states. *Int J Mental Health Addict.* (2020) 2020:1–25. doi: 10.1007/s11469-020-00421-x
17. Besser A, Flett GL, Zeigler-Hill V. Adaptability to a sudden transition to online learning during the COVID-19 pandemic: understanding the challenges for students. *Scholarsh Teach Learn Psychol.* (2021) 2021:stl0000198. doi: 10.1037/stl0000198
18. Orkibi H. Creative adaptability: conceptual framework, measurement, and outcomes in times of crisis. *Front Psychol.* (2021) 11:588172. doi: 10.3389/fpsyg.2020.588172
19. Zhang KS, Wu SZ, Xu YL, Cao WJ, Goetz T, Parks-Stamm EJ. Adaptability promotes student engagement Under COVID-19: the multiple mediating effects of academic emotion. *Front Psychol.* (2021) 11:633265. doi: 10.3389/fpsyg.2020.633265
20. Burns E, Martin AJ. ADHD and Adaptability: the roles of cognitive, behavioural, and emotional regulation. *Austral J Guidance Counsel.* (2014) 24:227–42. doi: 10.1017/jgc.2014.17
21. Martin AJ. Adaptability and learning. In: Seel NM editor. *Encyclopedia of the Sciences of Learning*. Boston, MA: Springer US (2012). p. 90–2. doi: 10.1007/978-1-4419-1428-6\_267
22. Perlis M, Shaw PJ, Cano G, Espie CA. Models of Insomnia. 5th ed. *Principles and Practice of Sleep Medicine*. Philadelphia: W.B. Saunders (2011). p. 850–65. doi: 10.1016/B978-1-4160-6645-3.00078-5
23. Rakhimov A, Ong J, Realo A, Tang NKY. Being kind to self is being kind to sleep? A structural equation modelling approach evaluating the direct and indirect associations of self-compassion with sleep quality, emotional distress and mental well-being. *Curr Psychol.* (2021) 2021:2661–z. doi: 10.1007/s12144-021-02661-z
24. Spielman AJ. Assessment of insomnia. *Clin Psychol Rev.* (1986) 6:11–25.
25. Spielman AJ, Caruso LS, Glovinsky PB. A behavioral perspective on insomnia treatment. *Psychiat Clin North Am.* (1987) 10:541–53.
26. Jin Y, Lan F, Sun W. Cognitive models of insomnia: a lecture. *Chin Mental Health J.* (2011) 25:496–9.
27. Gehrman P, Findley J, Perlis M. *Insomnia I: Etiology and Conceptualization*. Oxford: Oxford University Press (2012). doi: 10.1093/oxfordhb/9780195376203.013.0021
28. Harvey AG, Tang NKY, Browning L. Cognitive approaches to insomnia. *Clin Psychol Rev.* (2005) 25:593–611. doi: 10.1016/j.cpr.2005.04.005
29. Varela E, Koustouki V, Davos CH, Eleni K. Psychological consequences among adults following the 1999 earthquake in Athens, Greece. *Disasters.* (2008) 32:280–91. doi: 10.1111/j.1467-7717.2008.01039.x
30. Liu DY, Liu SH, Zhu L, Li DB, Huang DH, Deng HD, et al. Prevalence and related factors of insomnia among Chinese medical staff in the middle and late stage of COVID-19. *Front Psychiat.* (2020) 11:602315. doi: 10.3389/fpsyg.2020.602315
31. Cartwright RD, Wood E. Adjustment disorders of sleep: the sleep effects of a major stressful event and its resolution. *Psychiat Res.* (1991) 39:199–209. doi: 10.1016/0165-1781(91)90088-7
32. Otsuka Y, Kaneita Y, Itani O, Nakagome S, Jike M, Ohida T. Relationship between stress coping and sleep disorders among the general Japanese population: a nationwide representative survey. *Sleep Med.* (2017) 37:38–45. doi: 10.1016/j.sleep.2017.06.007
33. NHS. *Insomnia*. London: NHS (2021).
34. Beck F, Leger D, Fressard L, Peretti-Watel P, Verger P. Covid-19 health crisis and lockdown associated with high level of sleep complaints and hypnotic uptake at the population level. *J Sleep Res.* (2021) 30:13119. doi: 10.1111/jsr.13119
35. Lin LY, Wang J, Ou-yang XY, Miao Q, Chen R, Liang FX, et al. The immediate impact of the 2019 novel coronavirus (COVID-19) outbreak on subjective sleep status. *Sleep Med.* (2021) 77:348–54. doi: 10.1016/j.sleep.2020.05.018
36. Gao CL, Scullin MK. Sleep health early in the coronavirus disease 2019 (COVID-19) outbreak in the United States: integrating longitudinal, cross-sectional, and retrospective recall data. *Sleep Med.* (2020) 73:1–10. doi: 10.1016/j.sleep.2020.06.032
37. Yan Y, Liu M, Tang X, Lin R. On the relationship among stress response, coping and sleep quality. *Adv Psychol Sci.* (2010) 18:1734–46.
38. Salari N, Hosseini-Far A, Jalali R, Vaisi-Raygani A, Rasoulpoor S, Mohammadi M, et al. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Globaliz Health.* (2020) 16:57. doi: 10.1186/s12992-020-00589-w
39. Wu SZ, Zhang KS, Parks-Stamm EJ, Hu ZH, Ji YQ, Cui XX. Increases in anxiety and depression during COVID-19: a large longitudinal study from China. *Front Psychol.* (2021) 12:706601. doi: 10.3389/fpsyg.2021.706601
40. Mellinger GD, Balter MB, Uhlenhuth EH. Insomnia and its treatment: prevalence and correlates. *Arch General Psychiat.* (1985) 42:225–32. doi: 10.1001/archpsyc.1985.01790260019002
41. Oh CM, Kim HY, Na HK, Cho KH, Chu MK. The effect of anxiety and depression on sleep quality of individuals with high risk for insomnia: a population-based study. *Front Neurol.* (2019) 10:849. doi: 10.3389/fneur.2019.00849
42. Taylor DJ, Lichstein KL, Durrence HH, Reidel BW, Bush AJ. Epidemiology of insomnia, depression, and anxiety. *Sleep.* (2005) 28:1457–64. doi: 10.1093/sleep/28.11.1457
43. Akram U, Gardani M, Akram A, Allen S. Anxiety and depression mediate the relationship between insomnia symptoms and the personality traits of conscientiousness and emotional stability. *Heliyon.* (2019) 5:e01939. doi: 10.1016/j.heliyon.2019.e01939
44. Akram U, Ellis JG, Barclay NL. Anxiety mediates the relationship between perfectionism and insomnia symptoms: a longitudinal study. *PLoS One.* (2015) 10:0138865. doi: 10.1371/journal.pone.0138865
45. Johnson EO, Roth T, Breslau N. The association of insomnia with anxiety disorders and depression: exploration of the direction of risk. *J Psychiat Res.* (2006) 40:700–8. doi: 10.1016/j.jpsychires.2006.07.008
46. Kokou-Kpolou CK, Megalakaki O, Laimou D, Kousouri M. Insomnia during COVID-19 pandemic and lockdown: prevalence, severity, and associated risk factors in French population. *Psychiat Res.* (2020) 290:113128. doi: 10.1016/j.psychres.2020.113128
47. Que JY, Shi L, Deng JH, Liu J, Zhang L, Wu SY, et al. Psychological impact of the COVID-19 pandemic on healthcare workers: a cross-sectional study in China. *Gen Psychiat.* (2020) 33:100259. doi: 10.1136/gpsych-2020-100259
48. Voitsidis P, Gliatas I, Bairachtari V, Papadopoulou K, Papageorgiou G, Parlapani E, et al. Insomnia during the COVID-19 pandemic in a Greek population. *Psychiat Res.* (2020) 289:113076. doi: 10.1016/j.psychres.2020.113076

49. Lenhard W, Lenhard A. *Computation of effect sizes*. Dettelbach: Psychometrica (2016).
50. Martin AJ, Nejad H, Colmar S, Liem GAD. Adaptability: conceptual and empirical perspectives on responses to change, novelty and uncertainty. *Austral J Guid Counsel*. (2012) 22:58–81. doi: 10.1017/jgc.2012.8
51. Derogatis LR, Lipman RS, Covi L. SCL-90: an outpatient psychiatric rating scale—preliminary report. *Psychopharmacol Bull*. (1973) 9:13–28.
52. Zung WW. Rating instrument for anxiety disorders. *Psychosomatics*. (1971) 12:371–9. doi: 10.1016/S0033-3182(71)71479-0
53. Wu WY. Self-rating anxiety scale. *Chin Mental Health J*. (1999) 1999:235–8.
54. Zung WW. A self-rating depression scale. *Arch Gen Psychiat*. (1965) 12:63–70.
55. Shu L. Self-rating depression scale. *Chin Mental Health J*. (1999) 1999:194–6.
56. Hayes A. Introduction to mediation, moderation, and conditional process analysis. *J Educ Measur*. (2013) 51:335–7. doi: 10.1111/jedm.12050
57. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol*. (2003) 88:879–903. doi: 10.1037/0021-9010.88.5.879
58. Martin AJ, Nejad HG, Colmar S, Liem GAD. Adaptability: how students' responses to uncertainty and novelty predict their academic and non-academic outcomes. *J Educ Psychol*. (2013) 105:728–46. doi: 10.1037/a0032794
59. Xiao H, Zhang Y, Kong DS, Li SY, Yang NX. Social capital and sleep quality in individuals who self-isolated for 14 days during the coronavirus disease 2019 (COVID-19) outbreak in January 2020 in China. *Med Sci Monit*. (2020) 26:923921. doi: 10.12659/MSM.923921
60. Zheng W, Luo XN, Li HY, Ke XY, Dai Q, Zhang CJ, et al. Gender differences in the prevalence and clinical correlates of sleep disturbance in general hospital outpatients. *Psychiat Res*. (2018) 269:134–9. doi: 10.1016/j.psychres.2018.08.043
61. Tang F, Liang J, Zhang H, Kelifa MM, He QQ, Wang PG. COVID-19 related depression and anxiety among quarantined respondents. *Psychol Health*. (2021) 36:164–78. doi: 10.1080/08870446.2020.1782410
62. Mertens G, Gerritsen L, Duijndam S, Saleminck E, Engelhard IM. Fear of the coronavirus (COVID-19): predictors in an online study conducted in March 2020. *J Anxiety Disord*. (2020) 74:102258. doi: 10.1016/j.janxdis.2020.102258
63. Baud D, Qi XL, Nielsen-Saines K, Musso D, Pomar L, Favre G. Real estimates of mortality following COVID-19 infection [Letter]. *Lancet Infect Dis*. (2020) 20:773–773. doi: 10.1016/S1473-3099(20)30195-X
64. Yang W, Kandula S, Huynh M, Greene SK, Van Wye G, Li WH, et al. Estimating the infection-fatality risk of SARS-CoV-2 in New York City during the spring 2020 pandemic wave: a model-based analysis. *Lancet Infect Dis*. (2021) 21:E1–1. doi: 10.1016/S1473-3099(20)30865-3
65. Del Rio C, Collins LF, Malani P. Long-term health consequences of COVID-19. *JAMA*. (2020) 324:1723–4. doi: 10.1001/jama.2020.19719
66. Lin CY, Broström A, Griffiths MD, Pakpour AH. Investigating mediated effects of fear of COVID-19 and COVID-19 misunderstanding in the association between problematic social media use, psychological distress, and insomnia. *Internet Intervent Applcat Informat Technol Mental Behav Health*. (2020) 21:100345. doi: 10.1016/j.invent.2020.100345
67. Killgore WDS, Cloonan SA, Taylor EC, Dailey NS. Loneliness: a signature mental health concern in the era of COVID-19. *Psychiat Res*. (2020) 290:113117. doi: 10.1016/j.psychres.2020.113117
68. Cohen S, Wills TA. Stress, social support, and the buffering hypothesis. *Psychol Bull*. (1985) 98:310–57. doi: 10.1037/0033-2909.98.2.310
69. Cramer KM, Barry JE. Conceptualizations and measures of loneliness: a comparison of subscales. *Personal Individ Differ*. (1999) 27:491–502. doi: 10.1016/S0191-8869(98)00257-8
70. Cacioppo JT, Hawkley LC, Crawford LE, Ernst JM, Burleson MH, Kowalewski RB, et al. Loneliness and health: potential mechanisms. *Psychosomat Med*. (2002) 64:407–17. doi: 10.1097/00006842-200205000-00005
71. Cacioppo JT, Hawkley LC, Berntson GG, Ernst JM, Gibbs AC, Stickgold R, et al. Lonely days invade the nights: social modulation of sleep efficiency. *Psychol Sci*. (2002) 13:384–7. doi: 10.1111/1467-9280.00469
72. Kurina LM, Knutson KL, Hawkley LC, Cacioppo JT, Lauderdale DS, Ober C. Loneliness is associated with sleep fragmentation in a communal society. *Sleep*. (2011) 34:1519–26. doi: 10.5665/sleep.1390
73. House JS, Landis KR, Umberson D. Social relationships and health. *Science*. (1988) 241:540–5. doi: 10.1126/science.3399889
74. Glintborg B, Jensen DV, Engel S, Terslev L, Jensen MP, Hendricks O, et al. Anxiety and concerns related to the work situation during the second wave of the COVID-19 pandemic in > 5000 patients with inflammatory rheumatic disease followed in the DANBIO registry. *RMD Open*. (2021) 7:1649. doi: 10.1136/rmdopen-2021-001649
75. Zanghi A, D'Amico E, Luca M, Ciaorella M, Basile L, Patti F. Mental health status of relapsing-remitting multiple sclerosis Italian patients returning to work soon after the easing of lockdown during COVID-19 pandemic: a monocentric experience. *Multiple Scleros Relat Disord*. (2020) 46:102561. doi: 10.1016/j.msard.2020.102561
76. Schwarz H, Revilla M, Weber W. Memory effects in repeated survey questions: reviving the empirical investigation of the independent measurements assumption. *Survey Res Methods*. (2020) 14:325–44. doi: 10.18148/srm/2020.v14i3.7579
77. Liu D, Baumeister RF, Zhou Y. Mental health outcomes of coronavirus infection survivors: a rapid meta-analysis. *J Psychiatr Res*. (2021) 137:542–53. doi: 10.1016/j.jpsychires.2020.10.015
78. Marcoulides KM, Grimm KJ. Data integration approaches to Longitudinal Growth Modeling. *Educ Psychol Measure*. (2017) 77:971–89. doi: 10.1177/0013164416664117
79. Ayubi E, Bashirian S, Khazaei S. Depression and anxiety among patients with cancer during COVID-19 pandemic: a systematic review and meta-analysis. *J Gastroint Cancer*. (2021) 52:499–507. doi: 10.1007/s12029-021-00643-9

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Zhang, Mi, Parks-Stamm, Cao, Ji and Jiang. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Enhancing Mental Health, Well-Being and Active Lifestyles of University Students by Means of Physical Activity and Exercise Research Programs

Cornelia Herbert\*

*Applied Emotion and Motivation Psychology, Institute of Psychology and Education, Ulm University, Ulm, Germany*

## OPEN ACCESS

### Edited by:

Agnes Lai,  
The University of Hong Kong,  
Hong Kong SAR, China

### Reviewed by:

Nicola Luigi Bragazzi,  
York University, Canada  
Ariane Oliveira Viana,  
Universidade Nove de Julho, Brazil  
Livia Buratta,  
University of Perugia, Italy

### \*Correspondence:

Cornelia Herbert  
cornelia.herbert@uni-ulm.de

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 05 January 2022

**Accepted:** 04 March 2022

**Published:** 25 April 2022

### Citation:

Herbert C (2022) Enhancing Mental Health, Well-Being and Active Lifestyles of University Students by Means of Physical Activity and Exercise Research Programs. *Front. Public Health* 10:849093. doi: 10.3389/fpubh.2022.849093

Mental disorders (e.g., depression) and sedentary behavior are increasing, also among emerging adults. One particular target group of emerging adults with high sitting times and vulnerability to mental disorders are university students. In particular, anxiety and depressive symptoms as well as stress symptoms are very common among university students. The present manuscript discusses whether physical activity and exercise interventions can help to promote the mental health of emerging adults such as university students. The manuscript will summarize current scientific evidence and based on this evidence, introduce an university-based scientific research project that investigates if physical activity, exercise interventions and acute bouts of exercise of low- to moderate intensity can buffer perceived stress, alleviate mental health symptoms and strengthen well-being (psychologically and physiologically) among university students by positively influencing depressive and anxiety symptoms, perceived stress and emotion perception, body awareness and subjective well-being including overall quality of life. The research project, its concept, multimethod approach, and first results from available studies are discussed in relation to current scientific evidence, health care needs and future developments. The results from the studies conducted within the research project so far and that are briefly summarized in this manuscript suggest that physical activity, mental health and well-being are positively related, also in university students as an important group of emerging adults. The results further suggest that exercise interventions comprising aerobic exercises of low- to moderate intensity may work best to improve mental health (alleviate depressive symptoms and perceived stress) among university students after a few weeks of intervention. In addition, acute bouts of certain types of exercises (yoga in particular) seem to be particularly effective in changing perception of bodily signals, cardiac activity and emotion processing immediately after the exercise. The results underscore the importance of systematic investigations of the combined examination of psychological and physiological factors that promote an active lifestyle and that strengthen mental health and well-being (psychologically and physiologically) among emerging adults such as university students.

**Keywords:** physical activity, mental health, depression, well-being, low intensity exercise, perceived stress, emerging adults, university students

## INTRODUCTION

Mental disorders such as depression (major depressive disorder, MDD) and non-communicable diseases (NCDs), most of them lifestyle related diseases (LSRD), are becoming the major causes of ill health (1). According to the World Health Organization (WHO), the prevalence of mental disorders has increased dramatically in recent decades, even in non-industrialized countries (1). Today, risk of mental disorders, depression (MDD) in particular, is no longer restricted to certain vulnerable population groups. Mental disorders such as depression (MDD) constitute a public health burden and a major cause of premature mortality and disability among all age groups and cultures [e.g., (2, 3)]. In Europe alone, the prevalence of depressive disorders ranges between 5 and 10%, respectively (4).

Negative changes in lifestyle and health behavior, emotional burden (stress), and reduced well-being including changes in affect, along with social, genetic, and demographic factors, are common factors involved in the onset and in the chronicity of many mental disorders such as MDD (5). As psychological and lifestyle related factors, many of these factors are not disease specific. They are significantly contributing to physical and mental health problems in general and impair physical, mental, and social performance, and quality of life of each individual. Therefore, mental health promotion is as important as is physical health promotion. There is no health without mental health (6).

Physical activity and regular exercise are essential for a positive, active and health-promoting lifestyle. According to the WHO, interventions aimed at increasing physical activity are sustainable health promoting interventions (7). Positive effects of physical activity and of regular exercise on health have been reported across all age groups in epidemiological studies and prospective, longitudinal follow-up studies [e.g., for an overview, (8, 9)]. As summarized in these studies, physical activity and the person's physical fitness are factors, both associated with a number of health improvements. Improvements can concern (a) physical health such as improved body composition, healthier lipoprotein profiles and cholesterol levels, better glucose, insulin and inflammation status, lower blood pressure, better cardiac functions and autonomic balance of the autonomous nervous system (ANS) and (b) improved and stable well-being (10, 11).

Based, among others, on this evidence, the WHO [latest version, see (7)] developed recommendations and guidelines for physical activity and regular exercise to provide the population and political, social and health-care decision-makers with general recommendations for health promotion. The physical activity guidelines distinguish between age and the degree or amount of physical activity and regular exercise required for health prevention, and the degree or amount of physical activity and regular exercise necessary to achieve health gain and health benefits beyond the basic health prevention level. As summarized in **Figure 1**, for health prevention, the physical activity and exercise should include (a) a significant amount of moderate to vigorous (high-intensity) aerobic exercise (e.g., endurance activities such as walking, swimming, treadmill

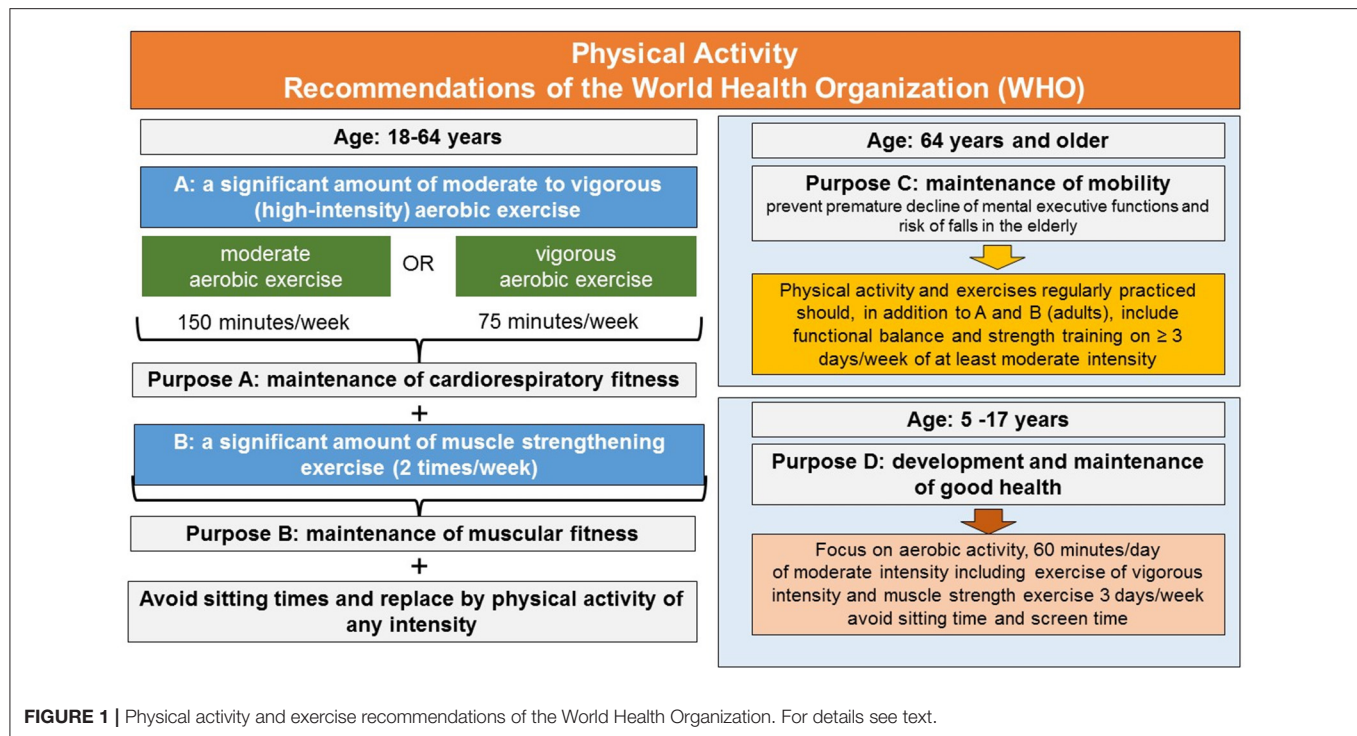
running, or cycling) to improve cardiorespiratory fitness and (b) additionally include activities that foster muscle strength to improve muscular fitness. Furthermore, as people age, physical activity and the exercises regularly practiced should trigger somatosensory processing and neurocognitive functions as well. This is recommended to prevent the risk of falls and premature decline of mental executive functions in the elderly: executive functions are significantly involved in the cognitive control of walking and the maintenance of mental and motor mobility (12). In addition, the latest guidelines also make specific recommendations for vulnerable target groups and make recommendations how to increase physical activity of the population (7).

These basics rules are the major building blocks in almost any national physical activity guidelines and are also recommended by the American College of Sports Medicine (13). They are therefore in many countries current state of the art of health promotion initiatives and recommended by health care providers for daily practice to guarantee the maintenance of health and well-being in the general population.

The need for global physical activity recommendations for everyday life becomes reasonable when looking at the results of recent studies [e.g., (14, 15)]. These studies attest physical inactivity in a high proportion of the (world) population already at young age and during adulthood. Recent national health reports, for example for Germany, observed that about only 42.6% of the surveyed women and 48.0% of the surveyed men reported to meet the WHO's physical activity guidelines. In other words, they do reach at least 2.5 h of endurance activity per week during leisure time [e.g., (16)]. When the WHO's physical activity guidelines of weekly endurance and strength training are considered together, only few women and men in Germany and Europe women and men, aged between 18 and 84 years achieve the WHO's physical activity and exercise recommendation (17). When only considering adults at working age (18–64 years), even less women and men are able to exercise as recommended to maintain and promote a healthy and active lifestyle (17). Thus, physical activity recommendations comprising moderate intensity exercises are often not reached neither globally nor nationally nor individually and adherence to and maintenance of exercise recommendations is a general problem, well known in the literature [e.g., (18)], not only in the elderly.

In parallel with this global decrease in physical activity, daily periods of predominantly sedentary behavior, whether at work or during leisure time, have continuously increased across age groups and significantly in the majority of the young population [e.g., (19, 20)]. Significant relationships between a preferentially sedentary lifestyle of 4–8 h sitting time daily and negative mental and physical health outcomes have been confirmed by several studies for a number of health indicators (metabolic, cardiovascular, mental/psychological) (21). Further research suggests that a lifestyle characterized by excessive sitting, even in the presence of physical activity, contributes to an increased risk of chronic physical and mental conditions such as depression (22). The majority of the world's population already leads a physically inactive lifestyle (23). In a recent





representative survey conducted among the adult population in Germany, on average, adults have been found to sit about 8 h per day [e.g., (24)]. There is consensus that a lifestyle characterized by sitting should be avoided at all costs (7). In line with this, experts including the WHO [see (7)] suggest that any physical activity could make an important contribution to the global endeavor of fighting sedentarism, and at the same time help to promote health and avoid illness among the population and age groups including emerging adults (25).

One particular target group of emerging adults at risk of mental disorders (26–28) and potentially also of increasing sedentarism (29–31) are university students. University students are young adults who, after completing their first educational career, pursue an academic education at a state or private university usually finishing with a bachelor's, master's degree or state examination. The aim is qualifying for an academic profession or pursuing a subsequent qualification for an academic degree. The average years spent at university is 6 years. The workload during this time is high. The accumulated work load for instance in a bachelor's degree corresponds to 45–56.25 h/week, a time spent predominantly in terms of sedentary activities in lecture halls, seminar rooms, or at the desk at home. On average, this results in a daily sitting time of approximately 6.4–11.25 h, 5-days a week. This sitting time has been approved in international studies (29–32). Recent international surveys have reported an increase in mental health complaints and perceived stress among university students. According to recent survey estimates, worldwide about every fifth student reports anxiety and depressive symptoms and

just as many students report to seek help for coping with academic stress and mental health conditions [e.g., (27, 28)]. Statistics from university counseling centers complement these numbers showing that roughly over half of the counseling cases of the clients (university students) report already seeking therapeutic help. However, according to recent surveys, most mental disorders among college students aged 18–22 years are untreated (26). The current Covid-19 pandemic is expected to increase these numbers in emerging adults (33) and among university students (34). Worldwide, 2.7% of the total world population are university students. In future, an increase of 30 million of university students per year is expected globally due to improved access to education. Accordingly, university students as emerging adults with high cognitive demands, high self-reported psychological stress, and high weekly sedentary time may constitute an at-risk group in primary health care prevention who could benefit from exercise interventions in the short as well as in long run.

However, which type of physical activity or exercise might be most effective for mental health promotion during adulthood, in particular in emerging adults such as university students?

The positive health effects of regular exercise of moderate to high and vigorous intensity exercise that builds on aerobic endurance and muscle strength exercise in an amount and daily/weekly regularity recommended by the WHO guidelines (see **Figure 1**) have been as outlined above investigated intensively in the past in scientific research. Undisputed are the results from epidemiologic studies according to which physically active people who report practicing a daily or weekly routine of regular exercise of moderate to high intensity have permanently



reduced impairments in general health and reduced mortality risk [e.g., see for an overview (35, 36)].

In line with these observations, recent review- and meta-analytic studies have revealed promising effects of moderate intensity exercise for alleviating depressive symptoms in the treatment of patients with clinical diagnosis of depression (e.g., major depressive disorders, MDD) [e.g., for an overview (37, 38)]. These positive effects associated with regular exercise of moderate intensity encouraged medical recommendations of exercise in the treatment of mental disorders such as MDD in addition to or in conjunct with treatment as usual (psychotherapy and pharmacological treatment). The prescriptions of exercise interventions have been included already in national guidelines. One prominent example is the UK National Institute of Health and Clinical Excellence (39), who included exercise interventions in their report for the treatment and management of depression in adults. The report reviews the current clinical evidence and based on it attempts to formulate exercise recommendations for the treatment of depressive symptoms (39). The recommendations address patients with a clinical diagnosis—irrespective of age—and with persistent mild to moderate depressive symptoms who should exercise 2–3 times a week for at least 45–60 min per session for at least 10–14 weeks to achieve improvement in the severity of depressive symptoms. The exercise should in line with the WHO's criteria (**Figure 1**) involve endurance and resistance exercise. A health care professional should supervise the exercise because in most studies, supervised-exercise interventions have proven superior over unsupervised exercise interventions in these patient groups. Regarding treatment of anxiety disorders by means of exercise, current evidence is less consistent than that for the treatment of depression, but there is evidence that state anxiety is significantly reduced after acute bouts of moderate intensity exercise [e.g., (40)].

In summary, the recommendations of moderate intensity exercise for mental health promotion are strengthened by findings that exercise of moderate intensity has comparable effects in lowering symptoms as pharmacological treatment with e.g., antidepressants in patients with MDD has (41, 42). Therefore, a common opinion and hypothesis is that dose-response relationships significantly matter, not only for achieving benefits in physical health but in mental health as well. In other words, it is assumed that if the exercises or the physical activity carried out during an exercise session or exercise intervention have no metabolic and no physiological effects, they cannot have any direct effect on physical health or on mental health for achieving changes in the physical symptoms, the physiological symptoms or the neurobiology of mental disorders. In fact, mental disorders such as major depressive disorder (MDD) or anxiety are not just mental disorders. As affective disorders, the key symptoms of for example depression comprise depressed mood and loss of interest in nearly almost all activities approximately all days and these key symptoms affect the whole person and organism (DSM-5, Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition). Mood changes and loss of interest occur in companion with changes

in psychomotor and sleep patterns, appetite and concentration, suicidal ideation, feelings of worthlessness and low self-esteem (DSM-5). Moreover, these physical and mental changes are accompanied by changes in neurotransmitters, by changes in brain functions and by changes in activity in prefrontal brain regions and subcortical reward and memory brain systems, i.e., brain regions and neuronal networks controlling emotions, mood, motivation, cognition, behavior and affect. Moreover, depression-related changes in peripheral-physiological bodily functions such as changes in blood pressure and heart rate variability (HRV), changes in cortisol levels and inflammatory parameters speak to altered functioning of the central, the autonomous nervous system (ANS) and the immune system in MDD [e.g., (43)].

So far, however, there is only little systematic research about the efficacy of exercise interventions in the field of primary prevention of health among the adult age groups, who are yet not suffering from clinical symptoms [for overviews see for example (36, 44, 45)]. A recent publication (46) summarizing data from the HUNT cohort prospective follow-up studies is one of the few studies that investigated the relationship between exercise and mental health in healthy adults and controlled for the role of exercise related dose-response effects. The publication (46) included a sample of 33 908 healthy, never depressed adults, with a mean age of 45.2 years (SD = 16.5 years) who were investigated two times in a time window of 11 years. The results suggest that exercise of low intensity of about 1 h (walking) exercise a week to be effective in reducing the risk of depression by 12% with little or no significant additional depression alleviating benefits of exercise with a duration beyond 1 h a week. Similar promising effects that low-intensity exercise interventions comprising a diversity of exercise types (aerobic exercise, yoga, dancing, resistance training, etc.) can alleviate stress- and depressive symptoms and improve mental health across a wide age range, comes from recent reviews of meta-analytic studies (44, 47). The meta-analyses suggest that a diversity of different types of exercise, specifically, mind-body exercises such as yoga have proven equivalent to aerobic moderate intensity exercise such as walking, swimming or cycling, in improving mental health at least in clinical groups or vulnerable groups at risk of mental ill health.

As far as the treatment of mental disorders in emerging adults by means of exercise interventions is concerned, still few systematic evidence is available so far. A recent scoping review suggests that the current evidence is restricted to only a few studies (48). Moreover, concerning primary prevention of health in emerging adults, evidence that physical activity, mental health and well-being are related comes mainly from self-report studies [e.g., (49)]. In addition, systematic research evaluating the effectiveness of exercise interventions on mental health of university students, depression in particular, seems also still limited (50). A recent meta-analysis compared seven exercise interventions for their effectivity in alleviating depressive symptoms in undergraduate college students and found that mind-body exercises such as Tai Chi and yoga were best suited to reduce depressive symptoms compared to team sports such as basketball or badminton or dance (50) in the targeted groups.

## AIM AND SCOPE OF THE PRESENT MANUSCRIPT

As summarized in the previous section, the following important and significant question remains: can exercise interventions of low- to moderate intensity and short duration as well as acute bouts of exercise make an important contribution to the primary prevention and the promotion of mental health and well-being of emerging adults such as university students, yet not suffering from clinically relevant mental health conditions? In this manuscript, first results from a still ongoing psychological research project (Anem Fit&Well) will be summarized that provides first answers to this question. The research project (Anem Fit&Well) and its studies examine the relationships between physical activity, different types of acute and regular exercise, mental health and well-being in healthy adults with a specific focus on emerging adults including university students.

In the following sections, the research project, its concept, methods, and first results from available, already published studies are summarized and discussed in relation to current scientific evidence, health care needs and future developments. In particular, the results from 5 studies will be summarized that investigated if physical activity, exercise interventions and acute bouts of exercise of low- to moderate intensity can buffer perceived stress, alleviate self-reported symptoms of mental health conditions such as depressive and anxiety symptoms, change cardiovascular activity during exercise and at rest, and strengthen subjective well-being by positively influencing mood and affect, emotion perception, body awareness, and overall quality of life.

The first section under Materials and Methods will describe briefly the general framework of the research project in terms of the theoretical understanding of concepts, the methodological approach including systematic classification of the exercises chosen in the research project and its studies. Next, the study designs, the participant samples, inclusion and exclusion criteria of the already available studies are described and the major results and conclusion drawn from the results are summarized in the Results and Discussion. Finally, a future outlook will be provided and the aims of the research project will be discussed in relation to health care needs and future developments.

## MATERIALS AND METHODS

### Conceptual Framework of the Project

Theoretically, the research projects builds on a biopsychosocial model and understanding of health. A biopsychosocial understanding of the effects of exercise on mental health allows to take physical and mental processes and their interaction into consideration. As illustrated in **Figure 2**, this is critical for the understanding of how psychological and physiological mechanisms interact at different exercise intensities to promote mental health and well-being. So far, most studies and most research programs focus on either the psychological or the physiological mechanisms of exercise on mental health. Several physiological and psychological variables have been suggested to play a role [e.g., (51)]. Therefore, and as summarized in **Figure 2**,

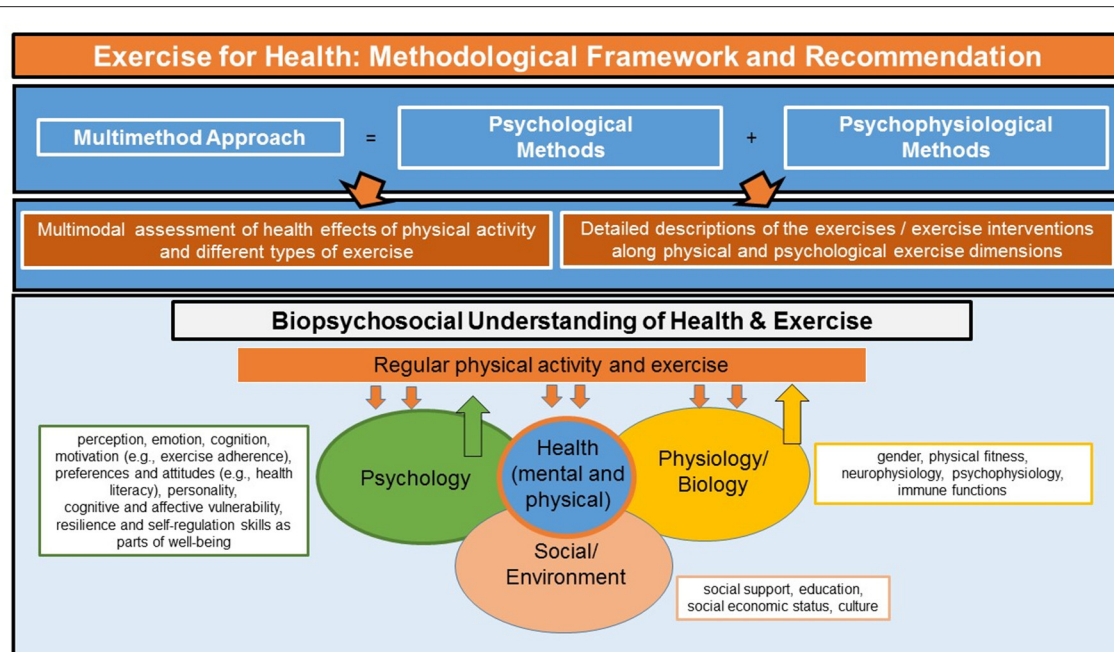
methodologically, the present research project and its scientific studies are following a multimethod approach that combines psychological methods and psychophysiological methods to investigate exercise-related health effects on behavior, physiology, and subjective experience in well controlled laboratory and field (survey, online) experiments.

### Exercise Classification and Methodology

There is a huge variation across exercise studies in the way physical activity and the individual exercises included in the exercise interventions are described. The exercise descriptions of the study protocols of previous studies often vary in terms of the outcome variables investigated in a particular study. They vary across the research disciplines that carry out the research (medicine, psychology, health and life science, etc.), and the exercise descriptions vary with the preconditions of measures available in a lab or research team/environment. This makes comparison across studies difficult. Therefore, one major attempt of the research project Anem Fit&Well is to describe the individual exercises and exercise interventions included in its studies as best as possible according to the major dimensions of exercise including type of exercise, exercise duration, and intensity (52, 53). Moreover, frequency, density and duration of the exercise sessions (its repetitions) are included if the exercise comprises more than one exercise session. Notably, all studies included in the research project follow the scientific nomenclature (52, 53): the term physical activity (PA) is used for the description of any activity that is carried out on a regular day including activities from or to work. In the following sections, the term physical activity (PA) is used whenever to describe the habitual physical activity levels of the participants engaged as study participants. The term “exercise” is used for the exercises included in the research project and its exercise intervention studies that are carried out as planned, structured, repetitive and intentional movements with the intention to explicitly improve or maintain mental health (52, 53). Like for each individual exercise of the research project, the exercise interventions are described along fundamental exercise dimensions including frequency of the individual exercise sessions, number of repetitions of a session per day or weeks (daily and weekly practice). The exercise protocols allow comparison with physical activity recommendations from the literature examining the relationship between mental health, physical activity and exercise.

### Standardized Assessment of Type of Exercise and Exercise Intensity

The individual exercises included in the research project comprise different types of exercises [e.g., cardio, resistance, coordination and balance, ergometer or treadmill exercise, mind-body exercise (e.g., yoga)] whose movements (isometric, isotonic, or isokinetic) and activity carried out can load on the different exercise dimensions (cardiorespiratory, endurance, muscular strength, flexibility, speed, balance, and coordination) in varying degrees and whose intensity and duration range above rest (> 1.5 MET), but below, at or if wished, above the physiologically and metabolically effective stimulus thresholds



**FIGURE 2 |** Exercise for health prevention. Overview of the theoretical and methodological approach of the research project. For details see text.

(1.5–6 MET or beyond; short: MET, metabolic equivalents) see **Figure 3** for examples<sup>1</sup>.

Objective measures of exercise intensity (e.g., measures of MET and of energy expenditure such as  $\text{VO}_2$  max, heart rate, respiration) might not be available in all research units or research labs, furthermore these measures are often difficult to obtain in online studies without wearable devices for monitoring and recording of these measures. This makes cross-comparison of exercises and exercises interventions described in the literature often difficult. To avoid this lack of standardization, in the current research project, exercise professionals and novices additionally rate the individual exercises on pre-chosen standardized exercise dimensions. Expert ratings are an excellent means and research tool for providing valid descriptions of the exercises from an expert's point of view (54). The Borg exercise scale(s) of perceived exertion (55) ask for bodily and cognitive exercise symptoms such as changes in heart rate, respiration or breathing rate, sweating, or (muscle) fatigue. The scales are often used as valid self-report methods to classify exercises. The Borg scale has received good validity and can be used by health care experts or by novices for exercise ratings. Its scores corresponds well with the objective measure of the degree of heart rate changes elicited by the exercise, at least for aerobic exercises

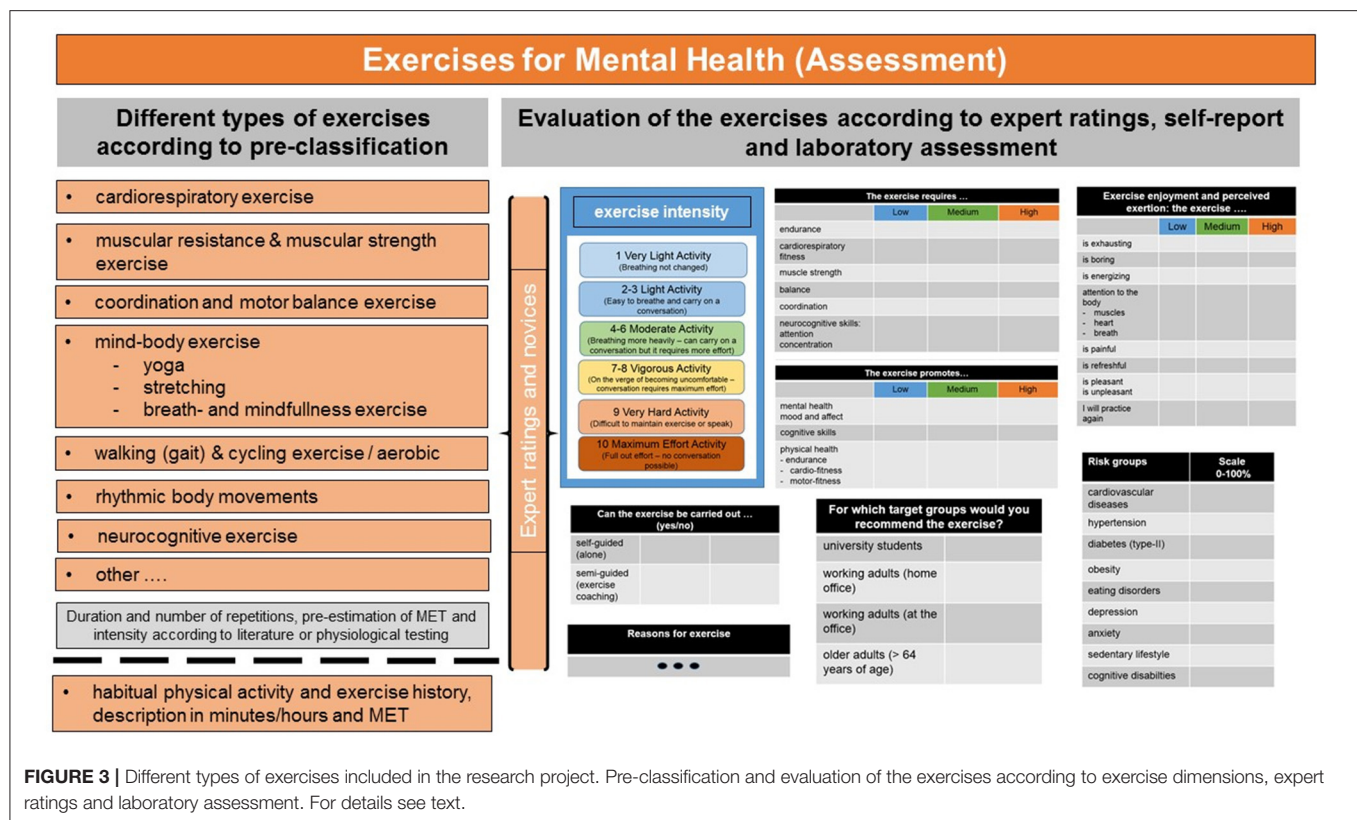
(55). Its verbal descriptions allow categorization of exercise activities into low, moderate and high intensity. Moreover, besides the evaluation by experts and novices, the individual exercises are compared to exercise descriptions in the literature. For example, the general classification schemes of physical activity provided by the Compendium of physical activities (56) comprise a plethora of physical activities grouped into daily physical activities and sports activities (exercise planned and structured). The Compendium provides MET values for each activity, and based on these, the activities are classified as low, moderate or high in intensity. Of note, the classification system of the Compendium of physical activities can only provide rough average estimates of categorization of activities into those of low, moderate or high intensity. In the present research project, the classification of the exercises based on the compendium (56) is included as heuristic additional source of comparison.

### Standardized Assessment of Mental Health, Perceived Stress, Well-Being and Habitual Physical Activity

Importantly within and across the scientific studies of the research project, a number of standardized psychological self-report measures as well psychological-experimental tasks and tests are included for profound mental health assessment and for capturing changes in perceived stress as well as in in other psychological domains including well-being and quality of life. Of note, mental health, well-being and quality of life are broad constructs, especially well-being and quality of life are often divided into subdomains of physical and psychological well-being or objective and subjective measures of quality

<sup>1</sup>Typically, exercises and physical activities with a maximum increase of only 30–39% of the resting heart rate (below 3 MET) are below the physiological threshold at which considerable adaption in performance and physiologic capacity in terms of exercise training effects can be expected. To achieve physical health-related training effects, the physical activities and exercises should preferably include large muscle groups and be above a certain physiological threshold of energy expenditure (EE) >6 MET and 75% of  $\text{VO}_2$  max (maximal aerobic capacity), i.e., the intensity range of moderate exercise.



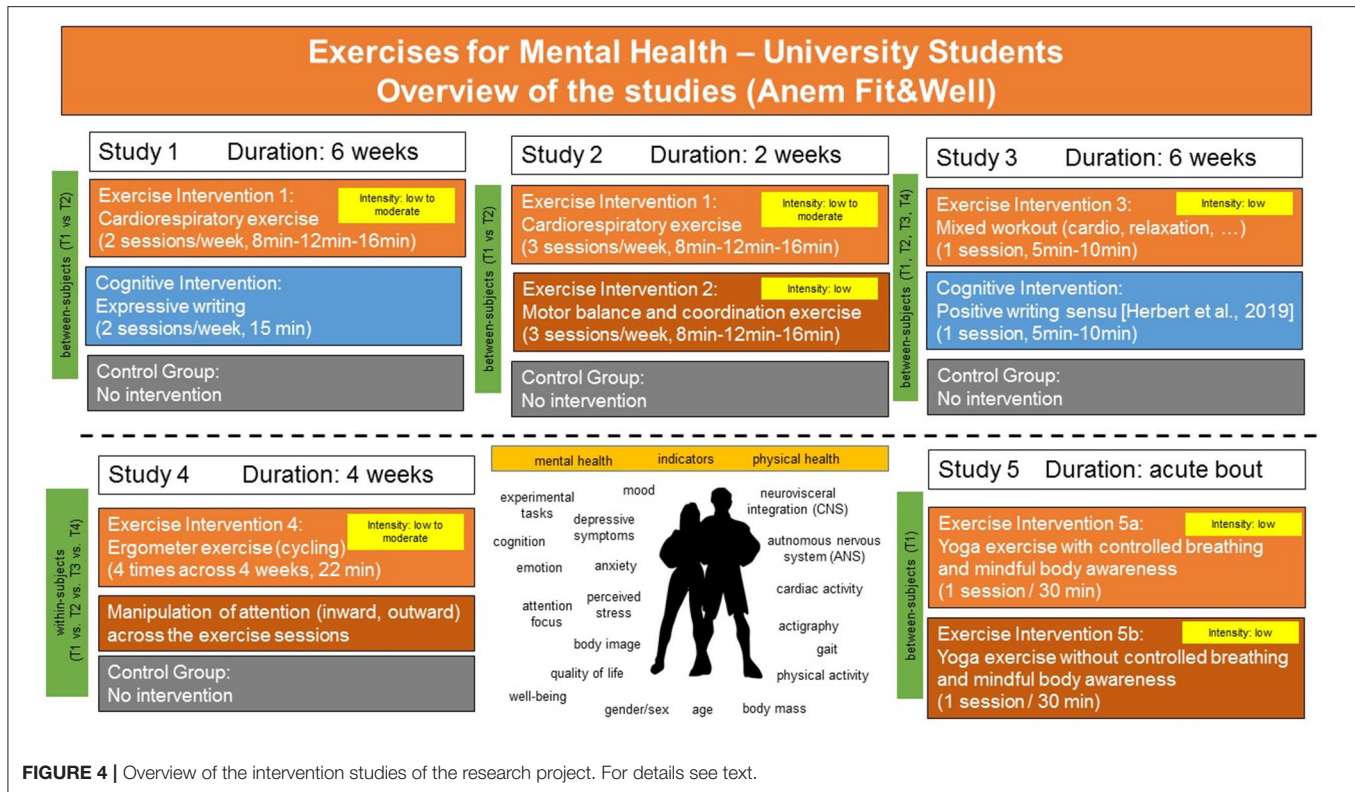


of life, the latter often comprising aspects of physical and mental health and well-being (e.g., material and physical well-being) as well. In addition, subjective well-being focuses on several factors such as mood, affect or emotions as well as a person's capacity, resilience and satisfaction with one's life [e.g., (57)]. As briefly illustrated in **Figure 4**, the research project and its studies aim to assess mental health, stress, and several facets of quality of life and subjective well-being with standardized questionnaires in addition to using standardized questionnaires for detailed profiling of depressive symptoms, anxiety, mood, body awareness and body image to name but a few of the dimensions included in the project's psychological assessment. In addition, the psychological assessment is not only based on self-report measures but aims to include experimental psychological paradigms to capture immediate changes in perception, cognition, and emotion or body awareness, during or after the exercise intervention compared to pre-exercise. In contrast to self-report measures, experimental investigations include objective outcome variables such as reaction times or task accuracy that can be further combined with measuring changes in brain activity or heart rate for psychophysiological assessment. Inclusion of a battery of self-report measures and assessment tools that comprise standardized self-report questions and short experimental investigations can give comprehensive insight into exercise-driven mental health effects. Moreover, the default assessment in the project includes the assessment of the participants' habitual physical activity level. In addition, each participant is

screened for his/her physical activity habits, and, if possible (e.g., in the laboratory), for cardiovascular/cardiorespiratory fitness according to standardized in house anamnestic screening protocols. From a biopsychological understanding of health undertaken in this research project, only a full assessment of this kind can improve understanding of the when and why physical activity and exercise interventions promote health and well-being in healthy adults.

## Study Description and Study Design

In summary, the study design of five intervention studies conducted within the research project and whose results have already been published separately, all investigating university students (gender-mixed samples or all-female samples) and some including randomized control trial studies (RCTs) are described in the following sections and their main findings are outlined in a brief review in the Results section. The original results of these studies can be found in the following publications (58–62). An overview of the studies and the study designs is illustrated in **Figure 4**. As illustrated in **Figure 4**, study 1, study 2 and study 3 were using similar study protocols comparing exercise interventions against cognitive interventions or against a non-exercise control group (59, 61). Study 1, study 2 and study 3 were carried out during the time course of a semester, i.e., when university students were at the campus and actively enrolled in their studies. Study 1 was carried out as an online intervention, study 2 was carried out in the laboratory (59) and study 3 (61) was carried out weekly once



**FIGURE 4 |** Overview of the intervention studies of the research project. For details see text.

within the classroom across the term. Study 1 and study 2 were RCTs.

### Study 1 Cardio Exercise vs. Cognitive Intervention vs. Wait List

In study 1, all interventions (exercise, cognitive intervention or wait list) lasted 6 weeks. In study 2 all interventions lasted 2 weeks. In study 1, the exercise intervention as well as the cognitive intervention comprised 12 sessions within 6 weeks. The 12 exercise sessions increased in duration across the 12 sessions from 8, 12, to 16 min, respectively. The cognitive intervention and wait list followed the same time schedule. The exercise intervention was semi-guided by a female and male exercise model at the age of the volunteers (all university students, women and men). The exercise sessions were delivered as exercise videos. The exercise intensity of the exercises included in study 1 were evaluated in a separate sample of volunteers by means of heart rate measures. Moreover, the exercises were evaluated by experts in a separate study (60). This suggested that the 16 min exercise sessions of study 1 (59) were at moderate intensity and suited to increase cardiorespiratory fitness and muscular strength.

### Study 2 Cardio Exercise vs. Motor Balance and Coordination Exercise vs. Wait List

To better understand the contributions of the type of exercise and the contribution of the duration of the exercise intervention to mental health improvements, the exercises included in study 1 were also used in study 2 and in study 2 compared against

an exercise intervention comprising balance, coordination and motor training. The effects of the exercise interventions in study 2 were compared against a wait list control group and in contrast to study 1, the exercise interventions were carried out across a period of 2 weeks only, with 3 sessions per week (see **Figure 4**). Thus, in study 2, the exercises of study 1 were carried out at the same intensities but the individual exercise sessions (frequency) was increased to 2 weeks instead of 6 weeks. Akin to the participants of study 1, the participants of study 2 performed the interventions on the same days, hours etc. to control and exclude as many confounding factors as possible (changes in circadian rhythm, etc). Moreover, study 2 included detailed psychophysiological assessment of parameters of cardiovascular fitness of the participants and improvements therein pre- to post intervention. Finally, participants of study 2 received the same psychological assessment battery of questionnaires as the participants of study 1, and although study 2 was conducted in the laboratory, the exercises were presented akin to study 1 as semi-guided exercise videos [for an overview see, (59)].

### Study 3 Short Physical Activity Breaks vs. Cognitive Intervention

In study 3, the duration and frequency of the interventions were reduced to 1 session/week, the interventions were carried out weekly once within the classroom across the winter term (1 session per week, starting at T1, T2 until T3; the distance between T1, T2 and T3 was 3 weeks, follow-up at T4), guided by an exercise model. The exercise interventions were carried out at



the beginning of the class and lasted about 5 min and no longer than 10 min. Moreover, in contrast to study 1 and study 2, the exercises included in study 3 consisted of a mix of exercises of low intensity that comprised muscle relaxation and other types of activities such as simple dance steps [see (61); and **Figure 4** for an overview and summary].

The cognitive intervention included in study 1 and study 3 comprised an expressive writing task (12 sessions, 6 weeks, study 1 or 1 session weekly across the winter term, study 3). The participants in the expressive writing group of study 1 wrote about their most stressful weekly events (59). In study 3, the cognitive intervention included writing about positive events following the in-house protocol of the author of this manuscript. The effects of a single session of expressive writing about stressful events as well as of positive writing used in study 1 and study 3 is described in detail (63). The writing intervention of study 1 was carried out online, whereas in study 3, it was akin to the exercise session carried out in the classroom, weekly, starting at T1, T2 until T3 with a distance of 3 weeks between T1, T2, and T3, respectively. Like in study 1 and study 2, the participants of study 3 underwent detailed psychological assessment including assessment of global physical activity, depressive symptoms, and quality of life.

#### **Study 4 Acute Bouts of Cycling Exercise of Moderate Intensity vs. Control Group**

Whereas, study 1, study 2 and study 3 used individual exercises comprising aerobic cardio fitness exercises, motor balance and coordination training, and relaxation exercise (study 3 only) to investigate specifically the mental health benefits of different types of exercises combined in the interventions, the laboratory study 4 (62) investigated the effectiveness of 4 sessions of ergometer exercise (bicycling of moderate intensity) in a within study design in which the same participants performed all exercise sessions and the control condition.

#### **Study 5 Mind-Body Exercise (Yoga) With Controlled and Mindful Breathing vs. Without**

The laboratory study 5 (64) used yoga exercises with and without controlled breathing and mindfulness instructions as mind-body exercise intervention and investigated the effects of the exercise after a single exercise session (see **Figure 4**). Moreover, akin to study 2, the laboratory study 4 and the laboratory study 5 included detailed psychophysiological assessment of cardiovascular improvements pre- to post intervention and a set of experimental tasks allowing first answers to the question of the role psychophysiological interactions play in the improvement of cognitive-affective processing, and body awareness after single sessions of low to moderate intensity exercise.

#### **Study Participants, Inclusion and Exclusion Criteria**

Study 1 comprised a mixed gender sample, study 3 aimed at including women and men, and study 2, 4 and 5 comprised all female samples (to keep psychophysiological recordings constant). All participants were screened for mental and physical health conditions because a history of mental or physical

disorders and past and current injuries or cardiovascular disorders and other health conditions were exclusion criteria. An age of at least 18 years was an inclusion criterion as was German as native language. Study 1 comprised  $n = 153$  university students (127 women), study 2 comprised  $n = 32$  university students ( $n = 2$  men), study 3 comprised  $n = 105$  university students, whereas study 4 included  $n = 30$  university students (all-female) and study 4 included  $n = 34$  university students (all-female sample). In study 1 and study 3, participants with missing data or drop outs were excluded from the final analysis of pre-post intervention effects, resulting in smaller sample sizes, especially in study 3 [for a detailed overview of the study design and drop outs see (59, 61)].

## **RESULTS**

### **Habitual Physical Activity Behavior and Sedentarism Among University Students**

As summarized in this section and in **Table 1**, the RCT studies, i.e., study 1 (mixed-gender sample) and study 2 (all-female sample) yielded an overall sitting time of 7.45 h/day (study 1) and 7.6 h/day (study 2) in the samples of university students. Averaged across the study sample, 23.94% and 26.76% of the participants of study 1 reported to not engage in any vigorous or moderately intensive activities in their free time. Regarding the total duration of their weekly physical activity (i.e., including activities at work, during transport or leisure), 14.79% participants of study 1 and 30% of the all-female sample of study 2 did not reach the WHO guidelines of 150 min of moderate-intensive physical activity, and about 7% (study 1) reported to not engage in vigorous activity and this held true for both, women and men [for an overview see (59)]. Study 3 confirmed this trend in sedentary behavior (574.62 min/week vs. 638.57 min/week corresponding to 9.6–10.64 h/week sitting). Thirty-five percentage of the university students reported to spend between 15 and 25 h/week at the university and akin to the participants of the study 1 and study 2, the participants of the study 3 reported to be physically active only about 62.86–137.96 min/day and 15% in total did not reach the WHO recommendations. Seventy-four percentage of the all-female sample of study 5 (64) reported to spend at least once a week in regular exercise activities such as jogging, swimming, cycling, dancing, team sports, martial arts, strength training, balance, or gymnastics.

### **Mental Health and Relationship With Physical Activity Among University Students**

Importantly, akin to the results obtained for sedentarism and physical activity behavior, the assessment of mental health yielded heightened scores of depression, anxiety and perceived stress among university students. In study 1, only 63.40% of the participants received an average score on the depression inventory [Beck Depression Inventory, BDI-II (65)] indicating no depression. In study 2, 16.7% of the all-female sample reported minimal depressive symptoms (on the BDI-II), while in study 3, depressive symptoms as assessed with the BDI-II ranged on

**TABLE 1 |** Overview of the results of the studies (study 1 and study 2) of the research project assessing prevalence of physical activity (A), self-reported depressive, anxiety and stress symptoms (B) and the relationship between habitual physical activity, mental health and well-being (C) among university students.

<b>A. Sedentarisms and physical activity</b>	
Average sitting time (hours per day/week)	7.45–7.6 h/day
Not reaching the WHO recommendations of moderate exercise intensity	14.79–30%
<b>B. Mental health and stress</b>	
Depressive symptoms	63.40% (study 1) - 83.3% (study 2) no depression
State anxiety	23.3–41.83%
Perceived stress	mainly stress due to uncertainty
<b>C.Relationship between mental health, well-being and habitual physical activity</b>	
Self-reported overall habitual physical activity level (GPAQ) and self-reported depressive symptoms (–)	
Self-reported overall habitual physical activity level (GPAQ) trait as well as state anxiety (–)	
Self-reported overall habitual physical activity level (GPAQ) and body dissatisfaction (–)	
Self-reported overall habitual physical activity level (GPAQ) and self-reported psychosomatic stress symptoms (–)	
Self-reported overall habitual physical activity level (GPAQ) and physical as well as psychological quality of life including aspects of well-being (+)	

(–): negative correlation, (+): positive correlation. For details see text.

average from 3.85 (no depression)–10.14 (minimal depression). Assessment of trait and state anxiety revealed that in study 1, 29.41% of the participants scored above the clinical cutoff score of trait anxiety and 41.83% reported state anxiety (comparable to clinical samples) and this was confirmed in study 2 in the all-female sample [i.e., 30% (trait) and 23.3% (state) of the participants obtained high scores on trait and state anxiety]. The participants in study 3 reported on average comparable trait anxiety to the participants of study 1 and study 2, respectively. As far as perceived stress is concerned, across studies, perceived stress seemed to be more pronounced in the domains of perceived stress due to uncertainty or excessive demands than perceived stress due to actual negative life events among the study samples of university students.

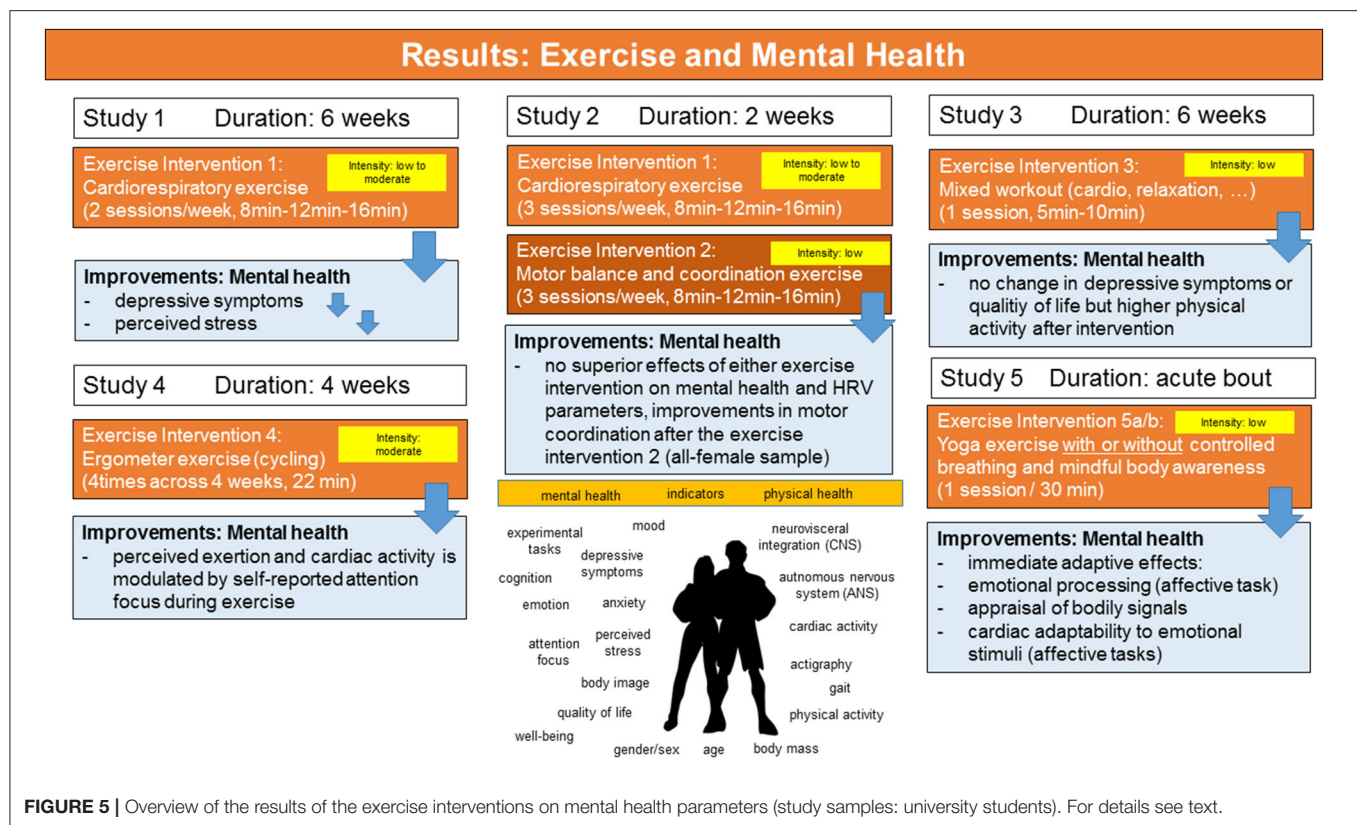
In accordance with the literature, the results of the RCT studies 1–2 (59) showed significant relationships between mental health and regular physical activity and exercise. Significant negative correlations were found between the participants' self-reported overall habitual physical activity level [GPAQ, (66)] and self-reported depressive symptoms, trait as well as state anxiety, body dissatisfaction and self-reported psychosomatic stress symptoms. Moreover, regular physical activity was positively correlated with well-being and physical as well as psychological quality of life domains. In study 2, relationships between physical fitness and mental health were confirmed by correlations

between the participants' cardiovascular fitness [assessed by heart rate variability (HRV) at rest] and the degree of self-reported depressive and anxiety symptoms.

**Health Benefits: Comparison of Exercises Across Studies**

When compared across the studies, particularly aerobic exercises (cardio exercise) alleviated depressive symptoms and perceived stress. These effects are seen in women and men when the exercises are carried out regularly, 3 times a week for a duration of 6 weeks at exercise intensities comprising both, low to moderate intensities (study 1). Interestingly, when the same exercise intervention is reduced to 2 weeks and the session number per week are increased (3 sessions per week instead of two sessions per weeks), these effects cannot be found in an all-female sample (study 2). Likewise, the results of study 3 in which a single session of exercise per week was carried out for the period of the winter term and a weekly session comprised a mix of 5–10 min of exercises with low intensity not exclusively focusing on aerobic exercise, this did not significantly change self-reported depression in university students pre to post intervention. In study 2, the exercise intervention comprising balance and motor-coordination exercise only, was not superior to cardio exercise in alleviating perceived psychological stress, depression or anxiety symptoms when carried out for 2 weeks [3 sessions/week, see study 2 in (59)]. However, it improved the participants' performance of motor balance and motor coordination significantly in the all-female sample of study 2 and therefore, not just as known from the literature in the elderly. The participants in study 3 performing low intensity exercise executed for 5–10 min on 1 day per week showed significantly higher overall physical activity and less sedentary behavior at the end of the intervention compared to the participants who engaged in a cognitive intervention of positive writing carried out at the same amount of time and frequency as the exercise intervention (61).

Interestingly, four sessions of 22 min of ergometer exercises [cycling at moderate intensity, see (62)] carried out with different attentional focus (internal vs. external) at moderate intensity seem not to have differential effects on cardiovascular activity during the exercise compared to a control condition (no cycling) in a sample of healthy women, however, the self-reported attentional focus during exercise seems to influence both, the degree of exertion from the exercise and the correlations with measures of cardiac activity [see Table 4 in (62)]. In contrast to the cycling exercise used in study 4, the results of study 5 (64) found significant effects on indicators of well-being after a single session of mind-body exercise (yoga). In study 5, women (all university students) performed yoga exercises either with (exercise group 1) or without controlled breathing and mindfulness instructions (exercise group 2) for 30 min. Self-other referential emotional processing, awareness of bodily signals and changes in cardiac activity (heart rate, respiratory sinus arrhythmia, time- and frequency-domain measures of HRV as estimates of parasympathetic cardiac control) were investigated before, during and after the exercise using standardized



experimental tasks, standardized questionnaires, and mobile recording devices. This showed that a single session of yoga exercise (of 30 min duration) can facilitate (a) emotional processing, appraisal of bodily signals and cardiac adaptability during the exercise as well as during affective task processing post- to pre-exercise in healthy women. Assessment of cardiac activity showed that mean HR increased during the exercise session. The results of the interventions used in the studies 1–5 are summarized in **Figure 5**.

## DISCUSSION

There is currently open questions of whether exercise interventions of low to moderate intensity can improve or promote mental health in emerging adults such as university students. This question is the focus of the research project described in this manuscript and its related studies. Emerging adults such as university students are considered vulnerable to mental health conditions, depression and anxiety in particular as well as to the experience of stress [for a discussion, (67)]. Additionally, there is evidence that a majority of emerging adults are not adhering to the physical activity levels recommended in the national and international physical activity guidelines [for metaanalytic results, see (31)]. The results of the already available studies of the research project reviewed above support the hypothesis that university students as emerging adults are suffering from mental health problems including depressive symptoms, anxiety and stress and that among

university students, both, the individual physical fitness and the individual regular exercise and physical activity behavior are significantly related to mental health and well-being. Moreover, the studies suggest that these relationships hold true in study samples of university students whose regular physical activity behavior, on average, might range below the weekly physical activity level recommended by the physical activity guidelines. Moreover, the prevalence of sedentary behavior and the amount of habitual physical activity behavior observed in the studies confirm results from previous studies among college students (29) that also support the nationwide trend that a significant majority of the young emerging adult population including university students spends too many hours/days sitting (68). Recent recommendations suggests that sitting more than 8 h/day is as damaging to one's health as obesity or smoking (69).

Of note, all the studies whose results are reviewed in the manuscript were conducted before the COVID-19 pandemic. There is concerns and evidence from research that the mental health of university students might be seriously affected by the consequences of the pandemic. Sadly, this is supported by own survey data (58) collected during the first wave and lockdown in 2020. The results show that compared to the prevalence scores obtained in studies conducted before the pandemic, depression and anxiety as well as threat perception (as type of stress) have increased significantly. Similar results are reported in the surveys conducted in other countries across the world that were affected by lockdowns (34).



The exercise interventions investigated in the different studies summarized in the Results varied in the type of exercises, the frequency and duration of the exercise sessions and the intensity of the exercises. Reviewing the results across the studies allowed giving first answers to the question of when, i.e., at which intensity, frequency and duration low to moderate exercise interventions exert effects on the mental health of university students either immediately after a single exercise session or after repeated and regular exercise sessions. The results of the studies suggest that exercise interventions with a certain frequency (3 times weekly) and frequency and duration of the sessions (6 weeks) and of moderate exercise intensity are best suited to decrease certain mental health problems such as depressive symptoms and perceived stress pre to post intervention in emerging adults (i.e., university students), reporting mild to moderate symptoms in standardized questionnaires and yet not having been diagnosed with a mental disorder [study 1, (59)]. This does however not mean that exercise interventions comprising exercises of low intensity do not have any positive effects on mental health and well-being of university students. Motor balance and coordination training might be effective as well [study 2, (59)]. In addition, even one session comprising a mix of low intensity exercise executed for 5–10 min on 1 day per week might motivate university students to adhere to an active lifestyle with participants taking part in this intervention showing higher overall physical activity and less sedentary behavior at the end of the intervention compared to the participants who engaged in a cognitive intervention of positive writing over the period of a semester [study 3, (61)]. Moreover, the results of study 5 (64) investigating acute bouts of mind-body exercise (yoga) are particularly promising because they support immediate adaptive effects of low intensity exercise (yoga exercise) on both, physical and psychological health parameters. Although effects of additional exercise sessions were not investigated, the results of this experimentally controlled study demonstrate that mind-body exercise of low intensity such as yoga can not only be recommended as an exercise for mental and physical health prevention in the elderly or in certain vulnerable target groups but be recommended among university students as well. The results support the notion that promotion of regular physical activity and exercise of low- to moderate intensity is an important health promotion task in order to help emerging adults such as university students to buffer the psychological, cognitive and emotional demands of pre-dominantly sedentary activities and mental stress.

## CONCLUSION

### Limitations and Future Outlook

The results briefly summarized in this manuscript await future investigations. In particular, more evidence is needed from studies that use combined examination of psychological and physiological factors to determine the mechanisms of how exercise of low and moderate intensity strengthen mental health and well-being (psychologically and physiologically) and promote an active lifestyle in emerging adults. In light of the so far limited systematic research given (48), the present studies

and specifically, the approach of the research project described in this manuscript can be considered a first step into that direction underscoring the importance of the relevance of systematic scientific investigations. Moreover, as proposed by the research project, future studies should focus more on “the individual person” and consider the person’s individual preexisting physical activity behavior, the individual’s needs, preferences, motivation and reasons for exercise and physical activity behavior. The results and the scientific approach taken by the research project support the notion that theoretical assumptions from exercise psychology, health psychology, but also from neuroscience and emotion and motivation and sports psychology could be helpful when examining mental health effects of exercise interventions. In the long run, the multidimensional approach suggested and approached by the research project can give theoretically guided and personalized exercise and physical activity recommendations for building psychologically-driven exercise interventions that strengthen mental health and well-being of emerging adults in the field of primary prevention. To this end, the investigation of exercise-related effects on mental health should as recommended in this manuscript include a precise description of the exercise and its health benefits along several psychological and exercise dimensions. A detailed and systematic description of both, the exercise itself and its possible health benefits, in addition to a detailed description of the physical activity habits, sedentary behavior, and mental profile of the participants is mandatory for a better understanding of how exercise of different type and intensity influences mental health. Moreover, the purpose of the interventions (e.g., for improving physical health, mental health, or both or other domains such as well-being) should be clearly stated and if relevant may include a description of training principles known from sports psychology and exercise physiology [for an overview see (70, 71)].

Importantly, exercise adherence and dissemination of the interventions also play a role. As outlined in this manuscript, university students as emerging adults display high numbers of activities (job, leisure time) with a high sitting time and sedentary behavior. Therefore, the present research project also includes and provides exercises in a format that can be easily integrated into the daily activity without much need of persuasion or effort. For example the exercises of study 1–3 and study 5 could be carried out as e.g., workout at home or at work. To this end, the individual exercises are videotaped with different exercise models [women and men, e.g., see (59, 60)] at the age of the target groups. Moreover, because guidance of exercise as well as the physical appearance and expertise of the exercise models can have a significant impact on exercise adherence, the individual exercises are also available as standalone (without videos) as digital paper-pencil booklets [see e.g., (60)]. In these exercise manuals, each exercise is given a verbal and a pictorial description of its movements with feedback about its duration, intensity and frequency. The manuals are currently available in two languages, German and English, the latter reducing language and cultural barriers [see e.g., (60)]. The exercises investigated in the research project will be continuously updated, include different types of exercises (as illustrated in **Figure 2**). Thus, the exercises can be delivered to a broad audience digitally and semi-guided with or without real and symbolic

exercise models and with health recommendations from health experts [see (60)].

## AUTHOR CONTRIBUTIONS

CH: drafting and writing of the manuscript, conceptualization, methodology, validation, formal analysis, resources, writing—review and editing, visualization, project

administration, and funding acquisition. The author authored and approved the submitted version of the manuscript.

## FUNDING

This study was funded by the budgetary resources of the Department of Applied Emotion and Motivation Psychology, Ulm University, Germany.

## REFERENCES

- World Health Organization. Depression and other common mental disorders: global health estimates (No. WHO/MSD/MER/2017.2) (2017). Available online at: <https://apps.who.int/iris/bitstream/handle/10665/254610/WHO-MSD-MER-2017.2-eng.pdf>
- Kessler RC, Bromet EJ. The epidemiology of depression across cultures. *Annu Rev Public Health*. (2013) 34:119–38. doi: 10.1146/annurev-publhealth-031912-114409
- Liu Q, He H, Yang J, Feng X, Zhao F, Lyu J. Changes in the global burden of depression from 1990 to 2017: findings from the global burden of disease study. *J Psychiatr Res*. (2020) 126:134–40. doi: 10.1016/j.jpsychires.2019.08.002
- La Arias-de Torre J, Vilagut G, Ronaldson A, Serrano-Blanco A, Martin V, Peters M, et al. Prevalence and variability of current depressive disorder in 27 European countries: a population-based study. *Lancet Public Health*. (2021) 6:e729–38. doi: 10.1016/S2468-2667(21)00047-5
- Ingram RE, Price JM. Vulnerability to Psychopathology: *Risk Across the Lifespan*. 2nd ed. Guilford Press (2010).
- Prince M, Patel V, Saxena S, Maj M, Maselko J, Phillips MR, et al. No health without mental health. *Lancet*. (2007) 370:859–77. doi: 10.1016/S0140-6736(07)61238-0
- Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. (2020) 54:1451–62. doi: 10.1136/bjsports-2020-102955
- Blair SN, Cheng Y, Holder JS. Is physical activity or physical fitness more important in defining health benefits? *Med Sci Sports Exerc*. (2001) 33:S379–99. doi: 10.1097/00005768-200106001-00007
- Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. *CMAJ*. (2006) 174:801–9. doi: 10.1503/cmaj.051351
- Biddle S, Fox KR, Boutcher SH, editors. *Physical Activity and Psychological Wellbeing* (Vol. 552). London: Routledge (2000).
- Patel H, Alkhawam H, Madanieh R, Shah N, Kosmas CE, Vittorio TJ. Aerobic vs anaerobic exercise training effects on the cardiovascular system. *World J Cardiol*. (2017) 9:134–8. doi: 10.4330/wjc.v9.i2.134
- Lee PG, Jackson EA, Richardson CR. Exercise prescriptions in older adults. *Am Fam Physician*. (2017) 95:425–32. Available online at: <https://www.aafp.org/afp/2017/0401/p425.html>
- American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. Baltimore: Lippincott Williams and Wilkins (2013).
- Guthold R, Ono T, Strong KL, Chatterji S, Morabia A. Worldwide variability in physical inactivity: a 51-country survey. *Am J Prev Med*. (2008) 34:486–94. doi: 10.1016/j.amepre.2008.02.013
- Dumith SC, Hallal PC, Reis RS, Kohl III HW. Worldwide prevalence of physical inactivity and its association with human development index in 76 countries. *Prev Med*. (2011) 53:24–8. doi: 10.1016/j.ypmed.2011.02.017
- Luzak A, Heier M, Thorand B, Laxy M, Nowak D, Peters A, et al. Physical activity levels, duration pattern and adherence to WHO recommendations in German adults. *PLoS ONE*. (2017) 12:e0172503. doi: 10.1371/journal.pone.0172503
- Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. *The Lancet*. (2012) 380, 247–57. doi: 10.1016/S0140-6736(12)60646-1
- Robison J, Rogers MA. Adherence to exercise programmes. *Sports Med*. (1994) 17:39–52. doi: 10.2165/00007256-199417010-00004
- McLaughlin M, Atkin AJ, Starr L, Hall A, Wolfenden L, Sutherland R, et al. Worldwide surveillance of self-reported sitting time: a scoping review. *Int J Behav Nutr Phys Act*. (2020) 17:1–12. doi: 10.1186/s12966-020-01008-4
- Peltzer K, Pengpid S. Sitting time and its associated factors in university students from 18 low, middle and emerging economy countries. *Afr J Phys Health Educ*. (2014) 20:1379–89.
- Park JH, Moon JH, Kim HJ, Kong MH, Oh YH. Sedentary lifestyle: overview of updated evidence of potential health risks. *Korean J Fam Med*. (2020) 41:365–73. doi: 10.4082/kjfm.20.0165
- Kandola A, Lewis G, Osborn DPJ, Stubbs B, Hayes JF. Depressive symptoms and objectively measured physical activity and sedentary behaviour throughout adolescence: a prospective cohort study. *Lancet Psychiatry*. (2020) 7:262–71. doi: 10.1016/S2215-0366(20)30034-1
- Guthold R, Stevens GA, Riley LM, Bull FC. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. *Lancet Glob Health*. (2018) 6:e1077–e10863. doi: 10.1016/S2214-109X(18)30357-7
- Froböse I, Biallas B, Wallmann-Sperlich B. (2018). *Der DKV-Report 2018 Wie gesund lebt Deutschland*. Köln: Zentrum für die Gesundheit durch Sport und Bewegung der Deutschen Sporthochschule Köln.
- Arnett J. Emerging adulthood: a theory of development from the late teens through the twenties. *Am Psychol*. (2000) 55:469–80. doi: 10.1037/0003-066X.55.5.469
- Auerbach RP, Alonso J, Axinn WG, Cuijpers P, Ebert DD, Green JG, et al. Mental disorders among college students in the World Health Organization world mental health surveys. *Psychol Med*. (2016) 46:2955–70. doi: 10.1017/S0033291716001665
- Brown JSL. Student mental health: some answers and more questions. *J Ment Health*. (2018) 27:193–6. doi: 10.1080/09638237.2018.1470319
- Ibrahim AK, Kelly SJ, Adams CE, Glazebrook C, A. systematic review of studies of depression prevalence in university students. *J Psychiatr Res*. (2013) 47:391–400. doi: 10.1016/j.jpsychires.2012.11.015
- Buckworth J, Nigg C. Physical activity, exercise, and sedentary behavior in college students. *J Am Coll Health*. (2004) 53:28–34. doi: 10.3200/JACH.53.1.28-34
- Irwin JD. Prevalence of university students' sufficient physical activity: a systematic review. *Percept Mot Skills*. (2004) 98:927–43. doi: 10.2466/pms.98.3.927-943
- Keating XD, Guan J, Piñero JC, Bridges DM. A meta-analysis of college students' physical activity behaviors. *J Am Coll Health*. (2005) 54:116–26. doi: 10.3200/JACH.54.2.116-126
- Butler KM, Ramos JS, Buchanan CA, Dalleck LC. Can reducing sitting time in the university setting improve the cardiometabolic health of college students? *Diabetes Metab Syndr Obes*. (2018) 11:603–10. doi: 10.2147/DMSO.S179590
- Alzueta E, Podhajsky S, Zhao Q, Tapert SF, Thompson WK, De Zambotti M, et al. Risk for depression tripled during the COVID-19 pandemic in emerging adults followed for the last 8 years. *Psychol Med*. (2021) 1–8. doi: 10.1017/S0033291721004062
- Halliburton AE, Hill MB, Dawson BL, Hightower JM, Rueden H. Increased stress, declining mental health: Emerging adults' experiences in college during COVID-19. *Emerging Adulthood*. (2021) 9:433–48. doi: 10.1177/21676968211025348
- Dishman RK, Heath G, Schmidt MD, Lee IM. *Physical activity epidemiology*. Champaign: Human Kinetics (2022).
- Saxena S, van Ommeren M, Tang KC, Armstrong TP. Mental health benefits of physical activity. *J Ment Health*. (2005) 14:445–51. doi: 10.1080/09638230500270776



37. Miko HC, Zillmann N, Ring-Dimitriou S, Dorner TE, Titze S, Bauer R. (2020). Effects of physical activity on health. *Gesundheitswesen (Bundesverband der Ärzte des Öffentlichen Gesundheitsdienstes)*. (2020) 82:S184–95. doi: 10.1055/a-1217-0549
38. Stanton R, Reaburn P. Exercise and the treatment of depression: a review of the exercise program variables. *J Sci Med Sport*. (2014) 17:177–82. doi: 10.1016/j.jsams.2013.03.010
39. National Institute for Health and Clinical Excellence. *Depression: the Treatment and Management of Depression in Adults*. (2009). Available online at: <http://www.nice.org.uk/guidance/CG90>
40. Paluska SA, Schwenk TL. Physical activity and mental health: current concepts. *Sports Med*. (2000) 29:167–80. doi: 10.2165/00007256-200029030-00003
41. Blumenthal JA, Babyak MA, Doraiswamy PM, Watkins L, Hoffman BM, Barbour KA, et al. Exercise and pharmacotherapy in the treatment of major depressive disorder. *Psychosom Med*. (2007) 69:587–96. doi: 10.1097/PSY.0b013e318148c19a
42. Cooney G, Dwan K, Mead G. Exercise for depression. *JAMA*. (2014) 311:2432–3. doi: 10.1001/jama.2014.4930
43. Zhao JL, Jiang WT, Wang X, Cai ZD, Liu ZH, Liu GR, et al. Exercise, brain plasticity, and depression. *CNS Neurosci Ther*. (2020) 26:885–95. doi: 10.1111/cns.13385
44. Conn VS. Depressive symptom outcomes of physical activity interventions: meta-analysis findings. *Ann Behav Med*. (2010) 39:128–38. doi: 10.1007/s12160-010-9172-x
45. Rebar AL, Stanton R, Geard D, Short C, Duncan MJ, Vandelanotte C, et al. A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health Psychol Rev*. (2015) 9:366–78. doi: 10.1080/17437199.2015.1022901
46. Harvey SB, Øverland S, Hatch SL, Wessely S, Mykletun A, Hotopf M. Exercise and the prevention of depression: results of the HUNT cohort study. *Am J Psychiatry*. (2018) 175:28–36. doi: 10.1176/appi.ajp.2017.16111223
47. Hu MX, Turner D, Generaal E, Bos D, Ikram MK, Ikram MA, et al. Exercise interventions for the prevention of depression: a systematic review of meta-analyses. *BMC Public Health*. (2020) 20:1–11. doi: 10.1186/s12889-020-09323-y
48. Pascoe MC, Bailey AP, Craike M, Carter T, Patten R, Stepto NK, et al. Exercise interventions for mental disorders in young people: a scoping review. *BMJ Open SEM*. (2020) 6:e000678. doi: 10.1136/bmjsem-2019-000678
49. Maher JP, Doerksen SE, Elavsky S, Hyde AL, Pincus AL, Ram N, et al. A daily analysis of physical activity and satisfaction with life in emerging adults. *Health Psychol*. (2013) 32:647–56. doi: 10.1037/a0030129
50. Guo S, Liu F, Shen J, Wei M, Yang Y. Comparative efficacy of seven exercise interventions for symptoms of depression in college students: a network of meta-analysis. *Medicine*. (2020) 99:e23058. doi: 10.1097/MD.00000000000023058
51. Portugal EMM, Cevada T, Monteiro-Junior RS, Guimarães TT, da Cruz Rubini E, Lattari E, et al. Neuroscience of exercise: from neurobiology mechanisms to mental health. *Neuropsychobiology*. (2013) 68:1–14. doi: 10.1159/000350946
52. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*. (1985) 100:126–31.
53. Warburton DE, Nicol CW, Bredin SS. Prescribing exercise as preventive therapy. *CMAJ*. (2006) 174:961–74. doi: 10.1503/cmaj.1040750
54. Howley ET. Type of activity: resistance, aerobic and leisure versus occupational physical activity. *Med Sci Sports Exerc*. (2001) 33:S364–9. doi: 10.1097/00005768-200106001-00005
55. Williams N. The Borg Rating of Perceived Exertion (RPE) scale. *Occup Med*. (2017) 67:404–5. doi: 10.1093/occmed/kqx063
56. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR, Tudor-Locke C, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. *Med Sci Sports Exerc*. (2011) 43:1575–81. doi: 10.1249/MSS.0b013e31821ec12
57. Diener E, Scollon CN, Lucas RE. The evolving concept of subjective Wellbeing: the multifaceted nature of happiness. In: Diener E, Editor. *Assessing Wellbeing: the collected works of Ed Diener*. New York: Springer (2009).
58. Herbert C, El Bolock A, Abdennadher S. How do you feel during the COVID-19 pandemic? a survey using psychological and linguistic self-report measures, and machine learning to investigate mental health, subjective experience, personality, and behaviour during the COVID-19 pandemic among university students. *BMC Psychol*. (2021) 9:1–23. doi: 10.1186/s40359-021-00574-x
59. Herbert C, Meixner F, Wiebking C, Gilg V. Regular physical activity, short-term exercise, mental health, and Wellbeing among university students: the results of an online and a laboratory study. *Front Psychol*. (2020) 11:509. doi: 10.3389/fpsyg.2020.00509
60. Herbert C, Gilg V, Sander M, Kobel S, Jerg A, Steinacker JM. Preventing mental health, Wellbeing and physical activity during the corona pandemic—recommendations from psychology and sports medicine. *Dtsch Z Sportmed*. (2020) 71:249–57. doi: 10.5960/dzsm.2020.458
61. Marschin V, Herbert C. A short, multimodal activity break incorporated into the learning context during the Covid-19 pandemic: effects of physical activity and positive expressive writing on university students' mental health—results and recommendations from a pilot study. *Front Psychol*. (2021) 12:3074. doi: 10.3389/fpsyg.2021.645492
62. Meixner F, Herbert C. Does attentional focus influence psychophysiological responses to an acute bout of exercise? evidence from an experimental study using a repeated-measures design. *Front Psychol*. (2021) 12:608149. doi: 10.3389/fpsyg.2021.680149
63. Herbert C, Bendig E, Rojas R. My sadness—our happiness: writing about positive, negative, and neutral autobiographical life events reveals linguistic markers of self-positivity and individual Wellbeing. *Front Psychol*. (2019) 9:2522. doi: 10.3389/fpsyg.2018.02522
64. Herbert C. (2021). Can yoga boost access to the bodily and emotional self? Changes in heart rate variability and in affective evaluation before, during and after a single session of yoga exercise with and without instructions of controlled breathing and mindful body awareness in young healthy women. *Front Psychol*. 12, 731645–731645.
65. Hautzinger M, Keller F, Kühner C. *BDI-II. Beck-Depressions-Inventar. Revision 2. Auflage*. Frankfurt: Pearson Assessment (2010).
66. Armstrong T, Bull F. Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). *J Public Health*. (2006) 14:66–70. doi: 10.1007/s10389-006-0024-x
67. Schwartz SJ, Petrova M. Prevention science in emerging adulthood: a field coming of age. *Prev Sci*. (2019) 20:305–9. doi: 10.1007/s11211-019-0975-0
68. Bauman AE, Petersen CB, Blond K, Rangul V, Hardy LL. The descriptive epidemiology of sedentary behaviour. In *Sedentary behaviour epidemiology*. Cham: Springer (2018) pp. 73–106.
69. Mayo Clinic. Sitting risks: How harmful is too much sitting? (2021). Available online at: <https://www.mayoclinic.org/healthy-lifestyle/adult-health/expert-answers/sitting/faq-20058005> (accessed December 03, 2021).
70. Herold F, Müller P, Gronwald T, Müller NG. Dose–response matters!—a perspective on the exercise prescription in exercise–cognition research. *Front Psychol*. (2019) 10:2338. doi: 10.3389/fpsyg.2019.02338
71. Strath SJ, Kaminsky LA, Ainsworth BE, Ekelund U, Freedson PS, Gary RA, et al. Guide to the assessment of physical activity: clinical and research applications. *Circulation*. (2013) 128:2259–79. doi: 10.1161/01.cir.0000435708.67487.da

**Conflict of Interest:** The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Herbert. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Mental Health and Wellbeing in Lithuanian Medical Students and Resident Doctors During COVID-19 Pandemic

Agne Stanyte<sup>1</sup>, Aurelija Podlipskyte<sup>1</sup>, Egle Milasauskiene<sup>2</sup>, Orsolya Király<sup>3</sup>, Zsolt Demetrovics<sup>3,4</sup>, Laurynas Ambrasas<sup>2</sup>, Julius Burkauskas<sup>1\*</sup> and Vesta Steibliene<sup>1,2</sup>

<sup>1</sup> Laboratory of Behavioral Medicine, Neuroscience Institute, Lithuanian University of Health Sciences, Palanga, Lithuania, <sup>2</sup> Clinic of Psychiatry, Lithuanian University of Health Sciences, Kaunas, Lithuania, <sup>3</sup> Institute of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary, <sup>4</sup> Centre of Excellence in Responsible Gaming, University of Gibraltar, Gibraltar, Gibraltar

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Wenning Fu,  
Huazhong University of Science  
and Technology, China  
Hever Krüger,  
Universidad Peruana Cayetano  
Heredia, Peru

### \*Correspondence:

Julius Burkauskas  
julius.burkauskas@ismuni.lt

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

**Received:** 07 February 2022

**Accepted:** 29 March 2022

**Published:** 27 April 2022

### Citation:

Stanyte A, Podlipskyte A,  
Milasauskiene E, Király O,  
Demetrovics Z, Ambrasas L,  
Burkauskas J and Steibliene V (2022)  
Mental Health and Wellbeing  
in Lithuanian Medical Students  
and Resident Doctors During  
COVID-19 Pandemic.  
Front. Psychiatry 13:871137.  
doi: 10.3389/fpsyt.2022.871137

**Background:** The coronavirus disease 2019 (COVID-19) pandemic has had a negative effect on mental health and subjective psychological wellbeing. One of the most affected population is medical students, reporting higher levels of depression, anxiety, sleep difficulties, and overall poorer wellbeing. However, the relationship between depression, anxiety, and sleep difficulties, and subjective psychological wellbeing has not been extensively researched in medical students in the context of COVID-19 pandemic. The aim of this study was to investigate the associations between depression, anxiety, and sleep quality, and subjective psychological wellbeing.

**Methods:** In total, 524 medical students and resident doctors (78.6% female, mean age  $24 \pm 3$  years old) participated in an online survey between December 2020 and February 2021. Participants completed the WHO—Five Wellbeing Index Questionnaire, the Pittsburgh Sleep Quality Index questionnaire, the Patient Health Questionnaire-9, and the Generalized Anxiety Disorder Assessment-7.

**Results:** Multivariable logistic regression analysis showed that female participants' worse subjective psychological wellbeing was associated with sleep difficulties [odds ratio (OR) = 2.39, 95% CI = 1.37–4.18,  $p = 0.002$ ], higher depression (OR = 6.13, 95% CI = 3.46–10.88,  $p < 0.001$ ), and anxiety symptoms (OR = 2.95, 95% CI = 1.66–5.22,  $p < 0.001$ ). In male participants, analysis revealed an association between worse subjective psychological wellbeing and higher depression scores (OR = 9.94, 95% CI = 3.29–30.03,  $p < 0.001$ ).

**Conclusion:** Sex differences are an important factor to consider when evaluating subjective psychological wellbeing. Clinicians should be aware of significant contributors, such as sleep patterns anxiety, and depression, to subjective psychological wellbeing.

**Keywords:** sleep, anxiety, depression, wellbeing, COVID-19, medical students, resident doctors

## INTRODUCTION

It is known that external life circumstances can have an impact on a persons' subjective wellbeing (1, 2). The coronavirus disease 2019 [COVID-19; (3)] pandemic and restrictions, implemented to stop the spread of the virus, have caused a lot of disruption in today's world. The COVID-19 pandemic can be described as a traumatic event, as one study in China found that the post-traumatic stress symptoms in the hardest-hit areas reached 7% (4). Individuals' mental health and subjective psychological wellbeing may be jeopardized under such circumstances.

Early evidence suggests that the pandemic has had a negative and substantial effect on mental wellbeing. Research reports that subjective wellbeing is decreasing during the COVID-19 pandemic (5–9). Subjective psychological wellbeing is strongly linked to depression and anxiety symptoms (10) as well as sleep problems, such as insomnia (11), all of which have also been on the rise since the start of the COVID-19 pandemic (11–14).

When it comes to mental health and wellbeing, a significant amount of research has found differences between genders. In general, men are known to report higher levels of wellbeing compared with women (15). Across various different studies, women are more likely to have mental health problems compared with men (16–18), such as depressive symptoms, suicidal ideation, sleeping problems, and fatigue (18). Many risk factors for mental disorders, such as low educational level, low social support, inadequate income, and lack of physical, sexual, and psychological safety and security are more prominent in women compared with men (18, 19). Sex and gender differences can emanate from biomedical, psychosocial, or epidemiological reasons (19) and can impact the development of mental health disorders.

Differences in mental health and wellbeing have only escalated since the start of the pandemic. In a study conducted in the United Kingdom, women reported higher levels of depression, anxiety, insomnia, and had lower scores of wellbeing compared with men (20). Similar results were found in the United States (21), Poland (5), China (9), and Denmark (10). Overall, women have been found to be at a higher risk for psychological distress during the COVID-19 pandemic compared with men (22).

Nonetheless, men have also reported disturbances in their mental health, with depression symptoms being the most prevalent. A cross-sectional study of German students found major depressive syndromes were present for 36.8% of men, while anxiety syndromes were present for only 12% of men (23).

One of the most affected and vulnerable populations globally is medical students and resident doctors (24). Overall, medical students are known to have higher rates of depression, suicidal ideation, and are also less likely to seek help (25). The COVID-19 pandemic has only highlighted the problems in this population, with high levels of depression, anxiety (26–30), sleep problems, and decreased appetite (31). An Australian study found that the deterioration in mental wellbeing since the COVID-19 pandemic was reported by 68% of medical students (32). Another study reported that one in three students and medical residents showed symptoms of depression and anxiety, and almost 35% of students suffered from poor sleep quality (33). Such mental

health problems can lead to burnout, which in the COVID-19 pandemic have become more prevalent in both medical students and resident doctors (34, 35). Most medical students perceive that the COVID-19 pandemic had a negative impact on their medical training, with pre-clinical medical students reporting the most difficulties in their academic and social life (36–39). The prevalence of stress, anxiety, and depression in medical students is significantly higher than in medical staff and community populations (40), making this population more vulnerable to the psychological effects of the COVID-19 pandemic to their psychological wellbeing.

However, the relationship between depression, anxiety, and sleep problems and subjective psychological wellbeing has not been researched in medical students and resident doctors in the context of the COVID-19 pandemic. In this study, we aimed to investigate the associations between depression, anxiety, and sleep quality and subjective psychological wellbeing. In the light of reviewed literature, we hypothesize that there will be significant sex differences in subjective wellbeing: anxiety and depression will be more important in the relationship among women, while the most important determinant for wellbeing in men will be depression.

## MATERIALS AND METHODS

### Study Procedure

A cross-sectional study design was used to conduct the study within the Lithuanian University of Health Sciences (LUHS) during the COVID-19 pandemic period between December 2020 and February 2021. Participants—medical students and resident doctors—were invited to participate in the study *via* the official university mailing system and appropriate social media groups. They had to fill in an online survey available through Google Forms. To participate in the study, participants had to be older than or equal to 18 years old and provide online informed consent by ticking the appropriate answer “agree/disagree.” They received no incentives for participating in the study.

The study protocol was approved by the Bioethics committee of the LUHS (No. BEC-LSMU [R]-18) and the study was executed in accordance with the Declaration of Helsinki principles. More detailed description of study design and questionnaires used can be found in our initial study (41).

### Measures

The survey consisted of scales measuring general wellbeing (the WHO-Five Wellbeing Index (WHO-5) and Cronbach's  $\alpha$  was 0.88) (42, 43), sleeping patterns (Pittsburg sleep quality index (PSQI) and Cronbach's  $\alpha$  was 0.71) (44, 45), depression symptoms (Patient Health Questionnaire (PHQ-9) and Cronbach's  $\alpha$  was 0.84) (46), and anxiety symptoms (Generalized Anxiety Disorder Assessment (GAD-7) and Cronbach's  $\alpha$  was 0.91) (47, 48). Questions about socio-demographic characteristics, such as participants' sex, age, living conditions, family situation, physical activity, academic achievements, and participation in academic classes were developed by the researchers.

## Statistical Analysis

Statistical analyses were performed with the Statistical Package for Science Software v.27 (SPSS, Chicago, IL). The comparisons between the socio-demographic characteristics and subjective psychological assessments between male and female study participants were completed using the two-tailed Student's *t*-test and Fisher's  $\chi^2$ -test. Multivariable logistic regression analyses were used to assess the relationship between wellbeing, sleeping patterns, depression, and anxiety symptoms, and the outcome variable was wellbeing. Two different models were created for male and female participants, adjusted for age, types of studies, and marital state. Regarding the sample size, a 10:1 ratio of cases to variables was used (49). The level of significance was set at  $p < 0.05$ .

## RESULTS

Overall, 524 individuals participated in the study, of whom 65.6% were medical students and 34.4% were resident doctors. The mean age of participants was  $23.7 \pm 3.1$  years, and the majority of the participants were women ( $n = 412$ ). A detailed description of sample characteristics is presented in **Table 1**.

In general, 45.2% of the participants reported a WHO-5 wellbeing score of less than 50, which indicates serious impairment of subjective psychological wellbeing (42). Sleep problems were reported by 64.7% of the participants. Higher

depression symptoms were prevalent in 41.6% of the participants and anxiety symptoms in 34.2% of the participants.

Female participants were significantly younger ( $t = -3.34$ , 23.4 vs. 24.5,  $p < 0.001$ , medium effect  $d = 0.337$ ), more of them were pre-clinical medical students ( $\chi^2 = 12.68$ , 42.2 vs. 28.6%,  $p < 0.002$ , small effect  $V = 0.156$ ) and had a higher anxiety score ( $t = 2.33$ , 7.7 vs. 6.4,  $p = 0.020$ , small effect  $d = 0.255$ ) than men (**Table 1**). In addition, we noticed a tendency that women were more likely to be married or in a partnership ( $\chi^2 = 3.50$ , 59.0 vs. 49.1%,  $p = 0.061$ ), they were less likely to smoke ( $\chi^2 = 3.37$ , 19.7 vs. 27.7%  $p = 0.066$ ) and had lower wellbeing ( $t = -1.76$ , 51.1 vs. 54.6,  $p = 0.078$ ) compared with men. Due to significant differences between the sexes, further analysis was performed separately for men and women. Inter-correlation between study variables is presented in **Supplementary Tables 1, 2**.

**Table 2** shows multivariable logistic regression analyses for women and men separately. Both models were adjusted for age, types of studies, and marital state. Multivariable logistic regression analysis for women showed that worse subjective psychological wellbeing is significantly associated with sleep difficulties [odds ratio (OR) = 2.39, 95% CI = 1.37–4.18,  $p = 0.002$ ], higher depression (OR = 6.13, 95% CI = 3.46–10.88,  $p < 0.001$ ), and anxiety symptoms (OR = 2.95, 95% CI = 1.66–5.22,  $p < 0.001$ ). Multivariable logistic regression analysis for men revealed that worse subjective psychological wellbeing is significantly associated with higher depression scores (OR = 9.94, 95% CI = 3.29–30.03,  $p < 0.001$ ).

**TABLE 1 |** Socio-demographic characteristics and subjective psychological assessments in study participants.

Characteristics	All, $n = 524$	Female, $n = 412$	Male, $n = 112$	$t/\chi^2$	Cohen's $d$ /Cramer's $V$	$p$
Age, years; mean (SD)	23.7 (3.1)	23.4 (3.0)	24.5 (3.5)	−3.34	0.337	<0.001
<b>Types of studies, <math>n</math> (%)</b>				12.68	0.156	0.002
Pre-clinical medical student	206 (39.3)	174 (42.2)	32 (28.6)			
Clinical medical student	138 (26.3)	112 (27.2)	26 (23.2)			
Doctor resident	180 (34.4)	126 (30.6)	54 (48.2)			
<b>Living condition, <math>n</math> (%)</b>				0.40	0.028	0.525
Alone	174 (33.2)	134 (32.5)	40 (35.7)			
With partner/family members	350 (66.8)	278 (67.5)	72 (64.3)			
<b>Marital state, <math>n</math> (%)</b>				3.50	0.082	0.061
Single	266 (43.1)	169 (41.0)	57 (50.9)			
Married/Partnership	298 (56.9)	243 (59.0)	55 (49.1)			
<b>Smoking, <math>n</math> (%)</b>				3.37	0.080	0.066
Yes	112 (21.4)	81 (19.7)	31 (27.7)			
No	412 (78.6)	331 (80.3)	81 (72.3)			
Five wellbeing index WHO5, total score; mean (SD)	51.9 (18.9)	51.1 (18.6)	54.6 (19.7)	−1.76	0.183	0.078
WHO5 $\leq 50$ , $n$ (%)	237 (45.2)	195 (47.3)	42 (37.5)	3.44	0.081	0.064
Global PSQI index, mean (SD)	6.6 (3.0)	6.1 (3.0)	6.0 (3.1)	0.36	0.033	0.723
PSQI $\geq 5$ , $n$ (%)	339 (64.7)	271 (65.8)	68 (60.7)	0.99	0.043	0.320
PHQ-9, total score; mean (SD)	9.1 (5.7)	9.3 (5.8)	8.5 (5.6)	1.31	0.140	0.190
PHQ-9 $\geq 10$ , $n$ (%)	218 (41.6)	174 (42.2)	44 (39.3)	0.32	0.025	0.575
GAD-7, total score; mean (SD)	7.4 (5.1)	7.7 (5.2)	6.4 (5.0)	2.33	0.255	0.020
GAD-7 $\geq 9$ , $n$ (%)	179 (34.2)	149 (36.2)	30 (26.8)	3.44	0.081	0.063

SD, standard deviation; WHO5, World health Organization—five wellbeing index; PSQI, Pittsburgh sleep quality index; PHQ-9, Patient health questionnaire; GAD-7, Generalized anxiety disorder assessment.



**TABLE 2 |** Multivariable logistic regression analyses for women and men.

Predictors	$R^2$ (p)	Outcome	
		Women	Men
		WHO 5 $\leq$ 50	WHO 5 $\leq$ 50
PSQI $\geq$ 5 (1)	OR (95%CI) (p)	2.39 (1.37–4.18) (0.002)	0.94 (0.32–2.75) (0.910)
PHQ-9 $\geq$ 10 (1)	OR (95%CI) (p)	6.13 (3.46–10.88) (< 0.001)	9.94 (3.29–30.03) (<0.001)
GAD-7 $\geq$ 9 (1)	OR (95%CI) (p)	2.95 (1.66–5.22) (< 0.001)	1.27 (0.37–4.30) (0.609)
	Cohen's $f^2$	0.499	0.331

Multivariable: adjusted for age, types of studies, and marital state. WHO5, World Health Organization—five well-being index; PSQI, Pittsburgh sleep quality index; PHQ-9, Patient Health Questionnaire for depression symptom severity; and GAD-7, Generalized anxiety disorder assessment for anxiety symptom severity.

## DISCUSSION

Our study aimed to investigate the associations between depression, and anxiety, sleep quality and subjective psychological wellbeing. Our study revealed different associations of mental distress, such as anxiety and depression symptoms and subjective psychological wellbeing among men and women. In women, wellbeing was associated with sleep difficulties, depression, and anxiety symptoms. In comparison, in men, we found that wellbeing was associated only with depression. These results are in line with our hypotheses.

Comparing our results with other research, we can see some similarities between other countries. In a study conducted in Germany about students' wellbeing, the researchers found that 72.2% of the participants had a WHO-5 wellbeing score of less than 50. Of the responders, 41.6% had indications of the major depressive syndromes (measured by PHQ-9), 20%—for generalized anxiety or panic syndromes (measured by GAD-7) (23). However, the researchers reported that students of medicine were less affected compared with students from other disciplines (23). Our study sample consisted only of medical students and residents, which could help explain the differences between samples in subjective psychological wellbeing scores. It is believed that medical students and resident doctors had more opportunities for social exchange during the COVID-19 pandemic due to the nature of work in healthcare and the fact that they could not work remotely, providing more opportunities for everyday social interactions and activities.

Nevertheless, mental health is in decline during the COVID-19 pandemic. A study from Turkey before the COVID-19 pandemic investigated depression and anxiety among medical students and found that 30.6% of them reported feeling depressive symptoms (measured by Beck depression inventory II) and 20.7% of students reported feeling anxiety (measured by Beck anxiety inventory) (50). Other studies before the COVID-19 pandemic have found similar results (51). Some differences between studies could arise from different forms of screening of depression and anxiety as well as from different cultural backgrounds. However, the trend of students reporting more depression than anxiety is still prevalent in both cases as well as in the current study.

Our study showed that subjective psychological wellbeing in women was associated with sleep difficulties, depression and anxiety. It is known that women consistently report poorer wellbeing compared with men (52) and such a divide is being made more apparent in the midst of the COVID-19 pandemic. Other sex-related factors, such as the unemployment rate (53) during COVID-19 pandemic might have contributed to this burden. Furthermore, the newest data suggest that the loss of non-parental child care and involvement in homeschooling were associated with more negative employment outcomes for mothers but not for fathers (54).

In our study, women consistently reported higher levels of depression, anxiety, and sleep difficulties, all of which were important to women's overall wellbeing. This could be explained by the gender differences in mental disorders, where women are known to have a higher lifetime prevalence of mood and anxiety disorders (55). The differences can be partly explained by the potential role of the sex hormones acting as risk factors for depression (56), anxiety, stress-related, and trauma-related disorders (57).

Furthermore, we found that in men, the subjective psychological wellbeing was associated only with depression. No other research linking men's depression to their subjective psychological wellbeing could be found for comparison. Gender roles may have implications for coping styles used in stressful situations. A cross-sectional study investigating the risk factors of psychological distress during the COVID-19 pandemic found that men were more likely to experience higher psychological distress compared with women, and were more likely to use negative coping styles, for example, emotion suppression (58). Psychological distress and negative coping styles can lead to deteriorated mental health, as it has been discovered that stressful life events have a predictive role for major depressive episodes in men (59). During the COVID-19 pandemic, men feel more stressed than before the pandemic. They employ unhealthy coping mechanisms to deal with their emotions, which in turn can lead to feelings of depression. Therefore, depression can have a bigger impact on men's subjective psychological wellbeing compared with anxiety and sleep difficulties.



The study should be interpreted in the context of its design and limitations. First, the results depended on self-assessment data and cannot be generalized to a wider population, as only a small sample of medical students and resident doctors from Lithuania participated in the study. Second, the self-selected cross-sectional design prevents us from making implications with regards to causal effects between study variables. Third, the data for the study were collected during the COVID-19 pandemic period, therefore, we are unable to draw inferences on how the associations could possibly change after the pandemic is over. Last, we did not collect the COVID-19 related medical status of participants, isolation, or other variables related to the pandemic that could have had an impact on mental health and subjective psychological wellbeing.

It is known that women consistently report poorer wellbeing compared with men (52), however, not a lot of research has been dedicated to learn about sex differences. Understanding the differences and their causes could give us a more comprehensive understanding of psychological wellbeing as well as provide help in creating policies and programs designed to strengthen the wellbeing and mental health of men and women. This study highlighted the differences between associations of wellbeing, depression, anxiety, and sleep difficulties in men and women, showing that there are significant differences between the sexes and how they express subjective psychological wellbeing. Future research should concentrate on replicating these results in a wider population sample.

In conclusion, we found that in women, subjective psychological wellbeing is associated with sleep problems, depression, and anxiety. In men, subjective psychological wellbeing is associated only with depression.

## DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Institutional agreement. Requests to access these datasets should be directed to VS (vesta.steibliene@lsmuni.lt).

## REFERENCES

1. Abreu M, Oner O, Brouwer A, van Leeuwen E. Well-being effects of self-employment: a spatial inquiry. *J Bus Ventur.* (2019) 34:589–607.
2. Herrin J, Witters D, Roy B, Riley C, Liu D, Krumholz HM. Population well-being and electoral shifts. *PLoS One.* (2018) 13:e0193401. doi: 10.1371/journal.pone.0193401
3. World Health Organization. *Coronavirus Disease (COVID-19) Pandemic.* Geneva: World Health Organization (2022).
4. Liu N, Zhang F, Wei C, Jia Y, Shang Z, Sun L, et al. Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: gender differences matter. *Psychiatry Res.* (2020) 287:112921. doi: 10.1016/j.psychres.2020.112921
5. Bojanowska A, Kaczmarek LD, Koscielniak M, Urbanska B. Changes in values and well-being amidst the COVID-19 pandemic in Poland. *PLoS One.* (2021) 16:e0255491. doi: 10.1371/journal.pone.0255491

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Bioethics committee of the LUHS (No. BEC-LSMU [R]-18). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

JB and VS designed the study. EM and LA collected and analyzed the data. AP performed statistical analyses. AS drafted the first manuscript. EM, JB, LA, AP, ZD, OK, and VS edited the manuscript. All authors contributed to the manuscript and approved the final version.

## FUNDING

ZD's contribution was supported by the Hungarian National Research, Development and Innovation Office (KKP126835; K128614). OK was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences and by the ÚNKP-21-5 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund.

## ACKNOWLEDGMENTS

We thank the COST Action CA16207 “European Network for Problematic Usage of the Internet,” supported by COST (European Cooperation in Science and Technology: [www.cost.eu](http://www.cost.eu)) for the inspiration to explore this topic.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2022.871137/full#supplementary-material>

6. Gecaite-Stonciene J, Saudargiene A, Pranckeviciene A, Liaugaudaite V, Griskova-Bulanova I, Simkute D, et al. Impulsivity mediates associations between problematic internet use, anxiety, and depressive symptoms in students: a cross-sectional COVID-19 study. *Front Psychiatry.* (2021) 12:634464. doi: 10.3389/fpsy.2021.634464
7. Shibata M, Burkauskas J, Dores AR, Kobayashi K, Yoshimura S, Simonato P, et al. Exploring the relationship between mental well-being, exercise routines, and the intake of image and performance enhancing drugs during the coronavirus disease 2019 pandemic: a comparison across sport disciplines. *Front Psychol.* (2021) 12:689058. doi: 10.3389/fpsy.2021.689058
8. Lades LK, Laffan K, Daly M, Delaney L. Daily emotional well-being during the COVID-19 pandemic. *Br J Health Psychol.* (2020) 25:902–11. doi: 10.1111/bjhp.12450
9. Ahmed Z, Ahmed O, Aibao Z, Hanbin S, Siyu L, Ahmad A. Epidemic of COVID-19 in China and associated psychological problems. *Asian J Psychiatry.* (2020) 51:102092. doi: 10.1016/j.ajp.2020.102092

10. Sonderskov KM, Dinesen PT, Santini ZI, Ostergaard SD. The depressive state of Denmark during the COVID-19 pandemic. *Acta Neuropsychiatr.* (2020) 32:226–8. doi: 10.1017/neu.2020.15
11. Liu S, Yang L, Zhang C, Xiang Y, Liu Z, Hu S, et al. Online mental health services in China during the COVID-19 outbreak. *Correspondence.* (2020) 7:E17–8. doi: 10.1016/S2215-0366(20)30077-8
12. Bauerle A, Teufel M, Musche V, Weismuller B, Kohler H, Hetkamp M, et al. Increased generalized anxiety, depression and distress during the COVID-19 pandemic: a cross-sectional study in Germany. *J Public Health.* (2020) 42:672–8. doi: 10.1093/pubmed/fdaa106
13. Shah SMA, Mohammad D, Qureshi MFH, Abbas MZ, Aleem S. Prevalence, psychological responses and associated correlates of depression, anxiety and stress in a global population, during the coronavirus disease (COVID-19) pandemic. *Community Ment Health J.* (2021) 57:101–10. doi: 10.1007/s10597-020-00728-y
14. Fountoulakis KN, Apostolidou MK, Atsiova MB, Filippidou AK, Florou AK, Gousiou DS, et al. Self-reported changes in anxiety, depression and suicidality during the COVID-19 lockdown in Greece. *J Affect Disord.* (2021) 279:624–9. doi: 10.1016/j.jad.2020.10.061
15. Matud MP, Lopez-Curbelo M, Forter D. Gender and psychological well-being. *Int J Environ Res Public Health.* (2019) 16:3531. doi: 10.3390/ijerph16193531
16. Golinelli D, Bucci A, Boetto E, Maietti E, Toscano F, Fantini MP. Gender differences and multiple determinants of perceived physical and mental health in Italy. *Ann Ig.* (2021) 33:456–73.
17. Maestre-Miquel C, Lopez-de-Andres A, Ji Z, de Miguel-Diez J, Brocate A, Sanz-Rojo S, et al. Gender differences in the prevalence of mental health, psychological distress and psychotropic medication consumption in Spain: a nationwide population-based study. *Int J Environ Res Public Health.* (2021) 18:6350. doi: 10.3390/ijerph18126350
18. Otten D, Tibubos AN, Schomerus G, Brahler E, Binder H, Kruse J, et al. Similarities and differences of mental health in women and men: a systematic review of finding in three large German cohorts. *Front Public Health.* (2021) 9:553071. doi: 10.3389/fpubh.2021.553071
19. Afifi M. Gender differences in mental health. *Singapore Med J.* (2007) 48:385–91.
20. Pieh C, Budimir S, Delgadillo J, Barkham M, Fontaine JRJ, Probst T. Mental health during COVID-19 lockdown in the United Kingdom. *Psychosom Med.* (2021) 83:328–37. doi: 10.1097/PSY.0000000000000871
21. Zhang W, Walkover M, Wu YY. The challenge of COVID-19 for adult men and women in the United States: disparities of psychological distress by gender and age. *Public Health.* (2021) 198:218–22. doi: 10.1016/j.puhe.2021.07.017
22. Wang Y, Kala MP, Jafar TH. Factors associated with psychological distress during the coronavirus 2019 (COVID-19) pandemic on the predominantly general population: a systematic review and meta-analysis. *PLoS One.* (2020) 15:e0244630. doi: 10.1371/journal.pone.0244630
23. Holm-Hadulla RM, Klimov M, Juche T, Moltner A, Herpertz SC. Well-being and mental health of students during the COVID-19 pandemic. *Psychopathology.* (2021) 54:291–7. doi: 10.1159/000519366
24. Chandratte S. Medical students and COVID-19: challenges and supportive strategies. *J Med Educ Curric Dev.* (2020) 7:1–2. doi: 10.1177/2382120520935059
25. Schwenk TL, Davis L, Wimsatt LA. Depression, stigma, and suicidal ideation in medical students. *JAMA.* (2010) 304:1181–90. doi: 10.1001/jama.2010.1300
26. Pandey U, Corbett G, Mohan S, Reagu S, Kumar S, Farrell T, et al. Anxiety, depression and behavioural changes in junior doctors and medical students associated with the coronavirus pandemic : a cross-sectional survey. *J Obstet Gynaecol India.* (2021) 71:33–7. doi: 10.1007/s13224-020-01366-w
27. Aker S, Midik O. The views of medical faculty students in turkey concerning the COVID-19 pandemic. *J Community Health.* (2020) 45:684–8. doi: 10.1007/s10900-020-00841-9
28. Nakhostin-Ansari A, Sherafati A, Aghajani F, Khonji MS, Aghajani R, Shahmansouri N. Depression and anxiety among Iranian medical students during COVID-19 pandemic. *Iran J Psychiatry.* (2020) 15:228–35. doi: 10.18502/ijps.v15i3.3815
29. Cuschieri S, Agius JC. Spotlight on the shift to remote anatomical teaching during COVID-19 pandemic: a perspective and experiences from the University of Malta. *Anat Sci Educ.* (2020) 13:671–9. doi: 10.1002/ase.2020
30. Torun F, Torun SD. The psychological impact of the COVID-19 pandemic on medical students in Turkey. *Pakistan J Medical Sci.* (2020) 36:1355–9. doi: 10.12669/pjms.36.6.2985
31. Abdulghani HM, Sattar K, Ahmad T, Akram A. Association of COVID-19 pandemic with undergraduate medical students' perceived stress and coping. *Psychol Res Behav Manag.* (2020) 13:871–81. doi: 10.2147/PRBM.S276938
32. Lyons Z, Wilcox H, Leung L, Dearsley O. COVID-19 and the mental well-being of Australian medical students: impact, concerns and coping strategies used. *Australas Psychiatry.* (2020) 28:649–52. doi: 10.1177/1039856220947945
33. Saraswathi I, Saikarthik J, Senthil Kumar K, Madhan Srinivasan K, Ardhanaari M, Gunapriya R. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. *PeerJ.* (2020) 8:e10164. doi: 10.7717/peerj.10166
34. Zis P, Artemiadis A, Bargiotas P, Nteveros A, Hadjigeorgiou GM. Medical Studies during the COVID-19 pandemic: the impact of digital learning on medical students' burnout and mental health. *Int J Environ Res Public Health.* (2021) 18:349. doi: 10.3390/ijerph18010349
35. Dimitriu MCT, Pantea-Stoian A, Smaranda AC, Nica AA, Carap AC, Constantin VD, et al. Burnout syndrome in Romanian medical residents in time of the COVID-19 pandemic. *Med Hypotheses.* (2020) 144:109972. doi: 10.1016/j.mehy.2020.109972
36. TMS Collaborative. The perceived impact of the Covid-19 pandemic on medical student education and training – an international survey. *BMC Med Educ.* (2021) 21:566. doi: 10.1186/s12909-021-02983-3
37. Walters M, Phil M, Alonge T, Zeller M. Impact of COVID-19 on medical education: perspectives from students. *Acad Med.* (2022) 97:S40–8. doi: 10.1097/ACM.00000000000004525
38. Bachir B, Naji A, Tfayli A. The educational and psychological impact of the COVID-19 pandemic on medical students. *Medicine.* (2021) 100:e26646. doi: 10.1097/MD.00000000000026646
39. Caleb H, Jasmine L, Helen X, Pooja Y, Ian N, Muhammad H, et al. The negative impact of COVID-19 on medical education among medical students interested in plastic surgery: a cross-sectional survey study. *Plast Reconstr Surg Glob Open.* (2021) 9:e3535. doi: 10.1097/GOX.0000000000003535
40. Vahedian-Azimi A, Moayed MS, Rahimibashar F, Shojaei S, Ashtari S, Pourhoseingholi A. Comparison of the severity of psychological distress among four groups of an Iranian population regarding COVID-19 pandemic. *BMC Psychiatry.* (2020) 20:402. doi: 10.1186/s12888-020-02804-9
41. Milauskiene E, Burkauskas J, Podlipskyte A, Kiraly O, Demetrovics Z, Ambrasas L, et al. Compulsive internet use scale: psychometric properties and associations with sleeping patterns, mental health, and well-being in lithuanian medical students during the coronavirus disease 2019 pandemic. *Front Psychol.* (2021) 12:685137. doi: 10.3389/fpsyg.2021.685137
42. Topp CW, Østergaard SD, Søndergaard S, Bech P. The WHO-5 well-being index: a systematic review of the literature. *Psychother Psychosom.* (2015) 84:167–76. doi: 10.1159/000376585
43. World Health Organization. *Wellbeing Measures in Primary Health Care/The Depcare Project.* Stockholm: Report on a WHO Meeting (1998).
44. Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The pittsburgh sleep quality index: a new instrument for psychiatric practice and research. *Psychiatry Res.* (1989) 28:193–213. doi: 10.1016/0165-1781(89)90047-4
45. Varoneckas G. Subjektyvus miego įvertinimas pagal Pitsburgo miego kokybės indeksą. (subjective evaluation of sleep according to the pittsburgh sleep quality index). *Nervų Ir Psichikos Ligos.* (2003) 4:31–3.
46. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* (2001) 16:606–13. doi: 10.1046/j.1525-1497.2001.016009606.x
47. Spitzer RL, Kroenke K, Williams JB, Lowe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med.* (2006) 22:1092–7. doi: 10.1001/archinte.166.10.1092
48. Pranckeviciene A, Saudargiene A, Gecaite-Stonciene J, Liaugaudaite V, Griskova-Bulanova I, Simkute D, et al. Validation of the patient health questionnaire-9 and the generalized anxiety disorder-7 in Lithuanian student sample. *PLoS One.* (2022) 17:e0263027. doi: 10.1371/journal.pone.0263027

49. Agresti A. *Logistic Regression. An Introduction to Categorical Data Analysis*. 2nd ed. Hoboken: Wiley (2007). p. 99–136. doi: 10.1002/0470114754
50. Ediz B, Ozcakil A, Bilgel N. Depression and anxiety among medical students: examining scores of the beck depression and anxiety inventory and the depression anxiety and stress scale with student characteristics. *Cogent Psychol.* (2017) 4:1283829. doi: 10.1080/23311908.2017.1283829
51. Azad N, Shahid A, Abbas N, Shaheen A, Munir N. Frequency of anxiety and depression in medical students of a private medical college. *J Ayub Med Coll Abbottabad.* (2017) 29:123–7.
52. Alegria M, NeMoyer A, Falgas I, Wang Y, Alvarez K. Social determinants of mental health: where we are and where we need to go. *Curr Psychiatry Rep.* (2019) 20:95. doi: 10.1007/s11920-018-0969-9
53. Gezici A, Ozay O. *How Race and Gender Shape COVID-19 Unemployment Probability*. Amsterdam: Elsevier BV (2020). doi: 10.2139/ssrn.3675022
54. Petts RJ, Carlson DL, Pepin JR. A gendered pandemic: childcare, homeschooling, and parents' employment during COVID-19. *Gend Work Organ.* (2021) 28:515–34. doi: 10.1111/gwao.12614
55. Riecher-Rössler A. Sex and gender differences in mental disorders. *Lancet Psychiat.* (2017) 4:8–9. doi: 10.1016/S2215-0366(16)30348-0
56. Kuehner C. Why is depression more common among women than among men? *Lancet Psychiatry.* (2016) 4:146–58. doi: 10.1016/S2215-0366(16)30263-2
57. Li SH, Graham BM. Why are women so vulnerable to anxiety, trauma-related and stress-related disorders? The potential role of sex hormones. *Lancet Psychiatry.* (2016) 4:73–82. doi: 10.1016/S2215-0366(16)30358-3
58. Li N, Fan L, Wang Y, Wang J, Huang Y. Risk factors of psychological distress during the COVID-19 pandemic: the roles of coping style and emotional regulation. *J Affect Disord.* (2022) 299:326–34. doi: 10.1016/j.jad.2021.12.026
59. Assari S, Lankarani MM. Stressful life events and risk of depression 25 years later: race and gender differences. *Front Public Health.* (2016) 4:49. doi: 10.3389/fpubh.2016.00049

**Conflict of Interest:** In the past several years JB has been serving as a consultant to Cogstate, Ltd. VS reported being a consultant to SignantHealth; received personal fees from Lundbeck, Sanofi, Servier, Johnson and Johnson, KRKA, grants from the Research Council of Lithuania.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Stanyte, Podlipskyte, Milasauskiene, Király, Demetrovics, Ambrasas, Burkauskas and Steibliene. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Prospective Association Between Problematic Mobile Phone Use and Eating Disorder Symptoms and the Mediating Effect of Resilience in Chinese College Students: A 1-Year Longitudinal Study

Shaojie Li<sup>1,2</sup>, Guanghui Cui<sup>1</sup>, Yongtian Yin<sup>1\*</sup>, Kaixuan Tang<sup>1</sup>, Lei Chen<sup>1</sup> and Xinyao Liu<sup>1</sup>

<sup>1</sup> Shandong University of Traditional Chinese Medicine, Jinan, China, <sup>2</sup> Xiangya School of Public Health, Central South University, Changsha, China

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Zejun Hao,  
China Medical University, China  
Chunyu Yang,  
Nanjing University, China

### \*Correspondence:

Yongtian Yin  
yinyongtian@sducm.edu.cn

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 18 January 2022

**Accepted:** 24 March 2022

**Published:** 27 April 2022

### Citation:

Li S, Cui G, Yin Y, Tang K, Chen L and  
Liu X (2022) Prospective Association  
Between Problematic Mobile Phone  
Use and Eating Disorder Symptoms  
and the Mediating Effect of Resilience  
in Chinese College Students: A 1-Year  
Longitudinal Study.  
Front. Public Health 10:857246.  
doi: 10.3389/fpubh.2022.857246

A previous cross-sectional study found that problematic mobile phone use (PMPU) was associated with students' eating disorder symptoms. However, since the cross-sectional study cannot infer the causality and the direction of effect, the longitudinal relationship between the two and the mechanism behind this relationship are unclear. Therefore, the present study explores the prospective association between PMPU and eating disorder symptoms and related mediation mechanisms using a 1-year longitudinal study of 1,181 college students (from December 2019 [T1] to December 2020 [T2]). Survey tools used include the Mobile Phone Addiction Tendency Scale, the 10-item Connor-Davidson resilience scale, and the 12 item Short Form of the Eating Disorder Examination Questionnaire. The longitudinal relationship between PMPU and eating disorder symptoms and the mediating effect of resilience was analyzed using a cross-lagged model. The results showed that PMPU ( $\beta = 0.086$ ,  $P < 0.01$ ) and resilience ( $\beta = -0.145$ ,  $P < 0.01$ ) at T1 predicted eating disorder symptoms at T2, but not vice versa. PMPU was bidirectionally associated with resilience, and the prediction effect of PMPU at T1 to resilience at T2 ( $\beta = -0.151$ ,  $P < 0.001$ ) was higher than the prediction effect of resilience at T1 to PMPU at T2 ( $\beta = -0.134$ ,  $P < 0.001$ ). The standardized indirect effect of PMPU at T1 on eating disorder symptoms at T2 via resilience was significant ( $\beta = 0.022$ , 95% CI = 0.010~0.040,  $P < 0.001$ ). Therefore, PMPU and resilience were predictive for eating disorder symptoms in college students, and resilience may play a mediating role in the prospective association between PMPU and eating disorder symptoms. This study provides new ideas and higher-level evidence for the development of prevention and intervention measures for college students' eating disorder symptoms.

**Keywords:** problematic mobile phone use, eating disorder symptoms, resilience, mediation, college students, longitudinal study



## INTRODUCTION

Eating disorders are a class of psychiatric disorders characterized by abnormal diet or weight control behaviors, such as excessive dietary restrictions, body image disturbances (aversion to one's body shape or weight, excessive fear of gaining weight), or overeating (1). Previous studies have shown that eating disorders are associated with multiple adverse health outcomes such as type 2 diabetes (2), muscle dysmorphia (3), poor oral health (4), gastrointestinal disorders, malnutrition (5), and anxiety and depression symptoms (6). In addition, studies have found that eating disorders are associated with poor psychosocial functioning, such as alexithymia (7), increased risk of dropout (8), and illicit drug use (9). In recent years, with the increase in global overweight and obesity rates, eating disorder symptoms in non-clinical populations have received increasing attention from scholars. A meta-analysis showed the pooled lifetime and 12-month prevalence of eating disorder symptoms were 0.91% (95% CI, 0.48–1.71) and 0.43% (95% CI, 0.18–0.78), respectively (10). The prevalence of eating disorder symptoms in different age groups may be different. Previous studies have shown that eating disorder symptoms are the most common disorder in adolescence (11), and their prevalence peaks in late adolescence (12, 13), that is, early adulthood. A 14-year longitudinal study in the United States of 745 women aged 11 years old showed that the rate of their eating disorder symptoms increased year by year beginning at the age of 11 and showed significant stability after the age of 18 (14). During this subsequent period of stability, this demographic enters university, during which time they may experience high rates of eating disorder symptoms. A survey of 3,148 college students in six Asian countries showed that 11.5% of students are at risk of developing an eating disorder (15). Furthermore, research has also found that college students with eating disorder symptoms have higher suicidal tendencies (16), more depression and anxiety symptoms (17), and poorer quality of life (18). Considering these potential adverse effects and the higher risk of disease among college students, it is important to pay attention to the factors related to the occurrence of eating disorder symptoms in this group, as this is essential to designing related prevention and intervention measures to reduce their incidence.

Sociocultural models of eating disorders stated that the prevalence of body image concerns may exacerbate individual dissatisfaction or concerns about body image, lead to dietary restriction or overeating, and increase the risk of eating disorders (19). The rapid development of the Internet has widely disseminated the culture of dieting and bodybuilding (20, 21), which may create potential risks for eating disorders. Previous systematic reviews and meta-analysis studies also found that Internet use may be associated with eating disorder symptoms in college students (22, 23). Mobile phones provide the most convenient way for individuals to access the Internet anytime and anywhere (24). Due to the convenience and accessibility of mobile phones, they have become an indispensable communication tool for Chinese college students (25). Meanwhile, many problem behaviors, such as overuse and dependence, have also arisen through mobile phone use.

Currently, academics conceptualize these problem behaviors as problematic mobile phone use (PMPU), which is also known as mobile phone addiction, smartphone addiction, or smartphone dependency, and refers to the uncontrolled or excessive use of smartphones that has a negative impact on daily life (26). Problematic mobile phone use was relatively common among Chinese college students. A meta-analysis showed that the combined prevalence of PMPU among Chinese college students was 23% (27). A large number of studies has found that PMPU may be related to many health problems of college students, such as heart palpitations, nausea (28), anxiety, and depression (29). In addition, studies also found PMPU may increase body image dissatisfaction (30), and produce unhealthy eating behaviors (31). However, few studies have focused on the relationship between PMPU and eating disorder symptoms. To our knowledge, only one cross-sectional study has explored the relationship between PMPU and eating disorder symptoms in college students (24). However, we cannot determine the direction of the association between PMPU and eating disorder symptoms because cross-sectional studies are unable to infer the limitations of causality. Therefore, it is necessary to conduct longitudinal research to further explore the prospective association between the two factors.

When exploring the relationship between PMPU and eating disorder symptoms, understanding the mechanism of this association is of great significance for the prevention of eating disorders in the future. Previous studies found that resilience can mediate the relationship between PMPU and poor health status (such as depression and anger) (32, 33). However, it was unclear whether resilience is able to mediate the link between PMPU and eating disorder symptoms. Before exploring this mechanism, it is necessary to understand the association of resilience with PMPU and eating disorders. Resilience refers to an individual's ability to actively cope with and adapt to life events or adversities (34). Resilience is often considered a positive psychological resource that helps explain the psychological mechanisms underlying life events and adverse health outcomes in individuals. For example, a previous study found resilience could neutralize the association between online risk exposure and negative psychological problems (35). Meanwhile, resilience is seen as a dynamic process and is influenced by many environmental and behavioral factors (36). As an unhealthy behavior, PMPU may deplete an individual's internal psychological resources, resulting in the individual's maladaptation to stress and difficulties. Studies have found that resilience is significantly negatively correlated with PMPU (37, 38). This suggests that PMPU may be an important predictor of resilience, but there is a lack of evidence from longitudinal studies. In addition, resilience plays an important role in the development of eating disorders. Early research has examined the role of resilience during the eating disorder recovery process (39). A previous longitudinal study of patients diagnosed with eating disorder symptoms found that resilience predicts that eating disorder symptoms will decrease over time (40). However, the studies discussed above were conducted in patients with diagnosed eating disorder symptoms, and it is not clear whether resilience can predict eating disorder symptoms in the

non-clinical population. Obviously, exploring the relationship between resilience and eating disorder symptoms in non-clinical populations has important public health significance for early prevention and intervention. According to the test principle of the mediating effect, the mediating effect is established when both the independent variable and the mediating variable can predict the dependent variable and the independent variable can predict the mediating variable (41). Based on the above literature, it can be found that PMPU, resilience, and eating disorders are all pairwise correlated. Therefore, this study hypothesized that resilience may mediate the association between PMPU and eating disorder symptoms among college students.

In summary, the objectives of this study are as follows: (1) to explore the longitudinal association between PMPU, resilience, and eating disorder symptoms; and (2) to examine the mediating effect of resilience in the association between PMPU and eating disorder symptoms among college students.

## MATERIALS AND METHODS

### Participants

We conducted a 1-year longitudinal study at a comprehensive university in Shandong Province, China. Before the study, we estimated the required sample size using the formula for epidemiological estimation of continuous outcomes:  $n = n = \frac{2(Z_{1-\alpha/2} + Z_{1-\beta})^2}{\delta^2}$  (42). In this study, we set the effect size ( $\delta$ ) for eating disorder symptoms at 0.20, the  $\alpha$  at 0.05, and the power ( $1 - \beta$ ) at 80%. Based on the parameters assumed above,  $Z_{1-\alpha/2}$  was 1.96,  $Z_{1-\beta}$  was 0.84, and the calculated minimum sample size was 392. The stratified cluster sampling method was used to select 10 classes from freshman, sophomore, and junior levels, respectively, all of whom were 18 years of age or older. College students with clinically diagnosed diseases were excluded from the investigation. In December 2019 (T1), 1,235 participants completed the first survey. After 12 months (T2), 54 participants were not in school (due to leave and other reasons) and did not participate in the follow-up survey. In the end, 1,181 participants (599 women; age: mean = 18.91 years, SD = 0.85) participated in the two surveys (retention rate of 95.6%). Each survey takes ~30 min to complete, and each participant completed all survey content independently. This study was approved by the Medical Ethics Committee of the Second Affiliated Hospital of Shandong University of Traditional Chinese Medicine. All participants signed an informed consent document (on paper) before completing the survey.

### Measurements

#### PMPU (Both Waves)

PMPU was assessed using the Mobile Phone Addiction Tendency Scale (MPATS) (43), which is widely used in China (44). Participants rated the 16 items on a five-point Likert scale (from 1 “very inconsistent” to 5 “very consistent”). The total score, ranging from 16 to 80, is calculated by adding the scores of the 16 items. The higher the total score, the more serious the individual's PMPU. The Cronbach's alpha of this scale was 0.906 at T1 and 0.937 at T2.

#### Resilience (Both Waves)

The 10-item Connor-Davidson resilience scale (CD-RISC-10) (45) was used to measure the individuals' resilience. The scale has a total of 10 items and is scored using a four-point Likert scale (from 0 “never” to 4 “almost always”). The total score is obtained by adding the 10 items. A higher score indicates that the individual is more resilient. In this study, we used a validated Chinese version of the scale (46). The Cronbach's alpha of this scale was 0.925 at T1 and 0.947 at T2.

#### Eating Disorder Symptoms (Both Waves)

The 12 item Short Form of the Eating Disorder Examination Questionnaire was used to measure the individuals' eating disorder symptom severity (47). The scale has a single factor structure, with 12 items in total. Each item is scored using a four-point scale (from 0 “0 days” to 3 “6–7 days”). A higher total score indicates that the individuals' eating disorder symptoms are more severe. In this study, we used a validated Chinese version of the scale (48). The Cronbach's alpha of this scale was 0.809 at T1 and 0.903 at T2.

#### Sociodemographic Variable

At T1, a self-designed sociodemographic information questionnaire was used to collect participants' age, sex, residence (urban or rural), self-reported height and weight [used to calculate body mass index (BMI)], self-rated health status (good, medium, or poor), and self-rated family economic level (high, medium, or low). Self-reported height and weight were again collected at T2.

### Statistical Methods

Data was analyzed using SPSS version 25.0 (IBM Corporation, Armonk NY, USA) and Amos version 23.0. Continuous variables, such as age and PMPU, were described by mean  $\pm$  standard deviation (SD), while categorical variables, such as sex and residence, were described by  $n$  (%). Since all measurements were self-reported, we used Harman's single-factor test (49) to assess the presence of common method bias. According to the test criteria, when the variance explained by the first common factor is less than 50%, it means there is no serious common method bias (50). Spearman correlation analysis was used to investigate the relationship between PMPU, resilience, and eating disorder symptoms. The structural equation model with maximum likelihood estimation approach was used to construct a cross-lagged model to investigate the longitudinal relationship between PMPU, resilience, and eating disorder symptoms based on the control of sex, age, residence, BMI, self-rated health status, and self-rated family economic level at T1. Chi-square/degree of freedom, the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root-mean-square error of approximation (RMSEA), and the standard root-mean-square (SRMR) were used to evaluate the model fit. When the chi-square/degree of freedom is  $<5$ , CFI and TLI are  $>0.90$ , and RMSEA and SRMR are  $<0.08$ , then the model fit is acceptable (51). According to Cole and Maxwell's recommendation regarding two waves of longitudinal studies (52), we calculated the product of the regression coefficient from T1 PMPU to T2 resilience and the

regression coefficient from T1 resilience to T2 eating disorder symptoms, and we used the bootstrap method for the significance test. When the 95% confidence interval (CI) does not contain 0, then the mediating effect of resilience is statistically significant.

## RESULTS

### Descriptive Statistics

The data on the characteristics of sociodemographic variables, PMPU, resilience, and eating disorder symptoms are shown in Table 1.

### Common Method Bias Test

The results showed that the characteristic values of a total of 14 factors were  $>1$ , and that the first common factor explained 23.5% of the total variation, which is  $<50\%$ . This indicates there was no serious common method bias in this study.

### Correlation Analyses

Table 2 shows the correlations for BMI, PMPU, resilience, and eating disorder symptoms at two time points. The results show significant positive correlations between BMI, PMPU, resilience, and eating disorder symptoms of both T1 and T2, suggesting that the four factors have shown stability across time within a year. In addition, resilience at T1 and T2 was significantly negatively correlated with PMPU and eating disorder symptoms,

and PMPU was significantly positively correlated with eating disorder symptoms at two time points, indicating there was a certain synchronous correlation between the three factors at different time points. Moreover, BMI was positively associated with eating disorder symptoms at two time points.

### Cross-Lagged Model and Mediation Analyses

The results showed that the cross-lagged model has a fit index ( $\chi^2/df = 3.036$ , CFI = 0.989, TLI = 0.943, RMSEA = 0.042, SRMR = 0.024). The cross-lagged model showed that PMPU ( $\beta = 0.086$ ,  $P < 0.01$ ) and resilience ( $\beta = -0.145$ ,  $P < 0.01$ ) at T1 predicted eating disorder symptoms at T2, but not vice versa. PMPU was bidirectionally associated with resilience, and the prediction effect of PMPU at T1 to resilience at T2 ( $\beta = -0.151$ ,  $P < 0.001$ ) was higher than the prediction effect of resilience at T1 to PMPU at T2 ( $\beta = -0.134$ ,  $P < 0.001$ ). More details are displayed in Figure 1; Table 3.

In addition, the standardized indirect effect of PMPU at T1 on eating disorder symptoms at T2 *via* resilience was significant ( $\beta = 0.022$ , 95% CI = 0.010~0.040,  $P < 0.001$ ); that is, resilience mediated the relationship between PMPU and eating disorder symptoms.

## DISCUSSION

Our study clarifies the prospective association between PMPU, resilience, and eating disorder symptoms in college students using a 1-year follow-up survey. Our results show that early PMPU and resilience predict follow-up eating disorder symptoms, and PMPU can indirectly affect eating disorder symptoms through resilience. These findings provide scientific evidence for the early prevention of and intervention against eating disorder symptoms.

This study found that PMPU at T1 predicted eating disorder symptoms at T2, but not vice versa. Although previous cross-sectional studies have found that PMPU is associated with eating disorder symptoms (24), it is impossible to determine whether PMPU causes eating disorder symptoms or eating disorder symptoms cause PMPU. Our findings further clarified that PMPU is an antecedent variable for eating disorder symptoms, rather than the reverse. One possible reason to explain this result is that individuals with PMPU are more susceptible to sociocultural influences. At present, Chinese college students' smartphones were mainly used for accessing web pages, socializing, and taking selfies (53). Previous studies found that news about beauty and slimness prevalent on the web may cause frequent users to be dissatisfied with their body image and appearance (54, 55). In addition, studies also found that adolescents who frequently take selfies and post selfies on social media are more likely to develop eating disorder symptoms, as social media depictions and dissemination of the idealized female body can exacerbate habitual monitoring of physical appearance and body anxiety (56, 57). The above literature provides indirect support for the results of this study; that is, PMPU may lead individuals to pay more attention to body

**TABLE 1** | Descriptive statistic for all variables ( $N = 1,181$ ).

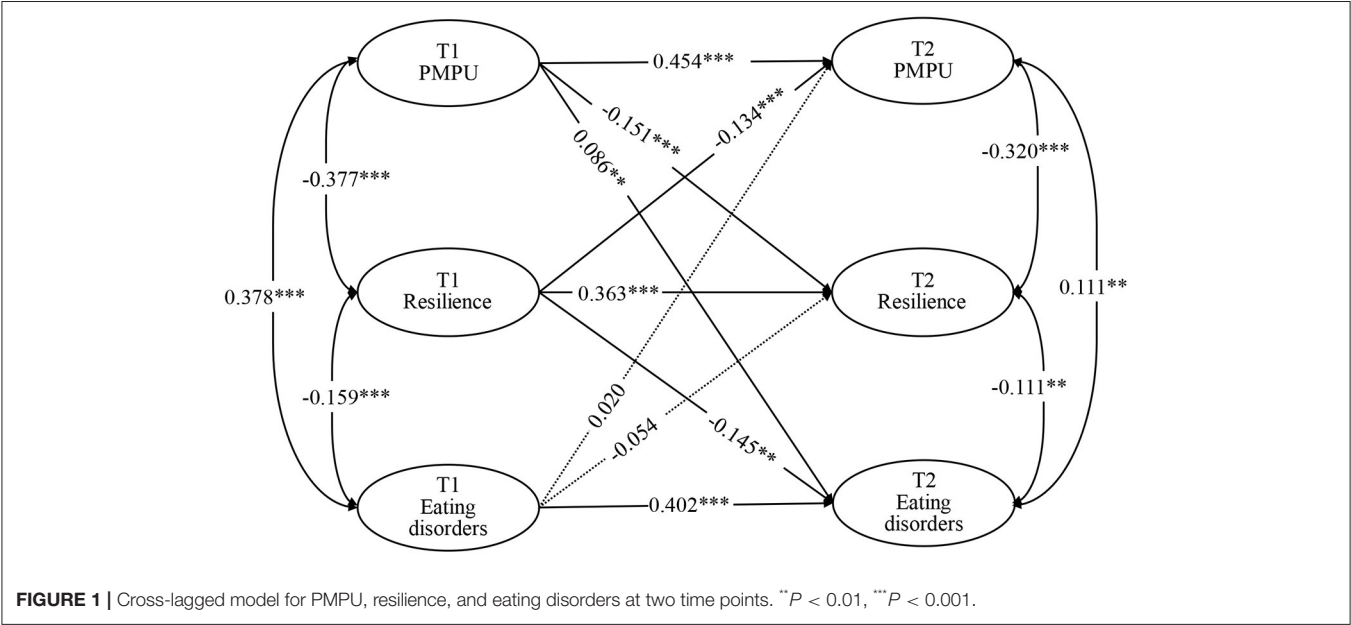
Variables	$n(\%)/M \pm SD$	Range
Age	18.91 $\pm$ 0.85	18-22
<b>Sex</b>		
Male	582 (49.3)	
Female	599 (50.7)	
<b>Residence</b>		
Urban	518 (43.9)	
Rural	663 (56.1)	
<b>Self-rated health status</b>		
Good	580 (49.1)	
Medium	418 (35.4)	
Poor	183 (15.5)	
<b>Self-rated family economic level</b>		
High	190 (16.1)	
Medium	827 (70.0)	
Low	164 (13.9)	
BMI-T1	20.81 $\pm$ 2.70	14.20-32.39
BMI-T2	20.98 $\pm$ 3.11	14.35-35.56
PMPU-T1	39.20 $\pm$ 12.27	16.00-80.00
Resilience-T1	26.74 $\pm$ 6.92	0.00-40.00
Eating disorders-T1	6.49 $\pm$ 4.95	0.00-26.00
PMPU-T2	37.08 $\pm$ 13.62	16.00-77.00
Resilience-T2	27.36 $\pm$ 7.61	0.00-40.00
Eating disorders-T2	6.39 $\pm$ 6.80	0.00-30.00

*M*, mean; *SD*, standard deviation.

**TABLE 2 |** Spearman correlations analyses for BMI, PMPU, resilience, and eating disorders at two time points.

Variables	1	2	3	4	5	6	7	8
1.BMI-T1	1.000							
2.BMI-T2	0.624**	1.000						
3.PMPU-T1	0.002	0.011	1.000					
4.PMPU-T2	0.037	0.040	0.527**	1.000				
5.Resilience-T1	−0.045	−0.017	−0.407**	−0.347**	1.000			
6.Resilience-T2	−0.012	−0.009	−0.319**	−0.480**	0.484**	1.000		
7.Eating disorders-T1	0.280**	0.207**	0.360**	0.240**	−0.197**	−0.190**	1.000	
8.Eating disorders-T2	0.237**	0.269**	0.276**	0.325**	−0.257**	−0.342**	0.456**	1.000

\*\**P* < 0.01.



**TABLE 3 |** Bootstrapped estimation of each path of the reciprocal cross-lagged model.

Path	Effect	SE	LLCI	ULCI	<i>P</i> -value
PMPU-T1 to PMPU-T2	0.454	0.031	0.391	0.512	<0.001
Resilience-T1 to resilience-T2	0.363	0.031	0.302	0.422	<0.001
Eating disorder symptoms-T1 to eating disorder symptoms-T2	0.402	0.030	0.344	0.459	<0.001
PMPU-T1 to resilience-T2	−0.151	0.027	−0.204	−0.098	<0.001
PMPU-T1 to eating disorder symptoms -T2	0.086	0.031	0.024	0.147	0.008
Resilience-T1 to PMPU-T2	−0.134	0.028	−0.187	−0.078	<0.001
Resilience T1 to eating disorder symptoms-T2	−0.145	0.041	−0.229	−0.066	0.001
Eating disorder symptoms-T1 to PMPU-T2	0.020	0.028	−0.035	0.075	0.462
Eating disorder symptoms-T1 to resilience-T2	−0.054	0.030	−0.114	0.003	0.059

LLCI, lower limit confidence interval 95%; ULCI, upper limit confidence interval 95%.

image, thereby causing them to reduce their food intake or deliberately stop eating, resulting in eating disorder symptoms. Moreover, the displacement effect assumption holds that the more time individuals watch TV, the less time and energy they spend on other activities (58), and this also applies to smartphones. This means that because individuals with PMPU use their smartphones for too long, they may reduce their eating time and choose to eat fast food or not eat at all, which increases their risk of developing eating disorder symptoms. In addition, individuals with PMPU are prone to sedentary behavior (59), which increases the likelihood of becoming overweight or obese (60) to a certain extent. Previous studies have found that



individuals with a higher BMI are vulnerable to discrimination, which can cause dissatisfaction with weight and induce eating disorder symptoms (61). Furthermore, research has also found that exposure to screen media can cause children and adolescents to increase their food intake while watching (62), and similar phenomena may also occur during smartphone use. Given the limited literature on the association of PMPU with eating disorders, our further interpretation of the association is also limited. It is necessary to conduct further observational studies in more countries and regions in the future to better understand the relationship between the two factors.

The results of the cross-lagged model show that resilience at T1 negatively predicted eating disorder symptoms at T2; that is, the higher one's resilience, the lower the risk of developing an eating disorder. However, the association between eating disorder symptoms at T1 and resilience at T2 was not significant. This result infers resilience from the patients with eating disorder symptoms to the college student population, extending the findings of previous studies. Many studies have confirmed the positive effect of resilience on individual health status (63, 64). For example, resilience is significantly positively correlated with the quality of life of adolescents (65) and negatively correlated with negative emotions, such as depression (66) and anxiety (67). In terms of eating-related aspects, research has also found that the higher the resilience of college students, the fewer the symptoms of food addiction and eating disorders they exhibit (68, 69). These studies further support that resilience has a positive effect on the reduction of the rate of eating disorder symptoms. In addition, the resilience framework proposed by Kumpfer (70) explains that resilience can help individuals actively cope with and adapt to the impact of negative factors after encountering negative life experiences. The epigenetic model of the etiology of eating disorder symptoms indicates that life stress is an important cause of eating disorder symptoms (71). Obviously, high resilience can help individuals actively adapt to stressful events, which helps reduce the incidence of bad eating behaviors. Meanwhile, individuals with lower resilience may respond negatively to stress and traumatic events, and may adopt disordered eating, overeating, and other poor eating behaviors to relieve stress, which greatly increases the risk of developing an eating disorder.

Another important finding of this study is that resilience can mediate the association between PMPU and eating disorder symptoms. This result deepens our understanding of the underlying mechanisms of PMPU and eating disorder symptoms. Previous studies have also identified a potential mediating effect of resilience in the development of eating disorder symptoms; that is resilience could mediate the relationship between posttraumatic stress disorder symptoms and disordered eating in college women (69). In this study, the mediation mechanism can be divided into two stages: (1) PMPU-reduced resilience, and (2) lower resilience-induced eating disorder symptoms. The latter has already been explained above. For the former, some studies have focused on the relationship between PMPU and resilience (72), but as we mentioned earlier, there is also a lack of evidence from longitudinal studies. Our research indicates that PMPU and resilience are bidirectionally related, and early PMPU has a greater predictive effect on follow-up resilience. Considering

that the prediction effect of PMPU at T1 to resilience at T2 was higher than the prediction effect of resilience at T1 to PMPU at T2, it can also be said that PMPU is an antecedent variable of resilience. Research has shown that resilience is an important internal resource formed in the development process of young people, and such resources can promote and protect healthy growth (73). However, research has also found that PMPU can reduce self-control (74), thereby consuming individual internal resources and reducing resilience. The possible explanation for the mediating effect of resilience is that PMPU may increase individual body image stress, consumes positive psychological resources, and reduces resilience to cope with stress, while low resilience makes individuals more likely to adopt poor eating behaviors, resulting in eating disorder symptoms. Therefore, if college students with PMPU can accept early psychological intervention programs to improve their resilience, such programs may, to a certain extent, be able to reduce their likelihood of developing eating disorder symptoms caused by PMPU.

According to our research, it may be a good idea to develop prevention and intervention programs related to PMPU and eating disorder symptoms in college students from the perspective of resilience. Previous randomized controlled trials conducted among American college students have found that interventions related to resilience significantly improved participants' mental health (75). A meta-analysis also showed that school-based resilience interventions can effectively reduce illicit substance use in adolescents (76). These studies suggest that interventions related to resilience may also have a positive impact on PMPU and eating disorder symptoms, but as far as we know, no relevant intervention studies currently exist. However, a meta-analysis also found that existing resilience intervention research has problems, such as the small intervention effect, small sample sizes, and poor compliance, and has made relevant recommendations for the development of high-quality intervention research (77). Therefore, we suggest that future research should learn from the problems and suggestions of previous studies, conduct resilience intervention studies on PMPU and eating disorder symptoms in college students, properly deal with all possible biases, and further understand whether resilience intervention can help reduce PMPU and eating disorder symptoms to provide a higher level of evidence for future prevention and intervention measures.

This study has the following advantages. First, as far as we know, this is the first study to investigate the longitudinal association between PMPU, resilience, and eating disorder symptoms, which provides a higher level of research evidence for understanding the direction of the association between the three. Second, we explored the mechanism of association between PMPU and eating disorder symptoms for the first time and found that resilience played a mediating role between the two, which provided a new direction for the prevention of eating disorder symptoms in college students. Third, all surveys were conducted using scales that have been tested by psychometrics, and the quality of the data is credible and reliable.

This study has the following limitations. First, we only conducted two waves of investigations. Although previous studies have suggested that two waves of research can also be

used to test the mediation effect (78), since there is no continuous time relationship between PMPU, resilience, and eating disorder symptoms in the two waves of the present study, the mediating effect of resilience has a certain limitation. In the future, three waves of longitudinal study will be needed to test whether the mediating role of resilience can be replicated. Second, due to the short 1-year follow-up period, it remains unclear whether the longitudinal relationship of the three factors in this study will change over time. Long-term follow-up research is needed to further determine the direction of associations among these factors. Third, the two surveys were conducted in the form of self-reports, and the results may be subject to recall and information bias. Finally, this study only selected college students from one university as the research object, which may introduce selection bias. In the future, a multi-center research design will be needed to verify whether the results of this study are applicable to college students in other regions of China.

## CONCLUSIONS

This study found that PMPU and resilience are predictive for eating disorder symptoms in college students. Resilience may play a mediating role in the prospective association between PMPU and eating disorder symptoms.

## DATA AVAILABILITY STATEMENT

The datasets can be made available to any interested person(s) contacting the corresponding author via email.

## REFERENCES

- Treasure J, Duarte TA, Schmidt U. Eating disorders. *Lancet*. (2020) 395:899–911. doi: 10.1016/S0140-6736(20)30059-3
- Nieto-Martínez R, González-Rivas JP, Medina-Inojosa JR, Florez H. Are eating disorders risk factors for type 2 diabetes? A systematic review and meta-analysis. *Curr Diab Rep*. (2017) 17:138. doi: 10.1007/s11892-017-0949-1
- Badenes-Ribera L, Rubio-Aparicio M, Sánchez-Meca J, Fabris MA, Longobardi C. The association between muscle dysmorphia and eating disorder symptomatology: A systematic review and meta-analysis. *J Behav Addict*. (2019) 8:351–71. doi: 10.1556/2006.8.2019.44
- Kisely S, Baghaie H, Lalloo R, Johnson NW. Association between poor oral health and eating disorders: systematic review and meta-analysis. *Br J Psychiatry*. (2015) 207:299–305. doi: 10.1192/bjp.bp.114.156323
- Gibson D, Watters A, Mehler PS. The intersect of gastrointestinal symptoms and malnutrition associated with anorexia nervosa and avoidant/restrictive food intake disorder: functional or pathophysiologic?—a systematic review. *Int J Eat Disord*. (2021) 54:1019–54. doi: 10.1002/eat.23553
- Lin JA, Jhe G, Vitagliano JA, Milliren CE, Spigel R, Woods ER, et al. The Association of Malnutrition, illness duration, and pre-morbid weight status with anxiety and depression symptoms in adolescents and young adults with restrictive eating disorders: a cross-sectional study. *J Eat Disord*. (2021) 9:60. doi: 10.1186/s40337-021-00415-7
- Westwood H, Kerr-Gaffney J, Stahl D, Tchanturia K. Alexithymia in eating disorders: systematic review and meta-analyses of studies using the Toronto Alexithymia Scale. *J Psychosom Res*. (2017) 99:66–81. doi: 10.1016/j.jpsychores.2017.06.007
- Agüera Z, Sánchez I, Granero R, Risco N, Steward T, Martín-Romera V, et al. Short-term treatment outcomes and dropout risk in men and women with eating disorders. *Eur Eat Disord Rev*. (2017) 25:293–301. doi: 10.1002/erv.2519

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Medical Ethics Committee of the Second Affiliated Hospital of Shandong University of Traditional Chinese Medicine. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

SL participated in questionnaire design, data collection and statistical analysis, and wrote the first draft of the manuscript. GC conducted data collection and gave comments on the draft. YY revised the first draft. KT, LC, and XL participated in data collection. All authors approved submission of the final manuscript.

## FUNDING

This study was supported by the Social Science Funding of Shandong Province (21CJYJ29). The source of funding had no role in study design, data collection, analysis, interpretation, or manuscript writing.

## ACKNOWLEDGMENTS

The authors thank all the participants and investigators for their efforts.

- Ganson KT, Murray SB, Nagata JM. Associations between eating disorders and illicit drug use among college students. *Int J Eat Disord*. (2021) 54:1127–34. doi: 10.1002/eat.23493
- Qian J, Wu Y, Liu F, Zhu Y, Jin H, Zhang H, et al. An update on the prevalence of eating disorders in the general population: a systematic review and meta-analysis. *Eat Weight Disord*. (2021) 27:415–28. doi: 10.1007/s40519-021-01162-z
- Herpertz-Dahlmann B. Adolescent eating disorders: update on definitions, symptomatology, epidemiology, and comorbidity. *Child Adolesc Psychiatr Clin North Am*. (2015) 24:177–96. doi: 10.1016/j.chc.2014.08.003
- Sim LA, McAlpine DE, Grothe KB, Himes SM, Cockerill RG, Clark MM. Identification and treatment of eating disorders in the primary care setting. *Mayo Clin Proc*. (2010) 85:746–51. doi: 10.4065/mcp.2010.0070
- Weaver L, Liebman R. Assessment of anorexia nervosa in children and adolescents. *Curr Psychiatry Rep*. (2011) 13:93–8. doi: 10.1007/s11920-010-0174-y
- Slane JD, Klump KL, McGue M, Iacono WG. Developmental trajectories of disordered eating from early adolescence to young adulthood: a longitudinal study. *Int J Eat Disord*. (2014) 47:793–801. doi: 10.1002/eat.22329
- Pengpid S, Peltzer K. Risk of disordered eating attitudes and its relation to mental health among university students in ASEAN. *Eat Weight Disord*. (2018) 23:349–55. doi: 10.1007/s40519-018-0507-0
- Lipson SK, Sonnevile KR. Understanding suicide risk and eating disorders in college student populations: Results from a National Study. *Int J Eat Disord*. (2020) 53:229–38. doi: 10.1002/eat.23188
- Goel NJ, Sadeh-Sharvit S, Trockel M, Flatt RE, Fitzsimmons-Craft EE, Balantekin KN, et al. Depression and anxiety mediate the relationship between insomnia and eating disorders in college women. *J Am Coll Health*. (2020) 69:1–6. doi: 10.1080/07448481.2019.1710152

18. Trojanowski PJ, Fischer S. The role of depression, eating disorder symptoms, and exercise in young adults' quality of life. *Eat Behav.* (2018) 31:68–73. doi: 10.1016/j.eatbeh.2018.08.005
19. Striegel-Moore RH, Bulik CM. Risk factors for eating disorders. *Am Psychol.* (2007) 62:181. doi: 10.1037/0003-066X.62.3.181
20. Stinson KM, Stinson K. *Women and Dieting Culture: Inside a Commercial Weight Loss Group*. New Jersey, NJ: Rutgers University Press (2001).
21. Law C, Labre MP. Cultural standards of attractiveness: a thirty-year look at changes in male images in magazines. *J Mass Commun Quarter.* (2002) 79:697–711. doi: 10.1177/107769900207900310
22. Hinojo-Lucena FJ, Aznar-Díaz I, Cáceres-Reche MP, Trujillo-Torres JM, Romero-Rodríguez JM. Problematic internet use as a predictor of eating disorders in students: a systematic review and meta-analysis study. *Nutrients.* (2019) 11:2151. doi: 10.3390/n11092151
23. Ioannidis K, Taylor C, Holt L, Brown K, Lochner C, Fineberg NA, et al. Problematic usage of the internet and eating disorder and related psychopathology: a multifaceted, systematic review and meta-analysis. *Neurosci Biobehav Rev.* (2021) 125:569–81. doi: 10.1016/j.neubiorev.2021.03.005
24. Tayhan Kartal F, Yabancı Ayhan N. Relationship between eating disorders and internet and smartphone addiction in college students. *Eat Weight Disord.* (2020) 26:1853–62. doi: 10.1007/s40519-020-01027-x
25. Leung L. Unwillingness-to-communicate and college students' motives in SMS mobile messaging. *Telemat Inform.* (2007) 24:115–29. doi: 10.1016/j.tele.2006.01.002
26. Joel B. Problematic use of the mobile phone: a literature review and a pathways model. *Curr Psychiatry Rev.* (2012) 8:299–307. doi: 10.2174/157340012803520522
27. Tao J, Luo C, Huang J, Liang L. Meta analysis of mobile phone dependence of Chinese college students. *Chin J School Health.* (2018) 39:1391–4. doi: 10.16835/j.cnki.1000-9817.2018.09.032
28. Mei S, Hu Y, Wu X, Cao R, Kong Y, Zhang L, et al. Health risks of mobile phone addiction among college students in China. *Int J Mental Health Addict.* (2022) 20:1–16. doi: 10.1007/s11469-021-00744-3
29. Li Y, Li G, Liu L, Wu H. Correlations between mobile phone addiction and anxiety, depression, impulsivity, and poor sleep quality among college students: a systematic review and meta-analysis. *J Behav Addict.* (2020) 9:551–71. doi: 10.1556/2006.2020.00057
30. Emirtekin E, Balta S, Sural I, Kircaburun K, Griffiths MD, Billieux J. The role of childhood emotional maltreatment and body image dissatisfaction in problematic smartphone use among adolescents. *Psychiatry Res.* (2019) 271:634–9. doi: 10.1016/j.psychres.2018.12.059
31. Domoff SE, Sutherland EQ, Yokum S, Gearhardt AN. Adolescents' addictive phone use: associations with eating behaviors and adiposity. *Int J Environ Res Public Health.* (2020) 17:2861. doi: 10.3390/ijerph17082861
32. Kim Y-H. Mediating effects of resilience on the relationship between smartphone addiction and anger coping strategies-focusing on the comparison of students of general high schools and special purpose high schools. *J Korea Soc Comput Inform.* (2018) 23:83–91. doi: 10.9708/jksoci.2018.23.02.083
33. Park H, Choi E. Smartphone addiction and depression: the mediating effects of self-esteem and resilience among middle school students. *J Korea Acad Commun Health Nurs.* (2017) 28:280–90. doi: 10.12799/jkacn.2017.28.3.280
34. Connor KM, Davidson JR. Development of a new resilience scale: the Connor-Davidson resilience scale (CD-RISC). *Depress Anxiety.* (2003) 18:76–82. doi: 10.1002/da.10113
35. Wisniewski P, Jia H, Wang N, Zheng S, Xu H, Rosson MB, et al. Resilience mitigates the negative effects of adolescent internet addiction and online risk exposure. In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. Seoul (2015). p. 4029–38.
36. Windle G. What is resilience? A review and concept analysis. *Rev Clin Gerontol.* (2011) 21:152–69. doi: 10.1017/S0959259810000420
37. Shen X. Is psychological resilience a protective factor between motivations and excessive smartphone use? *J Pac Rim Psychol.* (2020) 14:8. doi: 10.1017/prp.2020.10
38. Zhang C, Li G, Fan Z, Tang X, Zhang F. Psychological capital mediates the relationship between problematic smartphone use and learning burnout in chinese medical undergraduates and postgraduates: a cross-sectional study. (2021) 12:352. doi: 10.3389/fpsyg.2021.600352
39. Las Hayas C, Padierna JA, Muñoz P, Aguirre M, Gómez Del Barrio A, Beato-Fernández L, et al. Resilience in eating disorders: a qualitative study. *Women Health.* (2016) 56:576–94. doi: 10.1080/03630242.2015.1101744
40. Calvete E, las Hayas C, Gómez del Barrio A. Longitudinal associations between resilience and quality of life in eating disorders. *Psychiatry Res.* (2018) 259:470–5. doi: 10.1016/j.psychres.2017.11.031
41. Wen Z, Chang L, Hau K-T, Liu H. Testing and application of the mediating effects. *Acta Psychologica Sinica.* (2004) 36:614.
42. Hajian-Tilaki K. Sample size estimation in epidemiologic studies. *Caspian J Intern Med.* (2011) 2:289–98.
43. Xiong J, Zhou Z, Chen W, You Z, Zhai Z. Development of the mobile phone addiction tendency scale for college students. *Chin Ment Health J.* (2012) 26:222–5. doi: 10.1037/t74211-000
44. Li G, Xie J, An L, Hou G, Jian H, Wang W. A generalizability analysis of the mobile phone addiction tendency scale for Chinese College Students. *Front Psychiatry.* (2019) 10:241. doi: 10.3389/fpsyg.2019.00241
45. Campbell-Sills L, Stein MB. Psychometric analysis and refinement of the connor-davidson resilience scale (CD-RISC): validation of a 10-item measure of resilience. *J Traum Stress.* (2007) 20:1019–28. doi: 10.1002/jts.20271
46. Cheng C, Dong D, He J, Zhong X, Yao S. Psychometric properties of the 10-item Connor-Davidson Resilience Scale (CD-RISC-10) in Chinese undergraduates and depressive patients. *J Affect Disord.* (2020) 261:211–20. doi: 10.1016/j.jad.2019.10.018
47. Gideon N, Hawkes N, Mond J, Saunders R, Tchanturia K, Serpell L. Development and psychometric validation of the EDE-QS, a 12 item short form of the eating disorder examination questionnaire (EDE-Q). *PLoS ONE.* (2016) 11:e0152744. doi: 10.1371/journal.pone.0152744
48. He J, Sun S, Fan X. Validation of the 12-item short form of the eating disorder examination questionnaire in the Chinese context: confirmatory factor analysis and Rasch analysis. *Eat Weight Disord.* (2021) 26:201–9. doi: 10.1007/s40519-019-00840-3
49. Tehseen S, Ramayah T, Sajilan S. Testing and controlling for common method variance: a review of available methods. *J Manage Sci.* (2017) 4:142–68. doi: 10.20547/jms.2014.1704202
50. Podsakoff PM, Organ DW. Self-reports in organizational research: problems and prospects. *J Manage.* (1986) 12:531–44. doi: 10.1177/014920638601200408
51. Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equat Model Multidisciplin J.* (1999) 6:1–55. doi: 10.1080/10705519909540118
52. Cole DA, Maxwell SE. Testing mediational models with longitudinal data: questions and tips in the use of structural equation modeling. *J Abnorm Psychol.* (2003) 112:558–77. doi: 10.1037/0021-843X.112.4.558
53. Huang J, Liang Y, Chen B, Chen Y, Song J. Studying on the status of mobile phone use and dependence in college students. *Chin Health Serv Manage.* (2018) 7:534–38.
54. Kim Y, Park JY, Kim SB, Jung I-K, Lim YS, Kim J-H. The effects of Internet addiction on the lifestyle and dietary behavior of Korean adolescents. *Nutr Res Pract.* (2010) 4:51–7. doi: 10.4162/nrp.2010.4.1.51
55. Kamal NN, Kamal NN. Determinants of problematic internet use and its association with disordered eating attitudes among minia university students. *Int J Prev Med.* (2018) 9:35. doi: 10.4103/ijpvm.IJPVM\_489\_17
56. Loneragan AR, Bussey K, Fardouly J, Griffiths S, Murray SB, Hay P, et al. Protect me from my selfie: Examining the association between photo-based social media behaviors and self-reported eating disorders in adolescence. *Int J Eat Disord.* (2020) 53:755–66. doi: 10.1002/eat.23256
57. Cohen R, Newton-John T, Slater A. "Selfie"-objectification: the role of selfies in self-objectification and disordered eating in young women. *Comput Hum Behav.* (2018) 79:68–74. doi: 10.1016/j.chb.2017.10.027
58. Neuman SB. The Displacement Effect: Assessing the relation between television viewing and reading performance. *Read Res Quarter.* (1988) 23:414–40. doi: 10.2307/747641
59. Xiang MQ, Lin L, Wang ZR, Li J, Xu Z, Hu M. Sedentary behavior and problematic smartphone use in Chinese adolescents: the moderating role of self-control. *Front Psychol.* (2019) 10:3032. doi: 10.3389/fpsyg.2019.03032

60. Campbell SDI, Brosnan BJ, Chu AKY, Skeaff CM, Rehrer NJ, Perry TL, et al. Sedentary behavior and body weight and composition in adults: a systematic review and meta-analysis of prospective studies. *Sports Med.* (2018) 48:585–95. doi: 10.1007/s40279-017-0828-6
61. Fairburn C. *Cognitive Behavior Therapy and Eating Disorders*. New York, NY: Guilford (2008).
62. Robinson TN, Banda JA, Hale L, Lu AS, Fleming-Milici F, Calvert SL, et al. Screen media exposure and obesity in children and adolescents. *Pediatrics.* (2017) 140(Suppl 2):S97–101. doi: 10.1542/peds.2016-1758K
63. Davydov DM, Stewart R, Ritchie K, Chaudieu I. Resilience and mental health. *Clin Psychol Rev.* (2010) 30:479–95. doi: 10.1016/j.cpr.2010.03.003
64. Babić R, Babić M, Rastović P, Curlin M, Šimić J, Mandić K, et al. Resilience in health and illness. *Psychiatria Danubina.* (2020) 32(Suppl 2):226–32.
65. Bottolfs M, Støa EM, Reinboth MS, Svendsen MV, Schmidt SK, Oellingrath IM, et al. Resilience and lifestyle-related factors as predictors for health-related quality of life among early adolescents: a cross-sectional study. *J Int Med Res.* (2020) 48:300060520903656. doi: 10.1177/0300060520903656
66. Tafuya SA, Aldrete-Cortez V, Ortiz S, Fouilloux C, Flores F, Monterrosas AM. Resilience, sleep quality and morningness as mediators of vulnerability to depression in medical students with sleep pattern alterations. *Chronobiol Int.* (2019) 36:381–91. doi: 10.1080/07420528.2018.1552290
67. Li Y, Xia X, Meng F, Zhang C. Association between physical fitness and anxiety in children: a moderated mediation model of agility and resilience. *Front Public Health.* (2020) 8:468. doi: 10.3389/fpubh.2020.00468
68. Li S, Schulte EM, Cui G, Li Z, Cheng Z, Xu H. Psychometric properties of the Chinese version of the modified Yale Food Addiction Scale version 2.0 (C-mYFAS 2.0): prevalence of food addiction and relationship with resilience and social support. *Eat Weight Disord.* (2021) 27:273–84. doi: 10.1007/s40519-021-01174-9
69. Fergusson AK, Brausch AM. Resilience mediates the relationship between PTSD symptoms and disordered eating in college women who have experienced sexual victimization. *J Interpers Viol.* (2020) 37:NP1013–30. doi: 10.1177/0886260520918581
70. Kumpfer KL. Factors and processes contributing to resilience: The resilience framework. *Resilience and Development: Positive Life Adaptations. Longitudinal Research in the Social and Behavioral Sciences*. Dordrecht: Kluwer Academic Publishers (1999). p. 179–224.
71. Steiger H, Thaler L. Eating disorders, gene-environment interactions and the epigenome: roles of stress exposures and nutritional status. *Physiol Behav.* (2016) 162:181–5. doi: 10.1016/j.physbeh.2016.01.041
72. Sahu M, Gandhi S, Sharma MK, Marimuthu P. Perceived stress and resilience and their relationship with the use of mobile phone among nursing students. *Investigacion y educacion en enfermeria.* (2019) 37:e05. doi: 10.17533/udea.iee.v37n3e05
73. Furlong MJ, Ritchey KM, O'Brennan LM. Developing norms for the California resilience youth development module: internal assets and school resources subscales. *Calif School Psychol.* (2009) 14:35–46. doi: 10.1007/BF03340949
74. Cho MJJoDC. The Relationships among smart phone use motivations, addiction, and self-control in nursing students. *J Digit Conver.* (2014) 12:311–23. doi: 10.14400/JDC.2014.12.5.311
75. Akeman E, Kirlic N, Clausen AN, Cosgrove KT, McDermott TJ, Cromer LD, et al. A pragmatic clinical trial examining the impact of a resilience program on college student mental health. *Depress Anxiety.* (2020) 37:202–13. doi: 10.1002/da.22969
76. Hodder RK, Freund M, Wolfenden L, Bowman J, Nepal S, Dray J, et al. Systematic review of universal school-based “resilience” interventions targeting adolescent tobacco, alcohol or illicit substance use: a meta-analysis. *Prev Med.* (2017) 100:248–68. doi: 10.1016/j.ypmed.2017.04.003
77. Liu JJW, Ein N, Gervasio J, Battaion M, Reed M, Vickers K. Comprehensive meta-analysis of resilience interventions. *Clin Psychol Rev.* (2020) 82:101919. doi: 10.1016/j.cpr.2020.101919
78. Gao L, Liu J, Yang J, Wang X. Longitudinal relationships among cybervictimization, peer pressure, and adolescents' depressive symptoms. *J Affect Disord.* (2021) 286:1–9. doi: 10.1016/j.jad.2021.02.049

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Li, Cui, Yin, Tang, Chen and Liu. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





# Evolution in French University Students' Mental Health One Month After the First COVID-19 Related Quarantine: Results From the COSAMe Survey

Marielle Wathelet<sup>1,2,3,4\*</sup>, Camille Vincent<sup>5</sup>, Thomas Fovet<sup>1,3,4</sup>, Charles-Edouard Notredame<sup>1,4</sup>, Enguerrand Habran<sup>6</sup>, Niels Martignène<sup>2,3</sup>, Thierry Baubet<sup>3,7</sup>, Guillaume Vaiva<sup>1,3,4</sup> and Fabien D'Hondt<sup>1,3,4</sup>

<sup>1</sup> Univ. Lille, INSERM, Lille University Hospital (CHU de Lille), U1172—LilNCog - Lille Neuroscience & Cognition, Lille, France, <sup>2</sup> Fédération de Recherche en Psychiatrie et Santé Mentale des Hauts-de-France (F2RSM), Lille, France, <sup>3</sup> Centre National de Ressources et de Résilience Lille-Paris (CN2R), Lille, France, <sup>4</sup> Department of Psychiatry, Lille University Hospital (CHU de Lille), Lille, France, <sup>5</sup> Department of Public Health, Lille University Hospital (CHU de Lille), Lille, France, <sup>6</sup> Fonds FHF Recherche et Innovation, Paris, France, <sup>7</sup> Department of Infant, AP-HP, Avicenne Hospital, Child and Adolescent Psychiatry, Sorbonne Paris Nord, Paris, France

## OPEN ACCESS

### Edited by:

Agnes Lai,

The University of Hong Kong, Hong Kong SAR, China

### Reviewed by:

Abdullah Al Zubayer,

University of Barisal, Bangladesh

Anna Vittoria Mattioli,

University of Modena and Reggio

Emilia, Italy

### \*Correspondence:

Marielle Wathelet

marielle.wathelet@chu-lille.fr

### Specialty section:

This article was submitted to

Public Mental Health,

a section of the journal

Frontiers in Psychiatry

**Received:** 02 February 2022

**Accepted:** 12 April 2022

**Published:** 03 May 2022

### Citation:

Wathelet M, Vincent C, Fovet T, Notredame C-E, Habran E,

Martignène N, Baubet T, Vaiva G and

D'Hondt F (2022) Evolution in French

University Students' Mental Health

One Month After the First COVID-19

Related Quarantine: Results From the

COSAMe Survey.

Front. Psychiatry 13:868369.

doi: 10.3389/fpsy.2022.868369

**Introduction:** The COVID-19 related quarantine had negative psychological effects among University students. Evidence from previous epidemics suggests that negative psychological effects of quarantine measures can last or even worsen after the quarantine lift. The objective of this study was to assess the evolution of students' mental health and to identify factors associated with mental health outcomes 1 month after the lift of the lockdown.

**Materials and Methods:** This repeated cross-sectional study collected data during the first quarantine in France (T1,  $N = 68,891$ ) and 1 month after its lift (T2,  $N = 22,540$ ), through an online questionnaire sent to all French University students. Using cross-sectional data, we estimated prevalence rates of suicidal thoughts, severe anxiety (State-Trait Anxiety Inventory, State subscale), depression (Beck Depression Inventory), and stress (Perceived Stress Scale) at T1 and T2. Using longitudinal data ( $N = 6,346$ ), we identified risk factors of poor mental health outcomes among sociodemographic characteristics, precariousness indicators, health-related data, information on the social environment, and media consumption, adjusting for baseline mental health status.

**Results:** We found lower prevalence rates of severe stress (21.7%), anxiety (22.1%), and depression (13.9%) one month after the quarantine compared to the quarantine period (24.8%, 27.5%, and 16.1%, respectively). The prevalence rate of suicidal thoughts increased from 11.4 to 13.2%. Regardless of the existence of symptoms during quarantine, four factors were systematically associated with poor mental health outcomes 1 month after the quarantine was lifted: female gender, a low feeling of integration before the quarantine period, a low quality of social ties during the quarantine, and a history of psychiatric follow-up.

**Conclusions:** The prevalence rates of severe stress, anxiety, and depression, although being lower than during the first lockdown, remained high after its lift. The prevalence rate of suicidal ideation increased. This stresses the need to consider the enduring psychological impact of the pandemic on students as a critical public health issue.

**Keywords:** COVID-19, pandemic (COVID19), quarantine, students, mental health

## INTRODUCTION

On March 17, 2020, the French government mandated a quarantine on its territory, as many other countries did. This lockdown forbade all non-essential movements to limit the spread of the COVID-19 pandemic and lasted 8 weeks until May 11, 2020. If quarantine is one of the oldest tools to control contagious diseases, evidence from previous epidemics suggests that it also has a negative impact on the mental health of the population (1).

The negative psychological effects of the COVID-19 pandemic and related quarantine were rapidly confirmed (2), notably in University students, whose vulnerability to mental health problems is well-known (3). In France, the first measurement time (T1) of the repeated cross-sectional COSAMe study, conducted during the first lockdown period (from April 17 to May 4, 2020), revealed high prevalence rates of severe self-reported stress (24.7%), anxiety (27.5%), depression (16.1%), and suicidal thoughts (11.4%) among the 69,054 French University students who responded to the survey (4). Recently, a French study found that students reported more frequently perceived stress (33.1% vs 22.1%), anxiety (24.0% vs 14.7%), and depressive symptoms (32.5% vs 16.2%), as well as suicidal thoughts (11.7% vs 7.6%) than non-students during this period (5).

Evidence from previous epidemics suggests that the negative psychological effects of quarantine measures can last or even worsen after the quarantine lift (1). A recent review by Akinin et al. reports that, after an early peak, the psychological distress may have declined (6). While some studies showed a return to pre-pandemic levels after the first lockdown, other studies reported that the prevalence rates of mental health disorders, while being lower than those measured during the lockdown period, were still higher than estimates obtained outside any pandemic context (7, 8). The Lancet's COVID-19 Commission Mental Health Task Force recommends monitoring the mental health of populations over the next few years given the many warning signs that persist, beyond the first times of the pandemic (6). There are notably growing concerns about suicidal behavior (9, 10). If several sources demonstrate little change in suicide during the early months of the pandemic (6), the negative consequences of the pandemic on suicidal behavior could be delayed due to barriers to care access during the early stages of the pandemic (11), or due to the delayed economic consequences of the crisis, which are usually associated with an increase in suicidal behavior (12). France is particularly affected by suicide, with nearly 9,000 suicides per year. Suicide is also the second leading cause of death among young adults (15–24 years old), and the first warning signs have already been reported among this

population: the consumption of anxiolytics, antidepressants, and hypnotics has increased during the first year of the COVID-19 pandemic, compared to the five previous years (13).

The present study used data from the COSAMe survey, including those collected during the second measurement interval (T2) 1 month after the first quarantine was lifted (from June 15 to July 15, 2020). At this time, the total number of confirmed cases of COVID-19 in France was nearly 173,000, and nearly 30,000 deaths were attributed to COVID-19. The aims of the study were: (i) measuring changes in prevalence rates of self-reported mental health symptoms (stress, anxiety, depression, and suicidal thoughts) using repeated cross-sectional data, and (ii) identifying factors associated with mental health outcomes 1 month after the lift of the lockdown, adjusting for baseline mental health status, using longitudinal data.

## MATERIALS AND METHODS

### Study Design and Study Population

To promote student participation at each measurement interval of the COSAMe survey, the French Ministry of Higher Education, Research, and Innovation asked all 82 French universities to offer their students the opportunity to complete an online questionnaire sent by email (target population: approximately 1,600,000 students). The first measurement time (T1) took place during the COVID-19 lockdown, between April 17 and May 4, 2020. The second measurement time (T2) occurred 1 month after the quarantine was lifted between June 15 and July 15, 2020. The eligibility criteria were being a University student and having resided in France during the first lockdown. Students who answered both T1 and T2 were linked using a pseudonymization method.

The CHERRIES checklist, recommended for reporting the results of Internet e-surveys, is available in **Supplementary Table 1** (14).

This study was approved by a French research ethics committee, the *Comité de Protection des Personnes Ile de France VIII*, before its initiation. The protocol of COSAMe and detailed results of T1 have been published elsewhere (4).

### Data Collected Outcomes

We focused on the following 4 outcomes, collected at T1 and T2:

- i suicidal thoughts, by asking participants whether they had experienced suicidal thoughts during the preceding month,
- ii depression, using the validated French version of the 13-item Beck Depression Inventory (BDI-13) (15),

**TABLE 1 |** Crude and adjusted prevalence rates of mental health outcomes at T1 and T2 in the whole sample ( $n = 68,891$  at T1;  $n = 22,540$  at T2) and detailed prevalence rates according to gender and degree.

	Characteristics			Mental health outcomes							
	Target population	Study sample		Stress (PSS >26)		Anxiety (STAI-Y2 >55)		Depression (BDI >15)		Suicidal thoughts	
		T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Crude prevalence rate [95%CI] including non-binary students		<i>N</i> = 68,891	<i>N</i> = 22,540	24.8 [24.4–25.1]	21.7 [21.2–22.3]	27.5 [27.1–27.8]	22.1 [21.6–22.7]	16.1 [15.8–16.4]	13.9 [13.5–14.4]	11.4 [11.2–11.7]	13.2 [12.7–13.6]
Crude prevalence rate [95%CI] excluding non-binary students		<i>N</i> = 68,106	<i>N</i> = 22,205	24.5 [24.2–24.8]	21.4 [20.9–22.0]	27.2 [26.9–27.5]	21.8 [21.2–22.3]	15.8 [15.5–16.1]	13.7 [13.2–14.1]	11.0 [10.8–11.3]	12.7 [12.3–13.2]
Standardized prevalence rate [95%CI]	<i>N</i> = 1,635,350	<i>N</i> = 68,106	<i>N</i> = 22,205	22.4 [22.1–22.7]	20.1 [19.6–20.6]	25.5 [25.2–25.8]	20.8 [20.3–21.4]	14.3 [14.1–14.6]	12.6 [12.2–13.1]	10.6 [10.3–10.8]	12.3 [11.8–12.7]
Bachelor, n (%)											
Men	423,923 (25.9)	14,250 (20.9)	4,462 (20.1)	2,071 (14.5)	633 (14.2)	2,349 (16.5)	643 (14.4)	1,702 (11.9)	520 (11.6)	1,425 (10.0)	521 (11.7)
Women	573,542 (35.1)	40,521 (59.5)	12,717 (57.3)	11,430 (28.2)	3,014 (23.7)	12,370 (30.5)	3,001 (23.6)	7,347 (18.1)	1,971 (15.5)	4,744 (11.7)	1,713 (13.5)
Master, n (%)											
Men	234,829 (14.3)	3,266 (4.8)	1,207 (5.4)	515 (15.8)	176 (14.6)	652 (20.0)	215 (17.8)	339 (10.4)	120 (9.9)	298 (9.1)	134 (11.1)
Women	347,872 (21.3)	8,658 (12.7)	3,217 (14.5)	2,419 (27.9)	819 (25.5)	2,811 (32.5)	845 (26.3)	1,265 (14.6)	371 (11.5)	897 (10.4)	394 (12.2)
Doctorate, n (%)											
Men	28,365 (1.7)	463 (0.7)	187 (0.8)	59 (12.7)	24 (12.8)	80 (17.3)	32 (17.1)	35 (7.6)	14 (6.9)	55 (11.9)	15 (8.0)
Women	26,819 (1.6)	948 (1.4)	415 (1.9)	195 (20.6)	97 (23.4)	270 (28.5)	96 (23.1)	82 (8.6)	41 (9.9)	93 (9.8)	46 (11.1)

**TABLE 2 |** Association between no longer being quarantined (T2 vs. T1) and mental health outcomes, in the global and the paired samples: results of bivariate and multivariate analyses.

	Stress (PSS >26)	Anxiety (STAI-Y2 >55)	Depression (BDI > 15)	Suicidal thoughts
<b>Global sample</b>				
Crude OR [95%CI]	0.84 [0.81–0.87]	0.75 [0.72–0.78]	0.84 [0.81–0.88]	1.17 [1.12–1.23]
Adjusted OR [95%CI]	0.81 [0.77–0.86]	0.74 [0.69–0.78]	0.81 [0.76–0.87]	1.13 [1.05–1.21]
<b>Paired sample</b>				
OR [95%CI]	0.67 [0.59–0.76]	0.70 [0.62–0.79]	0.89 [0.76–1.05]	1.34 [1.12–1.61]

- iii anxiety, through the validated French version of the 20-item State-Trait Anxiety Inventory, State subscale (STAI Y-2) (16),
- iv stress, using the validated French version of the Perceived Stress Scale (PSS-10) (17).

Outcomes were the presence of severe self-reported symptoms, i.e., the presence of suicidal thoughts or a high score on at least 1 scale, as defined in the literature (i.e., PSS-10 >26; BDI-13 >15; or STAI-Y2 >55).

### Covariates

Regarding covariates, we considered (i) sociodemographic characteristics (gender, year of study, being a foreign student, living area, living in a worst-hit department), (ii) economic indicators (housing quality, loss of income due to quarantine), (iii) health-related information (history of psychiatric follow-up, symptoms consistent with COVID-19 since the beginning of the pandemic, and physical activity during the quarantine), (iv) media or information data (consumption of media information related to the pandemic in minutes per day and perceived quality of information received), and (v) social support indicators (feeling socially integrated before the quarantine, having children, housing composition during the quarantine, concern for relatives' health, quality of perceived social relationships during the quarantine).

### Statistical Analysis

Only students for whom full data was available were analyzed. The statistical analyses were conducted in three stages.

The first analysis described the crude prevalence rates of mental health outcomes at each measurement time as the number of prevalent cases divided by the total number of respondents. Gender- and degree-standardized prevalence rates were calculated using the University Students population 2019–2020 published by the French Ministry of National Education (18). These standardized rates were calculated excluding non-binary students since there is no available information regarding their proportion among students.

The second analysis assessed the association between quarantine and mental health outcomes. Bivariate analyses using Chi-2 tests compared proportions of mental health disorders at T2 (after quarantine) and T1 (during quarantine). Then, we carried out logistic regression models to assess the impact of no longer being quarantined (T2 vs. T1) on mental

health, after adjustment for all covariates described in the previous section.

In the third analysis, only students who answered both T1 and T2 questionnaires were considered. To identify factors associated with mental health outcomes at T2, we performed multivariate logistic regression models for each outcome. Models were adjusted for all covariates, including mental health status at baseline (score above the threshold at T1 for stress, anxiety, and depression, or presence of suicidal thoughts at T1 for suicidal thoughts). Moreover, associations between suicidal ideation and other mental health disorders at T2 have also been studied using Chi-square tests.

Data analysis was performed using R version 3.4.2. The significance level was set at  $\alpha = 0.05$  and all tests were 2-tailed. Results of regression models are presented as adjusted prevalence odds ratios and 95% confidence intervals (aOR [95%CI]).

## RESULTS

### Repeated Cross-Sectional Data

In total, 96,861 students opened the questionnaire at T1, and 28,120 at T2. A total of 68,891 students fully completed the questionnaire at T1 and 22,540 at T2 (response rate: 4.2% of French University students at T1 and 1.3% at T2). The vast majority of the sample was made up of bachelor students at both T1 and T2 (80.4% and 77.4%, respectively). Women were over-represented whatever the degree (72.7% at T1, 72.5% at T2), and more than half of the sample were female bachelor students (58.8% at T1, and 56.4% at T2). Non-binary students represented 1.1% of the sample at T1 ( $N = 785$ ), and 1.5% at T2 ( $N = 331$ ).

Crude and standardized prevalence rates are described in **Table 1**. A significant ( $p < 0.001$ ) lower proportion of severe self-reported stress, anxiety and depression was measured at T2 [standardized prevalence rates (95%CI) at 20.1% vs. 22.4%, 20.8% vs. 25.5%, and 12.6% vs. 14.3%, respectively]. However, the proportion of suicidal thoughts increased (12.3% vs. 10.6%,  $p < 0.001$ ).

After adjustment, identical patterns were identified (**Table 2**): no longer being quarantined (T2 vs. T1) was significantly associated with a lower risk of severe self-reported stress [OR (95%CI) = 0.81 (0.77–0.86)], anxiety [0.74 (0.69–0.78)] and depression [0.81 (0.76–0.87)]. However, it was associated with a significantly higher risk of suicidal thoughts [1.13 (1.05–1.21)].



**TABLE 3 |** Factors associated with severe symptoms at T2 ( $n = 6,346$ ): results of the multivariate logistic regression models.

Characteristics		PSS-10 > 26 at T2		STAI-Y2 > 55 at T2		BDI-13 > 15 at T2		Suicidal thoughts at T2	
Respondents at T1 and T2		aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>	aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>	aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>	aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>
Baseline mental health status <sup>¶</sup>		9.7 [8.4–11.3]	<0.001	10.5 [9.0–12.2]	<0.001	21.2 [17.4–25.9]	<0.001	33.8 [27.5–41.8]	<0.001
Demographic characteristics									
Gender, n (%)			0.001		0.003		0.104		0.046
Male	1,442 (22.7)	ref		ref		ref		ref	
Female	4,795 (75.6)	1.38 [1.14–1.68]	0.001	1.37 [1.13–1.66]	0.001	1.30 [1.02–1.68]	0.037	1.30 [1.01–1.67]	0.042
Non-binary	109 (1.7)	1.85 [1.12–3.03]	0.015	1.68 [1.02–2.77]	0.039	1.12 [0.60–2.05]	0.713	1.82 [0.99–3.30]	0.051
Year of study, n (%)			0.539		0.040		0.378		0.223
Bachelor	4,852 (76.5)	ref		ref		ref		ref	
Master	1,296 (20.4)	1.10 [0.92–1.32]	0.291	1.24 [1.03–1.48]	0.021	0.93 [0.72–1.19]	0.569	0.90 [0.70–1.16]	0.429
Doctorate	198 (3.1)	1.12 [0.72–1.69]	0.615	0.85 [0.54–1.30]	0.464	0.65 [0.33–1.21]	0.197	0.61 [0.32–1.10]	0.113
Foreign student (Yes vs No), n (%)		218 (3.4)	0.87 [0.58–1.27]	0.476	1.31 [0.89–1.91]	0.161	1.50 [0.92–2.40]	0.103	0.44 [0.23–0.81]
0.007									
Department of residence affected (Yes vs No), n (%)		1,850 (29.1)	0.96 [0.81–1.12]	0.588	1.03 [0.88–1.21]	0.675	1.00 [0.81–1.24]	0.966	1.02 [0.82–1.26]
0.869									
Area, n (%)			0.074		0.420		0.290		0.519
Urban	2,920 (46.0)	ref		ref		ref		ref	
Semiurban	1,658 (26.1)	1.15 [0.96–1.38]	0.586	1.03 [0.86–1.24]	0.739	1.19 [0.94–1.51]	0.141	1.09 [0.85–1.40]	0.483
Rural	1,768 (27.9)	0.92 [0.76–1.11]	0.374	0.91 [0.75–1.09]	0.309	1.15 [0.90–1.48]	0.258	0.93 [0.72–1.21]	0.600
Precariousness indicators									
Loss of income (Yes vs No), n (%)		1,071 (16.9)	1.13 [0.94–1.36]	0.195	1.03 [0.85–1.24]	0.755	1.15 [0.91–1.46]	0.246	1.31 [1.02–1.67]
0.035									
Housing quality (rated out of 10), n (%)			0.167		0.036		0.662		0.830
High (7–10)	5,504 (86.7)	ref		ref		ref		ref	
Medium (4–6)	705 (11.1)	1.23 [0.99–1.53]	0.058	1.32 [1.07–1.64]	0.010	1.13 [0.86–1.48]	0.370	0.92 [0.68–1.23]	0.587
Low (0–3)	137 (2.2)	1.07 [0.68–1.66]	0.765	0.98 [0.63–1.53]	0.931	0.99 [0.58–1.68]	0.979	0.90 [0.49–1.62]	0.724
Social data									
Having children (Yes vs No), n (%)		69 (1.1)	0.65 [0.29–1.35]	0.260	0.77 [0.36–1.57]	0.488	0.71 [0.23–1.83]	0.495	0.72 [0.21–2.01]
0.561									
Housing arrangement, n (%)			0.023		0.152		0.448		0.489
Living with family	5,262 (82.9)	ref		ref		ref		ref	
Living alone	773 (12.2)	1.24 [0.98–1.56]	0.071	1.23 [0.98–1.55]	0.077	1.20 [0.89–1.61]	0.221	1.10 [0.80–1.49]	0.550
Living with roommates	224 (3.5)	1.07 [1.22–1.59]	0.734	1.22 [0.82–1.79]	0.313	0.81 [0.45–1.41]	0.478	1.34 [0.79–2.21]	0.260
Other	87 (1.4)	2.16 [0.71–3.72]	0.006	1.55 [0.85–2.75]	0.145	0.82 [0.38–1.69]	0.594	1.52 [0.70–3.12]	0.273
Feeling of integration, n (%)			<0.001		<0.001		<0.001		<0.001
High (7–10)	4,037 (63.6)	ref		ref		ref		ref	

(Continued)

TABLE 3 | Continued

Characteristics		PSS-10 > 26 at T2		STAI-Y2 > 55 at T2		BDI-13 > 15 at T2		Suicidal thoughts at T2	
		aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>	aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>	aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>	aOR [95%CI] <sup>‡</sup>	p <sup>§</sup>
Medium (4–6)	1,872 (29.5)	1.34 [1.14–1.57]	<0.001	1.78 [1.52–2.08]	<0.001	2.42 [1.97–2.98]	<0.001	1.86 [1.50–2.29]	<0.001
Low (0–3)	437 (6.9)	2.43 [1.86–3.17]	<0.001	2.54 [1.94–3.32]	<0.001	4.40 [3.22–6.02]	<0.001	2.76 [1.98–3.85]	<0.001
Concern for relatives' health (rated out of 10), n (%)			<0.001		<0.001		0.001		0.700
Low (0–3)	1,040 (16.4)	ref		ref		ref		ref	
Medium (4–6)	2,050 (32.3)	1.07 [0.84–1.37]	0.562	0.93 [0.73–1.19]	0.590	0.91 [0.37–1.26]	0.594	1.11 [0.82–1.50]	0.496
High (7–10)	3,256 (51.3)	1.63 [1.30–2.05]	<0.001	1.30 [1.04–1.63]	0.022	1.36 [1.02–1.82]	0.034	1.13 [0.85–1.51]	0.406
Quality of social ties (rated out of 10), n (%)			0.005		<0.001		0.002		0.005
High (7–10)	2,847 (44.9)	ref		ref		ref		ref	
Medium (4–6)	2,475 (39.0)	1.15 [0.98–1.36]	0.079	1.35 [1.15–1.59]	<0.001	1.25 [1.00–1.56]	0.047	1.44 [1.16–1.80]	<0.001
Low (0–3)	1,024 (16.1)	1.40 [1.14–1.72]	0.001	1.39 [1.12–1.71]	0.002	1.59 [1.23–2.06]	<0.001	1.21 [0.91–1.59]	0.183
Media and information									
Time spent consulting information (in min/d), n (%)			0.273		0.215		0.022		0.011
<15	2,355 (37.1)	ref		ref		ref		ref	
15–29	1,110 (17.5)	0.90 [0.73–1.12]	0.370	0.88 [0.71–1.09]	0.260	0.97 [0.73–1.29]	0.863	0.70 [0.52–0.94]	0.020
30–59	1,339 (21.1)	1.02 [0.83–1.24]	0.854	0.97 [0.79–1.18]	0.748	0.78 [0.60–1.02]	0.071	0.72 [0.54–0.95]	0.020
60–119	1,066 (16.8)	1.06 [0.86–1.31]	0.595	1.05 [0.84–1.29]	0.671	1.11 [0.84–1.45]	0.469	1.01 [0.76–1.35]	0.917
≥120	476 (7.5)	1.27 [0.97–1.66]	0.081	1.26 [0.96–1.65]	0.096	1.44 [1.02–2.02]	0.037	1.18 [0.82–1.69]	0.359
Quality of information received (rated out of 10), n (%)			<0.001		0.002		0.313		0.879
High (7–10)	2,461 (38.8)	ref		ref		ref		ref	
Medium (4–6)	2,889 (45.5)	1.26 [1.07–1.48]	0.005	1.14 [0.97–1.34]	0.119	1.08 [0.87–1.33]	0.489	1.04 [0.84–1.29]	0.727
Low (0–3)	996 (15.7)	1.47 [1.19–1.82]	<0.001	1.47 [1.19–1.81]	<0.001	1.24 [0.94–1.62]	0.126	1.07 [0.81–1.42]	0.627
Health-related data									
History of psychiatric follow-up (Yes vs. No), n (%)		778 (12.2)	1.75 [1.44–2.12]	<0.001	1.77 [1.46–2.16]	<0.001	1.92 [1.51–2.42]	<0.001	2.14 [1.68–2.72]
Symptoms consistent with COVID-19 (Yes vs. No), n (%)		2023 (31.9)	1.61 [1.34–1.94]	<0.001	1.62 [1.34–1.95]	<0.001	1.23 [0.96–1.56]	0.095	1.35 [1.05–1.73]
Duration of physical activity (in min/d), n (%)			0.017		0.939		0.829		0.285
≥60	1,887 (29.7)	ref		ref		ref		ref	
30–59	1,824 (28.7)	1.12 [0.93–1.36]	0.229	1.01 [0.83–1.19]	0.922	0.95 [0.74–1.23]	0.702	0.96 [0.73–1.24]	0.580
15–29	1,205 (19.0)	1.00 [0.81–1.25]	0.963	1.05 [0.84–1.30]	0.669	1.05 [0.80–1.40]	0.706	1.25 [0.93–1.66]	0.207
<15	1,430 (22.5)	1.34 [1.10–1.64]	0.004	0.98 [0.80–1.22]	0.816	0.93 [0.72–1.21]	0.599	1.10 [0.84–1.45]	0.594

<sup>‡</sup>aOR [95%CI] = adjusted odd ratio [95% confidence interval].<sup>§</sup>For each variable, the p-value opposite the name of the variable refers to its global effect, and when applicable, p-value referring to each category vs reference are also presented.<sup>†</sup>Severe symptoms already reported at baseline (i.e., PSS-10 > 26 at T1 for stress, STAI-Y2 > 55 at T1 for anxiety, BDI-13 > 15 at T1 for depression, and suicidal thoughts at T1 for suicidal thoughts).

Bold values correspond to significant associations (p-values &lt; 0.05).

## Longitudinal Data

### Mental Health Outcomes at T1 and T2

Characteristics of the paired sample ( $N = 6,346$ ) are reported in **Table 3**. When considering only the students who answered both T1 and T2, we found similar prevalence rates of mental health outcomes to those observed in the full sample. At T1, among the 6,346 students who both answered T1 and T2, 795 (12.5%) reported suicidal thoughts, 1,653 (26.0%) severe stress, 1,658 (26.1%) severe anxiety, and 933 (14.7%) severe depression. At T2, they were 869 (13.7%), 1,432 (22.6%), 1,465 (23.1%), 900 (14.2%), respectively. For the association between the lift of quarantine and mental health outcomes, patterns were similar to those found in the overall sample, although not significant for depression (**Table 2**).

### Factors Associated With Mental Health Symptoms at T2

Factors associated with mental health outcomes at T2 are presented in **Table 3**. Excepted mental health status at baseline, four factors were significantly associated with all poor mental health outcomes at T2: female gender, low feeling of integration, low quality of social ties, and history of psychiatric follow-up. Concerning gender, aOR [95%CI] for female gender (vs male gender) was between 1.30 [1.01–1.67],  $p = 0.042$  (for suicidal thoughts) and 1.38 [1.14–1.68],  $p < 0.001$  (for stress). Non-binary gender was significantly at risk for stress and anxiety. The lower the feeling of integration, the more students were at risk (aOR [95%CI] from 2.43 [1.86–3.17],  $p < 0.001$  for stress, to 4.40 [3.22–6.02],  $p < 0.001$  for depression). Concerning the quality of social ties during quarantine, students were more at risk when they reported a lower quality (aOR [95%CI] from 1.39 [1.12–1.71],  $p = 0.002$  for anxiety, to 1.59 [1.23–2.06],  $p < 0.001$  for depression). This pattern was not as marked for suicidal ideation. Finally, compared to students without psychiatric history, those who reported a history of psychiatric follow-up were at higher risk of mental health outcomes [from 1.75 (1.44–2.12),  $p < 0.001$  for stress, to 2.14 (1.68–2.72),  $p < 0.001$  for suicidal thoughts].

Other factors were not associated with all mental health outcomes. Concerning demographic variables, students in master's degree were more at risk of anxiety than students in bachelor's degree [aOR (95%CI) = 1.24 [1.03–1.48],  $p = 0.021$ ], and foreign students were less at risk of suicidal thoughts [0.44 (0.23–0.81),  $p = 0.007$ ]. Regarding precarity, a loss of income due to the COVID-19 pandemic was at risk of suicidal thoughts at T2 [1.31 (1.02–1.67),  $p = 0.035$ ]. An association was also found between anxiety and medium housing quality, compared to high quality [1.32 (1.07–1.64),  $p = 0.010$ ]. But there was no association with low housing quality. Among social variables, a high level of concern for relatives' health was at risk of stress [1.63 (1.30–2.05),  $p < 0.001$ ], anxiety [1.30 (1.04–1.63),  $p = 0.022$ ], and depression [1.36 (1.02–1.82) at T2], but no association was found with suicidal thoughts. Concerning media and information, low quality of the information received was associated with a higher risk of stress [1.47 (1.19–1.82),  $p < 0.001$ ], and anxiety [1.47 (1.19–1.81),  $p < 0.001$ ]. Media consumption for more than 2 h per day, compared to <15 min, was associated with an increased risk of depression [1.44 (1.02–2.02),  $p = 0.037$ ],

while moderate consumption (between 15 min and an hour) was protective of suicidal ideation [0.70 (0.52–0.94),  $p = 0.020$  for 15–29 min, and 0.72 (0.54–0.95),  $p = 0.020$  for 30–59 min]. Finally, regarding health-related variables, having experienced symptoms consistent with COVID-19 was significantly associated with stress, anxiety and suicidal thoughts at T2 [1.61 (1.34–1.94),  $p < 0.001$ , 1.62 (1.34–1.95),  $p < 0.001$  and 1.35 (1.05–1.73),  $p = 0.019$ , respectively]. The year of study was significantly associated with worsening anxiety and depression, but patterns were unclear. A low practice of physical exercise (<15 min per day vs. more than 60 min), was associated with an increased risk of stress [1.34 (1.10–1.64),  $p = 0.004$ ].

### Association Between Suicidal Ideation and Other Mental Health Symptoms at T2

Finally, the prevalence rates of suicidal thoughts at T2 were significantly higher in students whose symptoms were severe at T2 (**Table 4**). Among students who reported severe symptoms of stress or anxiety, more than a third also reported suicidal ideation (38.5% vs. 6.5%,  $p < 0.001$  for stress, and 38.6% vs. 6.2%,  $p < 0.001$  for anxiety). This proportion exceeded 50% for those reporting severe symptoms of depression (57.6% vs. 6.4%,  $p < 0.001$ ).

## DISCUSSION

This study revealed lower prevalence rates of severe symptoms of stress (21.7%), anxiety (22.1%), and depression (13.9%) among University students 1 month after the COVID-19 related quarantine was lifted in France when compared to the quarantine period (24.8%, 27.5%, and 16.1% for severe self-reported stress, anxiety, and depression, respectively). Conversely, the prevalence rate of suicidal thoughts increased from 11.4% of the students during the quarantine, to 13.2% 1 month after the quarantine was ended. Overall, four factors, which had already been identified as risk factors for mental health disorders during the quarantine (4), were significantly associated with poor mental health outcomes (suicidal thoughts, severe symptoms of anxiety, depression, and stress) 1 month after the COVID-19 related quarantine was lifted: female gender, a low feeling of integration, low quality of social ties, and a history of psychiatric follow-up.

Regarding anxiety and depression, our results are consistent with the decrease in prevalence rates obtained by Lu et al. (19) in the only study that compared prevalence rates of mental health symptoms during and after a COVID-19 related lockdown period, although using different samples (19). In line with the particular vulnerability of the University student population to the psychological impact of the quarantine, we found higher prevalence rates of severe self-reported symptoms of anxiety and depression (22.1% and 13.9%, respectively) than Lu et al. (6.3 and 6.8%, respectively) who conducted their study in the Chinese general population. Importantly, although these prevalence rates were lower 1 month after than during the lockdown, they remained higher than before the COVID-19 pandemic. Indeed, a study involving 4,184 French undergraduate University students in 2017 reported prevalence rates of 12.6% and 7.6%, for depression and anxiety, respectively (20).

**TABLE 4 |** Association between suicidal thoughts and severe symptoms of stress, anxiety and depression at T2 ( $n = 6,346$ ): results of the bivariate analyses.

	PSS-10 > 26 at T2		STAI-Y2 > 55 at T2		BDI-13 > 15 at T2	
	Yes	No	Yes	No	Yes	No
	<i>N</i> = 1,432	<i>N</i> = 4,914	<i>N</i> = 1,465	<i>N</i> = 4,881	<i>N</i> = 900	<i>N</i> = 5,446
<b>Suicidal thoughts at T2</b>						
Yes	551 (38.5)	318 (6.5)	565 (38.6)	304 (6.2)	518 (57.6)	351 (6.4)
No	881 (61.5)	4,596 (93.5)	900 (61.4)	4,577 (93.8)	382 (42.4)	5,095 (93.6)
<i>p</i>	<b>&lt; 0.001</b>		<b>&lt; 0.001</b>		<b>&lt; 0.001</b>	

Bold values correspond to significant associations ( $p$ -values < 0.001).

Regarding suicidal ideations, several studies found high rates of suicidal ideations during COVID-19 related quarantine (4, 21) but the present study is the first to assess and show increased suicidal ideation after a quarantine lift. This result is in line with observations made by the *French Institute of Public Opinion* (IFOP), which found that 17% of the participants with lifetime suicidal ideations reported having experienced them after the quarantine, compared to 11% during the quarantine (overall 20% of the sample reported lifetime suicidal ideation) in a survey of 2,000 participants, representative of the French population aged 18 and over, carried out in September 2021 (22). Importantly, we found more frequent suicidal ideations among students who reported other severe mental health symptoms after the lift of the quarantine, which is consistent with the high prevalence of suicidal ideations in people affected by psychiatric symptoms and disorders (23), including during pandemic crises (24). Loss of income, feeling of integration, and quality of social ties, which are well-documented predisposing factors for suicide (12, 23), were also significantly associated with an increased risk of reporting suicidal thoughts after quarantine. The female gender is also a well-known risk factor for depression, anxiety, stress, and suicidal ideation in the general population (25, 26). Among University students, while literature is inconclusive concerning depression, many studies have also shown that female students are vulnerable to these disorders (27). Beyond genetic and biological factors, the pandemic context may have reinforced inequalities, including those based on gender, as has been shown in previous epidemics (28). Furthermore, although the sample is smaller and subject to a lack of power, the proportions of mental health disorders among non-binary participants were particularly high and should be the subject of in-depth studies.

Considering that stressful life events, including natural disasters, precede many suicides and suicide attempts (23) and because suicidal ideation is an indicator of future suicide attempts, psychiatric disorders, and global impaired functioning (29–32), particular attention should be paid to the high prevalence rates of suicidal ideation in the student population during the COVID-19 pandemic. Moreover, recent estimations predict an increase in the number of suicides based on the expected number of job losses due to COVID-19 (12). Several recommendations have been formulated using examples from countries that have efficiently broken the link between unemployment and suicide rates and notably promote: (i) access to secondary prevention (treat disorders such as depression), (ii)

active labor market programs, and (iii) gender equality in the workplace (33).

Some limitations should be considered in the interpretation of these results. First, although the number of respondents is large, it represents 4.2% of French University students at T1 and 1.3% at T2. Caution is therefore necessary before generalizing these results. Nevertheless, this problem is encountered in all large epidemiologic studies and does not systematically mean that a self-selection bias has altered the results (34, 35). Indeed, it has been shown that a low response rate in epidemiological surveys only marginally affects prevalence and association measures (34, 35). Besides, the prevalence rates were stratified by and adjusted for gender and degree, and multivariate analyses included gender and degree as a covariate. To control for potential confounding bias related to differences in sample characteristics from one measurement time to another, the multivariate models included all covariates, and a subgroup analysis on the longitudinal data was performed. Second, although validated, the questionnaires used for this study to identify mental health symptoms are screening but not diagnostic tools. However, a high score on these validated tests is highly correlated with the presence of a mental health disorder. Finally, the questionnaire did not include other risk factors that could be associated with suicidal ideation, such as substance use disorder or personal or family history of suicidal behavior (36).

As a whole, two main conclusions can be drawn from the present study. First, severe symptoms of stress, anxiety, and depression were less prevalent after than during the COVID-19 related quarantine among University students but remained more prevalent than before the pandemic. Second, suicidal ideations, which were already frequent during the quarantine, were even more prevalent after the lift of the quarantine. This stresses the need to consider the psychological impact of the pandemic on students as a critical public health issue, demanding an urgent and strong policy response. Future studies will necessarily have to assess the long-term consequences of this enduring crisis, with a special focus on suicidal behavior.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.



## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comité de Protection des Personnes Ile de France VIII. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

MW, GV, and FD'H contributed to the conception and design of the study. MW, CV, NM, and EH organized the database. CV and MW performed the statistical analysis. MW and FD'H wrote the first draft of the manuscript. All authors

contributed to manuscript revision, read, and approved the submitted version.

## ACKNOWLEDGMENTS

We thank the French Ministry of Higher Education, Research and Innovation, and the French National Center for School and University Affairs (CNOUS) for disseminating the survey. We are also grateful to University students for their participation.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2022.868369/full#supplementary-material>

## REFERENCES

- Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet*. (2020) 395:912–20. doi: 10.1016/S0140-6736(20)30460-8
- Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health*. (2020) 17:1729. doi: 10.3390/ijerph17051729
- Ibrahim AK, Kelly SJ, Adams CE, Glazebrook C. A systematic review of studies of depression prevalence in University students. *J Psychiatr Res*. (2013) 47:391–400. doi: 10.1016/j.jpsychires.2012.11.015
- Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors associated with mental health disorders among University students in France confined during the COVID-19 pandemic. *JAMA Netw open*. (2020) 3:e20255. doi: 10.1001/jamanetworkopen.2020.25591
- Arsandaux J, Montagni I, Macalli M, Texier N, Pouriel M, Germain R, et al. Higher risk of mental health deterioration during the Covid-19 lockdown among students rather than non-students. the French confins study. *medRxiv*. (2020). doi: 10.1101/2020.11.04.20225706
- Aknin L, Neve J-E De, Dunn E, Fancourt D, Goldberg E, Helliwell J, et al. Mental health during the first year of the COVID-19 pandemic: a review and recommendations for moving forward. *Perspect Psychol Sci*. (2022). doi: 10.1177/17456916211029964
- Yu W, Singh SS, Calhoun S, Zhang H, Zhao X, Yang F. Generalized anxiety disorder in urban China: Prevalence, awareness, and disease burden. *J Affect Disord*. (2018) 234:89–96. doi: 10.1016/j.jad.2018.02.012
- Guo X, Meng Z, Huang G, Fan J, Zhou W, Ling W, et al. Meta-analysis of the prevalence of anxiety disorders in mainland China from 2000 to 2015. *Sci Rep*. (2016) 16:6. doi: 10.1038/srep28033
- Thompson EC, Thomas SA, Burke TA, Nesi J, MacPherson HA, Bettis AH, et al. Suicidal thoughts and behaviors in psychiatrically hospitalized adolescents pre- and post- COVID-19: A historical chart review and examination of contextual correlates. *J Affect Disord Reports*. (2021) 4:100100. doi: 10.1016/j.jadr.2021.100100
- Sher L. The impact of the COVID-19 pandemic on suicide rates. *QJM*. (2020) 113:707–12. doi: 10.1093/qjmed/hcaa202
- Jollant F, Roussot A, Corbule E, Chauvet-Gelinier JC, Falissard B, Mikaeloff Y, et al. Hospitalization for self-harm during the early months of the Covid-19 pandemic in France: a nationwide study. *medRxiv*. (2020). doi: 10.1101/2020.12.18.20248480
- Kawohl W, Nordt C. COVID-19, unemployment, and suicide. *Lancet Psychiatry*. (2020) 7:389–90. doi: 10.1016/S2215-0366(20)30141-3
- Levaillant M, Wathelet M, Lamer A, Riquin E, Gohier B, Hamel-Broza J-F. Impact of COVID-19 pandemic and lockdowns on the consumption of anxiolytics, hypnotics and antidepressants according to age groups: a French nationwide study. *Psychol Med*. (2021) 14:1–7. doi: 10.1017/S0033291721004839
- Gunther. Improving the quality of web surveys: the checklist for reporting results of internet E-surveys (CHERRIES). *J Med Internet Res*. (2004) 6:e34. doi: 10.2196/jmir.6.3.e34
- Bourque P, Beaudette D. Etude psychométrique du questionnaire de dépression de Beck auprès d'un échantillon d'étudiants universitaires francophones. *Can J Behav Sci Can des Sci du Comport*. (1982) 14:211–8. doi: 10.1037/h0081254
- Gauthier J, Bouchard S. Adaptation Canadienne-Française de la forme révisée du state-trait anxiety inventory de spielberger. *Can J Behav Sci*. (1993) 25:559–78. doi: 10.1037/h0078881
- Lesage FX, Berjot S, Deschamps F. Psychometric properties of the french versions of the perceived stress scale. *Int J Occup Med Environ Health*. (2012) 25:178–84. doi: 10.2478/s13382-012-0024-8
- Ministère de l'Education Nationale de la Jeunesse et des Sports. *Repères et références statistiques 2020* (2020).
- Lu P, Li X, Lu L, Zhang Y. The psychological states of people after Wuhan eased the lockdown. *PLoS ONE*. (2020) 15:e0241173. doi: 10.1371/journal.pone.0241173
- Tran A, Tran L, Geghre N, Darmon D, Rampal M, Brandone D, et al. Health assessment of French University students and risk factors associated with mental health disorders. *PLoS ONE*. (2017) 12:e0188187. doi: 10.1371/journal.pone.0188187
- Sapara A, Shalaby R, Osiogo F, Hrabok M, Gusnowski A, Vuong W, et al. COVID-19 pandemic: demographic and clinical correlates of passive death wish and thoughts of self-harm among Canadians. *J Ment Heal*. (2021) 30:170–8. doi: 10.1080/09638237.2021.1875417
- IFOP. *Les Français et le suicide*. (2020).
- Fazel S, Runeson B. Suicide. *N Engl J Med*. (2020) 382:266–74. doi: 10.1056/NEJMr1902944
- Hao F, Tan W, Jiang L, Zhang L, Zhao X, Zou Y, et al. Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? a case-control study with service and research implications for immunopsychiatry. *Brain Behav Immun*. (2020) 87:100–6. doi: 10.1016/j.bbi.2020.04.069
- Becker JB, Monteggia LM, Perrot-Sinal TS, Romeo RD, Taylor JR, Yehuda R, et al. Stress and disease: is being female a predisposing factor? *J Neurosci*. (2007) 27:11851–5. doi: 10.1523/JNEUROSCI.3565-07.2007
- Canetto SS, Sakinofsky I. The gender paradox in suicide. *Suicide Life-Threatening Behav*. (1998) 28:1–23. doi: 10.1111/j.1943-278X.1998.tb00622.x
- Gao W, Ping S, Liu X. Gender differences in depression, anxiety, and stress among college students: a longitudinal study from China. *J Affect Disord*. (2020) 263:292–300. doi: 10.1016/j.jad.2019.11.121

28. Thibaut F, van Wijngaarden-Cremers PJM. Women's mental health in the time of Covid-19 pandemic. *Front Glob Women's Heal.* (2020) 0:17. doi: 10.3389/fgwh.2020.588372
29. Harmer B, Lee S, Duong T, Saadabadi A. Suicidal Ideation. In *StatPearls*. StatPearls Publishing. (2021).
30. Silverman MM, Berman AL. Suicide risk assessment and risk formulation part I: a focus on suicide ideation in assessing suicide risk. *Suicide Life-Threatening Behav.* (2014) 44:420–31. doi: 10.1111/sltb.12065
31. Reinherz H. Adolescent suicidal ideation as predictive of psychopathology, suicidal behavior, and compromised functioning at age 30. *Am J Psychiatry.* (2006) 163:1226. doi: 10.1176/ajp.2006.163.7.1226
32. Goldney RD, Smith S, Winefield AH, Tiggeman M, Winefield HR. Suicidal ideation: its enduring nature and associated morbidity. *Acta Psychiatr Scand.* (1991) 83:115–20. doi: 10.1111/j.1600-0447.1991.tb07375.x
33. Reeves A, McKee M, Stuckler D. Economic suicides in the great recession in Europe and North America. *Br J Psychiatry.* (2014) 205:246–7. doi: 10.1192/bjp.bp.114.144766
34. Galea S, Tracy M. Participation rates in epidemiologic studies. *Ann Epidemiol.* (2007) 17:643–53. doi: 10.1016/j.annepidem.2007.03.013
35. Sogaard AJ, Selmer R, Bjertness E, Thelle D. The oslo health study: the impact of self-selection in a large, population-based survey. *Int J Equity Health.* (2004) 3:3. doi: 10.1186/1475-9276-3-3
36. Miranda-Mendizabal A, Castellví P, Parés-Badell O, Alayo I, Almenara J, Alonso I, et al. Gender differences in suicidal behavior in adolescents and young adults: systematic review and meta-analysis of longitudinal studies. *Int J Public Health.* (2019) 64:265–83. doi: 10.1007/s00038-018-1196-1

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Wathelet, Vincent, Fovet, Notre-dame, Habran, Martignè, Baubet, Vaiva and D'Hondt. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# The Impact of Post-traumatic Stress of SARS-CoV-2 Affliction on Psychological and Mental Health of Student Survivors: Cross Sectional Study

## OPEN ACCESS

### Edited by:

Xenia Gonda,

Semmelweis University, Hungary

### Reviewed by:

Srilatha Girish,

Gulf Medical University, United

Arab Emirates

Franziska Köhler-Dauner,

Ulm University Medical

Center, Germany

### \*Correspondence:

Snehil Dixit

snehildixit.pt@gmail.com;

snehildixit83@gmail.com

### Specialty section:

This article was submitted to

Public Mental Health,

a section of the journal

Frontiers in Public Health

**Received:** 30 December 2021

**Accepted:** 28 March 2022

**Published:** 09 May 2022

### Citation:

Dixit S, Musa A, Silva AB, Reddy RS,

Abohashrh M, Kakaraparthi VN,

Asiri F, Caruso FR, Govindappa SK

and Mohammed AA (2022) The

Impact of Post-traumatic Stress of

SARS-CoV-2 Affliction on

Psychological and Mental Health of

Student Survivors: Cross Sectional

Study.

Front. Public Health 10:845741.

doi: 10.3389/fpubh.2022.845741

**Snehil Dixit<sup>1,2\*</sup>, Alamin Musa<sup>3</sup>, Audrey Borghi Silva<sup>2</sup>, Ravi Shankar Reddy<sup>1</sup>, Mohammed Abohashrh<sup>4</sup>, Venkata Nagaraj Kakaraparthi<sup>1</sup>, Faisal Asiri<sup>1</sup>, Flavia Rossi Caruso<sup>2</sup>, Shashi Kumar Govindappa<sup>5</sup> and Arif Ahmad Mohammed<sup>6</sup>**

<sup>1</sup> Department of Medical Rehabilitation Sciences, College of Applied Medical Sciences, King Khalid University, Abha, Saudi Arabia, <sup>2</sup> Cardiopulmonary Physiotherapy Laboratory, Physiotherapy Department, Federal University of Sao Carlos, Sao Carlos, Brazil, <sup>3</sup> Department of Radiological Sciences, College of Applied Medical Sciences, King Khalid University, Abha, Saudi Arabia, <sup>4</sup> Department of Basic Medical Sciences, College of Applied Medical Sciences, King Khalid University, Abha, Saudi Arabia, <sup>5</sup> Department of Physiotherapy, College of Applied Medical Sciences, University of Hail, Hail, Saudi Arabia, <sup>6</sup> Centre of Excellence in Biotechnology Research, King Saud University, Riyadh, Saudi Arabia

**Background:** COVID-19 survivor's population is often associated with a long term impact on mental and psychological health. Recent included studies have also stated affliction of mental health due to fear of virus and preventive policies among the college students.

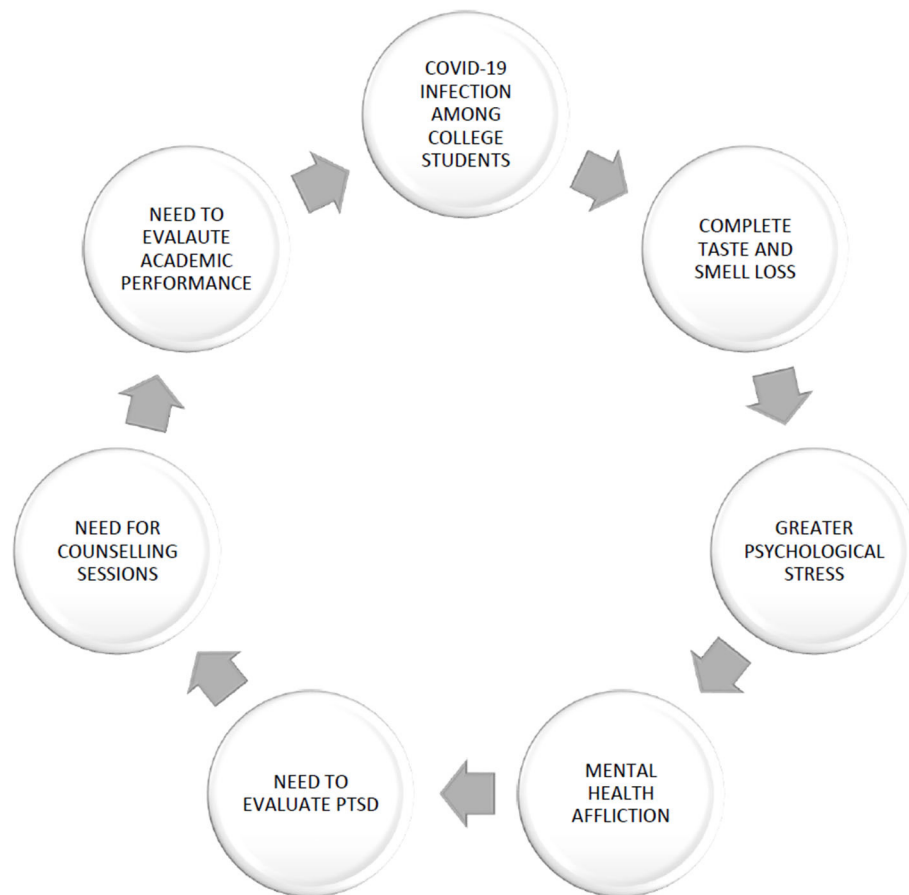
**Objectives:** The research was conducted to find the psychological and mental impacts of SARS-CoV-2 affliction among the students' survivors in the university.

**Methods:** The study design of the experiment was cross-sectional, sampling technique was non probability and sampling method being applied was convenience sampling. IBM Statistical Package for the Social Sciences version 20 was used for analyses. Descriptive data was examined and results were showed as mean and standard deviations, percentages, frequencies for continuous variables of IES-R scale (Intrusion, Avoidance, and Hyperarousal) using the total sample of  $n = 34$ .

**Results:** Out of 34 only 24 student survivors responded to the online survey post COVID-19 recovery, with an overall participation level of 71%. Grading was given for the total IES-R score which was subdivided into a predefined range. Out of 24 participants, 9 (38%) participants showed the symptoms of mild ( $n = 2$ )–severe ( $n = 7$ ) psychological impacts. On correlation of factors total IES-R score and taste and sense of smell were moderately correlated. The ordinal regression for complete loss of sense of taste and smell was also significant.

**Conclusion:** The results from IES-R evaluation clearly outlines the presence of psychological sequels post recovery of COVID-19 episodes among the young college survivors. Complete loss of sense of smell and taste may be an indicator of psychological sequelae as compared to reduce sense of smell.

**Keywords:** psychological impact, cognitive impact, post-traumatic stress, SARS-CoV-2, post-traumatic stress disorders (PTSD)



**GRAPHICAL ABSTRACT |** Psychological, mental health, and academic performance evaluation post COVID-19 infection among students.

## BACKGROUND

Since the outbreak of a novel coronavirus in December 2019 (which was first termed 2019-nCoV, then later SARS-CoV-2) a series of unprecedented events followed with the epicenter being in Wuhan, China (1). The global threat situation as categorized by WHO's for the pandemic was "very high" as it spreads very

quickly among the healthy and diseased population with a higher mortality rate (2).

A series of worldwide lockdowns were imposed causing anxiety, depression, stress and sedentary behaviors among the healthy and diseased population (3). A study analyzing the psychological impacts in Saudi Arabia of corona virus disease (COVID-19) found that almost one fourth of the sampled population experienced moderate to severe symptoms (4). It is usually observed that the mental health evaluation of persons exposed to such natural tragedy experiences frequently report emotional health issues including post-traumatic stress disorders (PTSD), anxiety, fear and depression (5).

**Abbreviations:** SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; COVID-19, Coronavirus disease of 2019; IES-R, Impact of event scale (IES)-Revised; NCEP ATP III, National Cholesterol Education Program and Adult Treatment Panel III; PTSD, Post-traumatic stress disorders; LOTAS, Loss of sense of taste and smell; WHO, World Health Organization; RT-PCR, Reverse Transcription-Polymerase Chain Reaction.



The norms of COVID-19 prevention were strictly enacted in the country, still due to high transmission rate present with the virus (2) it has affected the student population. Though death in younger population may be rare but, they may suffer from disruptive and even life altering perceptions (6). Another surprising discovery of COVID-19 is that the people affected with even milder strain of the virus may have long term complications of the disease (7). Long term complications may range from cardiovascular, neurological and musculoskeletal complications and the most commonly reported long term symptoms are fatigue and breathlessness (7).

As the transmission of the virus is high thereby isolation of the affected population is required. During the quarantine period usually the patients report psychological discomfort which could result in mental health problems in long run (8). It's been proven that COVID-19 survivors experience COVID-19 stigma, fear of eminent death, which may have long term impact (9).

Now there are also mounting evidences in the researches to suggest that stress can be caused by the disease process, anxiety of spreading the disease to others and COVID-19 humiliations can cause feeling of dejection among the survivors (9). Some researchers also suggested that there appears to be an increased risk of psychiatric consequences among the survivors (10). A recently published study found after 6 months of follow-up, lone survivors were primarily distressed by sleep difficulties, fatigue, depression and anxiety (11). The aforementioned studies clearly outline the development of psychological issues in COVID-19. Hence, from the previous researches it's quite obvious that it will be of vital importance to measure the psychological impact among young survivors post COVID-19 infection.

Originally the impact of event scale (IES) was developed for people experiencing post-traumatic stress disorders (12). It is the most commonly used scale for measurement of stress, anxiety and depressive symptoms after a traumatic event (13). Lately another version of the Impact of Events Scale-Revised (IES-R) is being inducted which is a 22-item self-reported scale for trauma related distress, validated in people with traffic injuries (12). The scale also have been adapted to measure the mental and psychological stress arising among the COVID-19 Survivors (14).

Commonly identified stressors among the college students include academic pressure, environmental pressure, social and interpersonal pressure (15). To elaborate, the student population have often encountered an increased psychological or mental health issues during the COVID-19 pandemic (15). The postulated reasons could be due to stress from long hours of online classes, exams, assignment submissions, no practical exposure, no recreational activities due to series of lockdown which may have further amplified the social stigma and psychological impacts from COVID-19. However, still we need to analyze the mental and psychological states of college students post COVID-19 recovery.

Hence the need of the present study is to understand the psychological and mental health of young student survivors in Saudi Arabia after getting infected with COVID-19 infection. So, the present objective of the research was to find the impact on psychological and mental health of the students' survivors at the university post SARS-CoV-2 infection.

## METHODS

### Study Design and Sampling Technique

The study had university ethical clearance number, University Protocol Record ECM#2020-2501 and also registered at *ClinicalTrials.gov* with number # NCT04746443. The study was open for recruitment to the participants by December 2020. The study design of the experiment was cross-sectional, sampling technique being non-probability and sampling method being implied was convenience sampling.

### Setting and Study Procedures

The study was conducted in King Khalid University, Saudi Arabia among the college going students of physiotherapy, radiology and medicine program. A prior consent was taken before they participated in the online version of IES-R. In the current study the participants were given online instructions and education related to the questionnaire in study, the associated advantages and risks and the way in which data from the participants will be used for analyses. The participants were also assured that under all circumstances anonymity and confidentiality of the participants will be maintained.

The participants were asked to join the experimental survey only when the active phase of the disease or related symptoms was over, that was mostly after 20<sup>th</sup> day, by then all study participants have recovered and resumed their diurnal activities and lifestyle. Before starting the survey, the participants were given sets of standardized instructions i.e., a brief how to fill the online survey. The IES-R is an easily self-administered 22-item questionnaire to evaluate the symptoms of posttraumatic stress disorder (PTSD) after any traumatic event. The scale consist of three parts mainly avoidance, intrusion, and hyper arousal. For each answers to the question it was rated using the score from zero to four, in the scale usually score of zero indicates "not at all" and score of four "extremely affected." The overall score for IES-R was mainly classified as either into 0–23 which says the score is normal, a score of 24–32 predicts a mild affliction, score of 33–36 predicts moderate affliction, and a score >37 predicts severe psychological impact (4). Apart from the routine IES-R questions additional questions were also recorded like age, ethnicity, ability to smell, approximate date of the event and presence of any previous comorbidities.

The validity of IES-R is well-established to measure delayed onset of post-trauma frequencies. Such findings have already facilitated our understanding regarding evaluation and management in younger population in clinical and research scenario. Moreover, the scale also reports a high test–retest reliability among the affected population collected at 6-month interval (0.89–0.94) (16).

The inclusion criteria of the study were college going students who were tested positive on RT-PCR testing and exhibited symptoms in accordance with the guidelines laid down by ministry of Saudi Arabia. The exclusion criteria for the study was unwillingness to participate, negative RT-PCR testing, inability to understand the instructions for online survey, severe illness affecting cognitive and intellectual functions and hospitalization

in ICU with mechanical ventilation. (<https://www.moh.gov.sa/en/Ministry/MediaCenter/Publications/Pages/covid19.aspx>).

## Data Analysis

The analysis was conducted using IBM SPSS Statistics for Windows, version 24. Each question in the survey were compulsory, that is, it was required to be filled before proceeding to the next questions. An analyses which mainly comprised of sociodemographic characteristics and symptom profile data (age and sense of smell) was showcased as descriptive statistics. The outcomes of these investigations were then showed as percentages and frequencies for categorical variables and means and standard deviations for continuous variables using the whole sample of  $n = 34$ . The results of which are presented in **Table 1**.

**TABLE 1** | Baseline characteristics of the participants in the study.

Variables	Number (n) = 24	Mean	Standard deviation
Age	24	21.42	1.21
Comorbidities	2 (Obesity)		
IES-R (Total score)	24	21.25	18.1
IES-R (Intrusion)		20.38	10.13
IES-R (Avoidance)		23.88	6.56
IES-R (Hyperarousal)		26	8.46

**TABLE 2** | Itemized response of participants for each questions of IES-R.

Questions	Not at all	A little bit	Moderately	Quite a bit	Extremely
1. Any reminder brought back feelings about it	50%	33.3%	8.3%	-	8.4%
2. I had trouble staying asleep	45.7%	8.3%	8.3%	29.2%	8.4%
3. Other things kept making me think about it	54.1%	4.2%	29.2%	4.2%	8.3%
4. I felt irritable and angry	45.8%	16.7%	8.3%	16.7%	12.5%
5. I avoided letting myself get upset when I thought about it or was reminded of it	54.2%	4.2%	8.3%	8.3%	25%
6. I thought about it when I didn't mean to	58.3%	16.7 %	12.5%	12.5%	-
7. I felt as if it hadn't happened or wasn't real	66.7%	4.2%	12.5%	8.3%	8.3%
8. I stayed away from reminders of it	41.7%	33.3%	20.8%	4.2 %	-
9. Pictures about it popped into my mind	54.2%,	12.5%	8.3%	8.3%	16.7%
10. I was jumpy and easily startled	45.8%	37.5%	4.2%	8.3%	4.2%
11. I tried not to think about it	66.6%	12.5%	16.7%	-	4.2%
12. I was aware that I still had a lot of feelings about it, but I didn't deal with them	58.3%	12.5%	8.3%	12.5%	8.4%
13. My feelings about it were kind of numb	54.2%	12.5%	8.3%	16.7%	8.3%
14. I found myself acting or feeling like I was back at that time	62.5%	16.7%	12.5%	-	8.3%
15. I had trouble falling asleep	50%	-	20.8%	16.7%	12.5%
16. I had waves of strong feelings about it	58.3%	12.5%	20.8	4.2%	4.2%
17. I tried to remove it from my memory	54.1%	16.7 %	4.2%	-	25%
18. I had trouble concentrating	50%	-	25%	16.7%	8.3%
19. Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	66.6%	25%	4.2%	-	4.2%
20. I had dreams about it	95.8%	-	4.2%	-	-
21. I felt watchful and on-guard	66.6%	4.2%	4.2%	8.3%	16.7%
22. I tried not to talk about it	66.6%	16.7%	4.2%	-	12.5%

The mental affliction of SARS-CoV-2 pandemic was evaluated utilizing the scores of the IES-R results described as mean and standard deviation. Further in the evaluation Bivariate analyses for correlation coefficients was used to a certain the strength of association amid discrete variables and scores the subscales of IES-R (Intrusion, Avoidance, and Hyperarousal) and the level of significance for the analysis was kept at  $p < 0.05$ . An Ordinal regression model was created using score rating (normal, mild, moderate, severe) on the IES-R as a dependent variable, and independent factors like sense of smell and covariate being age to know the degree of association of independent variable with dependent variable.

## RESULTS

All participants were from Aseer province, Saudi Arabia. A total of 34 students were established to have been infected by SARS-CoV-2 as also confirmed by the university record. The students of physical therapy, radiology and medicine programs were contacted through the online link, to fill the IES-R English version. A second reminder was sent after a week if in case the participants didn't respond to the first reminder. Out of 34 only 24 male students responded to the online survey with an overall participation level of 71%. Apart from IES-R additional factors like age, ethnicity, existing co-morbidity and ability to taste and smell were also reported.

The participant's average age was [Mean  $\pm$  Standard deviation (SD)] 21.63  $\pm$  1.27 years. According to this classification scores of each participant were analyzed which is presented in **Table 2**. Out of 24 participants, 9 (38%) participants showed the symptoms of mild ( $n = 2$ ) –severe ( $n = 7$ ) psychological impacts.

## Analysis of Participant's Response IES-R (1–22)

The frequency analysis of responses for each 22 items in the IES-R scale was done to know the individual effect on each participant, it has been summarized in **Table 2**.

## Loss of Sense of Taste and Smell

Out of 24, 16 (66.66%) participants reported temporary, complete loss of sense of taste and smell whereas 1(4.17%) participant reported in temporary reduction in sense of taste and smell. The other 7 (29.17%) participants reported no loss of sense of smell during the COVID-19 infection process.

## Psychological Impact as Measured Among Participants Based on Score of IES-R

The result from IES-R were interpreted under the pathological range and classified as per the scores from previous study (4, 17–19), usually a score  $>23$  was accepted to be in line with mental affliction. The scores were hence classified as 23 or more (mild) for persons who still do not have full blown symptoms of PTSD or at least some of the symptoms. Score of 33 (moderate) and above this represents the best cut off for a probable diagnosis of PTSD and a score of 37 (severe psychological impact) or more is high enough to suppress the immune system's functions. Seven participants out of 24 had a severe classification according to the scoring system, 2 participants had mild affection due to COVID-19, whereas 15 participants had normal scores.

## Correlation of Factors

Bivariate spearman correlation was done for factors like sense of taste and smell loss, age, IES-R total, intrusion, avoidance, hyperarousal scores. On correlation of factors like total IES-R score and sense of smell was significant with moderately negative association ( $-0.58^*$ ,  $p = 0.003$ ). Whereas, intrusion ( $0.11$ ,  $p = 0.79$ ), avoidance ( $-0.23$ ,  $p = 0.59$ ), hyperarousal ( $-0.11$ ,  $p = 0.84$ ) and age ( $-0.31$ ,  $p = 0.14$ ) aspect of IES-R was found to have very weak to weak correlation respectively.

## Ordinal Regression

A regression model was created using score rating (normal, mild, moderate, severe) on the IES-R as a dependent variable, independent factor as sense of smell and covariate being age. The model of fitting information was significant at  $p = 0.02$  (which implies we reject the null hypothesis i.e., there was a significant difference between the baseline model (dependent variables) to final model (independent variables), goodness of fit the Pearson value was  $> 0.05$  signifying a good statistical model between observed data and the fitted data in the model. A variance of [Pseudo  $r^2$ , (Nagelkerke)] 44.2% was found, which tells us the proportions of variance as explained by the independent variable on the dependent variable in the regression model.

The parameters estimate for age had a value of  $-0.45$  which was non-significant and for *complete* loss of sense of smell the estimate was  $-19.3$  which was significant, for *reduction* in sense of smell the estimate was  $-0.356$  with a non-significant. Thus, implying a significant difference between the IES-R score ratings of participants with complete loss of sense of smell as compared to reduced or normal sense of smell. In addition, the test of parallel lines was non-significant.

## DISCUSSION

This is the first study with the primary aim to address the psychological and mental impacts among young student's survivors post COVID-19 infections.

In the present study post COVID-19 infection, 38% of the population showed the symptoms of mild to severe psychological impacts. A study on anxiety and depression among COVID-19 survivors found that infection triggered turbulences in the immune system may start a vicious inflammatory cycle which may lead to psychiatric issues or worsening of symptoms among the survivors (20). It now evident that the psychiatric sequel to the infection may be caused by the virus or by psychological stress factors like social isolation, social stigma, rejection and living in limbo due to the risk of fatalities (9, 20). The immune reaction in the body to the coronavirus may pave way for local and systemic inflammatory process (20, 21) leading to insomnia and further aggravation of the impending psychiatric responses.

Almost 29% of the population abstained from answering the present surveys. A postulated reason could be social stigma. Social stigma in COVID-19 may be defined as a state in which people with potential source of infection may be excluded from daily social practices posing a risk to the active social living in the society (22). The magnitude of the problem may further be amplified with perceived racial, religion, tribe or caste discriminations (23).

Another interesting finding of the current study was loss of LOTAS among the participants which was found to be approximately 67%. In addition, LOTAS was found to be associated with the severity of the IES-R. Though the exact mechanism highlighting it isn't evident but this problem has been primarily postulated to central nervous system dysfunction (24) raising the wide possibilities for variety of emotional disturbances among the population. The present study is in line with studies which outline olfactory dysfunction to be strongly associated with psychological sequelae. Though the study didn't report any mortality among the participants, which is also commonly associated with loss of sense of smell and taste (24) among the afflicted population.

The diagnostic ability of IES-R which compared war survivors from two large populations found the self-reported questionnaire to be clinically useful in screening patients of post-traumatic stress disorders (PTSD) (25). The authors also found that cut-off scores from 22, 30, 33, and 44, respectively are linked with good to excellent sensitivity (25). Even in the present study it's evident that the college going students did suffer from traumatic episodes post COVID-19 recovery.

The biological links between COVID-19 and mental health among survivors certainly cannot be ignored. The immune-inflammatory modulation during COVID-19 and recovery may pave its way for mental illness (26). There is a need for development of student counseling strategies to control and minimize the long-term mental impacts among them. To add further, there is also a need to establish an online mobile helpline support for younger survivors, increase awareness regarding coping up strategies and assessment of interpersonal problems (27) will play a foremost role in promoting wellbeing. A meta-analysis has also concluded that the mental health interventions can play a positive constructive role for promoting mental wellbeing among the survivors of COVID-19 (27).

In the present study 2 obese students were also afflicted with COVID-19. The prevalence rate of metabolic syndrome in Saudi Arabia is already found to be near about 39.8% according to the data obtained from National Cholesterol Education Program and Adult Treatment Panel III (NCEP ATP III) (28), further studies also suggest that prevalence of overweight, obesity, hypertension and diabetes are also high in the region (29). These factors will accelerate the unfavorable outcomes among the survivors. A study outlined that obesity and pre-existing co-morbidities may increase the admissions to intensive care unit, lung damage and mortality among those affected by the SARS-CoV-2 virus (30). To add further, there is still ambiguity in data how the presence of comorbidities may affect the COVID-19 disease process in the younger population with economic, geographic and biological differences, hence there is better need for guidelines for rehabilitation and decision making process for children's, adolescent and young adults affected (31).

The current need is to develop a model for younger population afflicted by COVID-19 (Figure 1) in academic institutions. There is strong evidence that exercises may not only modulate cardiovascular risk factors but can also promote a feeling of wellbeing among those affected with COVID-19. It is also vital to encourage students post COVID-19 recovery to participate in mild to moderate activity as a strategy for self-management of anxiety and mood problems (32) among those affected. It is also reported that sports person who are physically active pose a lesser risk of transmission (33) a postulated reason could be physical activity modulate the immune defense mechanism (34) and a recent guidelines also emphasizes the need for staying active due to its multiple optimistic effects with the requirement to bring together clinical services together to address the current issue (35).

## Study Strength and Limitations

The study foremost strength is to identify the existence of psychological and mental health issue post COVID-19 episode among the survivors at the university. The severity of the IES-R score may depend on the complete loss of taste and sense of smell. The study also emphasizes the need for the development of an academic counseling model to be used at the college and university level to address the issue as it may affect the academic



**FIGURE 1** | Outlines the Counseling model to be used in the academic institutions if an individual gets afflicted with COVID-19.

performances of the students. The notable limitations were a smaller sample size, as the incidence rate was lesser during the study period. Additionally, other factors were not included such as socio-demographic factors, gender, BMI, Hospitalization/home isolation, treatment, prior physical activity levels which are known independent variables and could have influenced the mental health. A part from that all the participants were male who were included in the study and didn't had any previous history of mental or emotional illnesses.

## CONCLUSION

The study clearly outlines the presence of psychological sequels post recovery of COVID-19 infection among the young college going population. The students with complete loss of taste and smell may be more adversely affected than those who didn't experience the complete loss of taste and smell. It is also quite evident that there is a need for academic counseling models for the students affected.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University Protocol Record ECM#2020-2501. The



patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

SD: study conception and design. SD, AMu, VK, and RR: data collection. SD, AB, and MA: analysis and interpretation of results. FC, SG, and AMo: data cleaning. SD, AB, and FA: draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

## REFERENCES

- Supady A. Consequences of the coronavirus pandemic for global health research and practice. *J Glob Health*. (2020) 10:010366. doi: 10.7189/jogh.10.010366
- Yezli S, Khan A. COVID-19 social distancing in the Kingdom of Saudi Arabia: bold measures in the face of political, economic, social and religious challenges. *Travel Med Infect Dis*. (2020) 37:101692. doi: 10.1016/j.tmaid.2020.101692
- Dixit S, Nandakumar G. Promoting healthy lifestyles using information technology during the COVID-19 pandemic. *Medicine*. (2021) 2:1–12. doi: 10.31083/j.rcm.2021.01.187
- Alkhamees AA, Alrashed SA, Alzunaydi AA, Almohimeed AS, Aljohani MS. The psychological impact of COVID-19 pandemic on the general population of Saudi Arabia. *Compr Psychiatry*. (2020) 102:152192. doi: 10.1016/j.comppsy.2020.152192
- Jeong H, Yim HW, Song Y, Ki M, Min J, Cho J, et al. Mental health status of people isolated due to Middle East Respiratory Syndrome. *Epidemiol Health*. (2016) 38:e2016048. doi: 10.4178/epih.e2016048
- Abbasi J, Hall B. Younger adults caught in COVID-19 crosshairs as demographics shift. *JAMA*. (2020) 324:2141–3. doi: 10.1001/jama.2020.21913
- Shah W, Hillman T, Playford ED, Hishmeh L. Managing the long term effects of covid-19: summary of NICE, SIGN, and RCGP rapid guideline. *BMJ*. (2021) 372:n136. doi: 10.1136/bmj.n136
- Hu Y, Chen Y, Zheng Y, You C, Tan J, Hu L, et al. Factors related to mental health of inpatients with COVID-19 in Wuhan, China. *Brain Behav Immun*. (2020) 89:587–93. doi: 10.1016/j.bbi.2020.07.016
- Moradi Y, Mollazadeh F, Karimi P, Hosseingholipour K, Baghaei R. Psychological disturbances of survivors throughout COVID-19 crisis: a qualitative study. *BMC Psychiatry*. (2020) 20:594. doi: 10.1186/s12888-020-03009-w
- Taquet M, Luciano S, Geddes JR, Harrison PJ. Bidirectional associations between COVID-19 and psychiatric disorder: retrospective cohort studies of 62 354 COVID-19 cases in the USA. *Lancet Psychiatry*. (2021) 8:130–40. doi: 10.1016/S2215-0366(20)30462-4
- Huang C, Huang L, Wang Y, Li X, Ren L, Gu X, et al. 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study. *Lancet*. (2021) 397:220–32. doi: 10.1016/S0140-6736(20)32656-8
- Beck JG, Grant DM, Read JB, Clapp JD, Coffey SE, Miller LM, et al. The impact of event scale –revised: psychometric properties in a sample of motor vehicle accident survivors. *J Anxiety Disord*. (2008) 22:187–98. doi: 10.1016/j.janxdis.2007.02.007
- Guest R, Tran Y, Gopinath B, Cameron ID, Craig A. Prevalence and psychometric screening for the detection of major depressive disorder and post-traumatic stress disorder in adults injured in a motor vehicle crash who are engaged in compensation. *BMC Psychol*. (2018) 6:4. doi: 10.1186/s40359-018-0216-5
- Ifthikar Z, Fakhri SS, Johnson S, Alex J. Post-traumatic stress disorder following COVID-19 pandemic among medical students in Riyadh: a cross-sectional study. *Middle East Curr Psychiatry*. (2021) 28:44. doi: 10.1186/s43045-021-00127-3
- Yang C, Chen A, Chen Y. College students' stress and health in the COVID-19 pandemic: the role of academic workload, separation

## FUNDING

This work was funded by King Khalid University, RGP.2/134/43.

## ACKNOWLEDGMENTS

Grateful to the resources and software provided by the King Khalid University, Saudi Arabia, to conduct the study during the pandemic.

- from school, and fears of contagion. *PLoS ONE*. (2021) 16:e0246676. doi: 10.1371/journal.pone.0246676
- By E, John P, Wilson PD, Cleveland State University Cleveland, Ohio U, Catherine So-kum Tang PDNU of SS. *Cross-Cultural Assessment of Psychological Trauma and PTSD*. Springer. (2018).
- Asukai N, Kato H, Kawamura N, Kim Y, Yamamoto K, Kishimoto J, et al. Reliability and validity of the Japanese-language version of the impact of event scale-revised (ies-r-j): four studies of different traumatic events. *J Nerv Ment Dis*. (2002) 190:175–82. doi: 10.1097/00005053-200203000-00006
- Creamer M, Bell R, Failla S. Psychometric properties of the impact of event scale—revised. *Behav Res Ther*. (2003) 41:1489–96. doi: 10.1016/j.brat.2003.07.010
- Kawamura N, Kim Y, Asukai N. Suppression of cellular immunity in men with a past history of posttraumatic stress disorder. *Am J Psychiatry*. (2001) 158:484–6. doi: 10.1176/appi.ajp.158.3.484
- Gennaro M, Lorenzo R De, Conte C, Poletti S. Anxiety and depression in COVID-19 survivors: role of inflammatory and clinical predictors. *Brain Behav Immun*. (2020) 89:594–600. doi: 10.1016/j.bbi.2020.07.037
- Zhang J, Xu D, Xie B, Zhang Y, Huang H, Liu H. Poor-sleep is associated with slow recovery from lymphopenia and an increased need for ICU care in hospitalized patients with COVID-19: a retrospective cohort study. *Brain Behav Immun*. (2020) 88:50–8. doi: 10.1016/j.bbi.2020.05.075
- Bhanot D, Singh T, Verma SK, Sharad S. Stigma and discrimination during COVID-19 pandemic. *Front Public Heal*. (2021) 8:1–11. doi: 10.3389/fpubh.2020.577018
- Rodriguez-Seijas C, Stohl M, Hasin DS, Eaton NR. Transdiagnostic factors and mediation of the relationship between perceived racial discrimination and mental disorders. *JAMA Psychiatry*. (2015) 72:706–13. doi: 10.1001/jamapsychiatry.2015.0148
- Speth MM, Singer-Cornelius T, Oberle M, Gengler I, Brockmeier SJ, Sedaghat AR. Mood, anxiety and olfactory dysfunction in COVID-19: evidence of central nervous system involvement? *Laryngoscope*. (2020) 130:2520–5. doi: 10.1002/lary.28964
- Morina N, Ehring T, Priebe S. Diagnostic utility of the impact of event scale-revised in two samples of survivors of war. *PLoS ONE*. (2013) 8:6–13. doi: 10.1371/journal.pone.0083916
- Menon V, Padhy SK. Mental health among COVID-19 survivors: are we overlooking the biological links? *Asian J Psychiatry*. (2020) 53:102217. doi: 10.1016/j.ajp.2020.102217
- Soklaridis S, Lin E, Lalani Y, Rodak T, Sockalingam S. Mental health interventions and supports during COVID-19 and other medical pandemics: a rapid systematic review of the evidence. *Gen Hosp Psychiatry*. (2020) 66:133–46. doi: 10.1016/j.genhosppsych.2020.08.007
- Al-Rubeaan K, Bawazeer N, Al Farsi Y, Youssef AM, Al-Yahya AA, AlQumaidi H, et al. Prevalence of metabolic syndrome in Saudi Arabia - a cross sectional study. *BMC Endocr Disord*. (2018) 18:1–9. doi: 10.1186/s12902-018-0244-4
- Williams CD. Trends in social paediatrics. *J Trop Pediatr*. (1961) 7:83–6. doi: 10.1093/oxfordjournals.tropej.a057603
- Al S, Yaseen M, Yaseen I, Bin K, Hannawi H, Lakshmanan J, et al. Saudi journal of biological sciences combination of obesity

- and co-morbidities leads to unfavorable outcomes in COVID-19 patients. *Saudi J Biol Sci.* (2020) 28:1445–50. doi: 10.1016/j.sjbs.2020.11.081
31. Mofenson LM, Idele P, Anthony D, You D, Luo C, Peterson S. The evolving epidemiologic and clinical picture of SARS-CoV-2 and COVID-19 disease in children and young people. *BMJ Glob Health.* (2020) 5:e003454. doi: 10.1136/bmjgh-2020-003454
  32. Pelletier L, Shanmugasagaram S, Patten SB, Demers A. Self-management of mood and/or anxiety disorders through physical activity/exercise. *Heal Promot Chronic Dis Prev Canada.* (2017) 37:149–59. doi: 10.24095/hpcdp.37.5.03
  33. Jones B, Phillips G, Kemp S, Payne B, Hart B, Cross M, et al. CoV-2 transmission during rugby league matches : do players become infected after participating with SARS- - CoV-2 positive players? *J Sports Med.* (2021) 55:80–13. doi: 10.1136/bjsports-2020-103714
  34. Dixit S. Can moderate intensity aerobic exercise be an effective and valuable therapy in preventing and controlling the pandemic of COVID-19? *Med Hypotheses.* (2020) 143:109854. doi: 10.1016/j.mehy.2020.109854
  35. Faghy MA, Arena R, Stoner L, Haraf RH, Josephson R, Hills AP, et al. The need for exercise sciences and an integrated response to COVID-19: a position statement from the international HL-PIVOT network. *Prog Cardiovasc Dis.* (2021) 67:2–10. doi: 10.1016/j.pcad.2021.01.004
- Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
- Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Dixit, Musa, Silva, Reddy, Abohashrh, Kakaraparthi, Asiri, Caruso, Govindappa and Mohammed. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Psychological Responses and Strategies Towards the COVID-19 Pandemic Among Higher Education Students in Portugal and Switzerland: A Mixed-Methods Study

Françoise Schwander-Maire<sup>1</sup>, Ana Querido<sup>2,3,4</sup>, Tanya Cara-Nova<sup>1</sup>, Maria Anjos Dixe<sup>2,3,5</sup>, Djamel Aissaoui<sup>1</sup>, Zaida Charepe<sup>6,7</sup>, Derek Christie<sup>1\*</sup> and Carlos Laranjeira<sup>2,3,8\*</sup>

<sup>1</sup> HES-SO University of Applied Sciences and Arts Western Switzerland, School of Health Sciences Fribourg, Fribourg, Switzerland, <sup>2</sup> School of Health Sciences of Polytechnic of Leiria, Leiria, Portugal, <sup>3</sup> Centre for Innovative Care and Health Technology (ciTechCare), Polytechnic of Leiria, Leiria, Portugal, <sup>4</sup> Center for Health Technology and Services Research (CINTESIS), University of Porto, Porto, Portugal, <sup>5</sup> Comprehensive Health Research Centre (CHRC), Évora, Portugal, <sup>6</sup> Institute of Health Sciences (ICS), Universidade Católica Portuguesa, Lisboa, Portugal, <sup>7</sup> Center for Interdisciplinary Research in Health (CIIS), Universidade Católica Portuguesa, Lisboa, Portugal, <sup>8</sup> Research in Education and Community Intervention (RECI I&D), Piaget Institute, Viseu, Portugal

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Kuiyun Zhi,  
Chongqing University, China  
Francesco Chirico,  
Catholic University of the Sacred  
Heart, Italy

### \*Correspondence:

Derek Christie  
derek.christie@hefr.ch  
Carlos Laranjeira  
carlos.laranjeira@ipleiria.pt

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

Received: 24 March 2022

Accepted: 19 April 2022

Published: 11 May 2022

### Citation:

Schwander-Maire F, Querido A, Cara-Nova T, Dixe MA, Aissaoui D, Charepe Z, Christie D and Laranjeira C (2022) Psychological Responses and Strategies Towards the COVID-19 Pandemic Among Higher Education Students in Portugal and Switzerland: A Mixed-Methods Study. *Front. Psychiatry* 13:903946. doi: 10.3389/fpsy.2022.903946

**Background:** The COVID-19 pandemic has caused overwhelming changes in individual and community daily-life, resulting from the public health measures implemented to contain it, and also from its psychological and socio-economic consequences. These shifts and consequences impacted the entire population, but some groups are more likely to be affected by these changes, including higher education students.

**Objectives:** a) to investigate mental health status and its determinants among higher-education students in Portugal and Switzerland; and b) to explore adjustment patterns used by these students to overcome the impact of the COVID-19 pandemic.

**Methods:** A cross-sectional study with a mixed-methods sequential explanatory design was conducted in two phases. First, an online survey was conducted among higher education students in Portugal and Switzerland, in Portuguese and French respectively. A convenience sampling method was used. Second, some participants from the first phase were invited to participate in four online focus group discussions (two in each country) using a maximum variation sampling method.

**Results:** The survey was answered by 1,880 students. Portuguese students revealed higher levels of stress and anxiety, but lower depression symptoms and less resilient coping compared to Swiss respondents. Hope was identified as an explanatory variable for mental health symptoms in students from both countries. In the focus groups ( $n = 27$ ), 13 adjustment strategies were found, which were subdivided into three spheres: personal, social, and contextual.

**Conclusions:** The results suggest that the COVID-19 pandemic had a mild to moderate impact on most of the evaluated mental health variables. Nevertheless, the students

reacted and mobilized positive short-term strategies, which need to be reinforced in order to prevent long-term psychological harm. In addition, our results can inform psychosocial interventions to minimize psychological impact, anxiety, depression, and stress due to sanitary crises or other population-wide problems or disasters.

**Keywords:** Portugal, Switzerland, COVID-19, psychological impact, higher education, coping strategies, mixed-methods study, students

## INTRODUCTION

COVID-19 has brought physical, psychological, and social hardship to populations around the world. Arguably, the pandemic represents a “perfect storm” for mental health due to its prolonged and unpredictable character, based on an unfamiliar and invisible danger, and its real threat to lives and livelihoods (1).

Among the “at-risk” population, higher-education students have the dual characteristic of being vulnerable to stress and anxiety, and of potentially being able to embrace new technologies or new situations more readily than other groups. The former is evident from studies that pre-date COVID-19. Before the pandemic, “many students across the globe experienced high levels of anxiety, depressive moods, lack of self-esteem, psychosomatic problems, substance abuse, and suicidality” (2). A recent meta-analysis revealed that the prevalence of depression (39%) or anxiety (36%) among college students greatly increased during the COVID-19 pandemic (3). Another systematic review reported a general prevalence of anxiety in Europe as high as 51%, above that in Asia (33%), but lower than in the USA (56%) (4). In various studies, female gender, social isolation, student status, and low quality of social relations were identified as risk factors for lower mental health (5–7).

Although several studies have focused on the mental health of higher education students, there is a scarcity of studies documenting a holistic portrayal of associations between mental health and protective variables, such as hope and resilient coping. Students seem vulnerable to the negative effects of the pandemic and few studies find significant signs of resilience, such as the use of effective coping strategies (6). Moreover, no study used mixed methods to gain a better understanding of how COVID-19 affects mental health and what coping strategies students may employ in response.

The transactional model of stress by Lazarus and Folkman (8) served as the theoretical underpinning of the current study. It posits mutual interactions between people and their environment and suggests that the stress response is highly influenced by individual appraisal processes (9). This rationale underlies the interplay between physical, psychological, cultural, and social elements and their relationships with mental health, psychological well-being, and social functioning (10). As situations vary between countries, an investigation of the mental health and coping abilities of students under COVID-19 seemed of particular interest, if spanning culturally different settings. This study focuses on students in two middle-sized European countries, Portugal and Switzerland, which in December 2021

had a similar number of registered cases of COVID-19: around 1.3 million, for total populations of 10.3 and 8.6 million inhabitants, respectively (11).

The pragmatic aims of this study were: a) to investigate mental health status and its determinants among higher-education students in Portugal and Switzerland; and b) to explore adjustment patterns used by students to overcome the impact of the COVID-19 pandemic.

## METHODS

The study followed a mixed-methods approach with a cross-sectional explanatory sequential design, beginning with a quantitative phase that supplied context and participants for the subsequent qualitative phase (see **Figure 1**). Afterwards, the findings of the quantitative and qualitative phases of the study were combined (12).

The two parts of this international study were as follows:

- an online survey (quantitative) assessing the mental health status and psychological responses of higher-education students during the COVID-19 pandemic;
- a Focus Group study (qualitative) discussing the strategies adopted by students to face the COVID-19 pandemic.

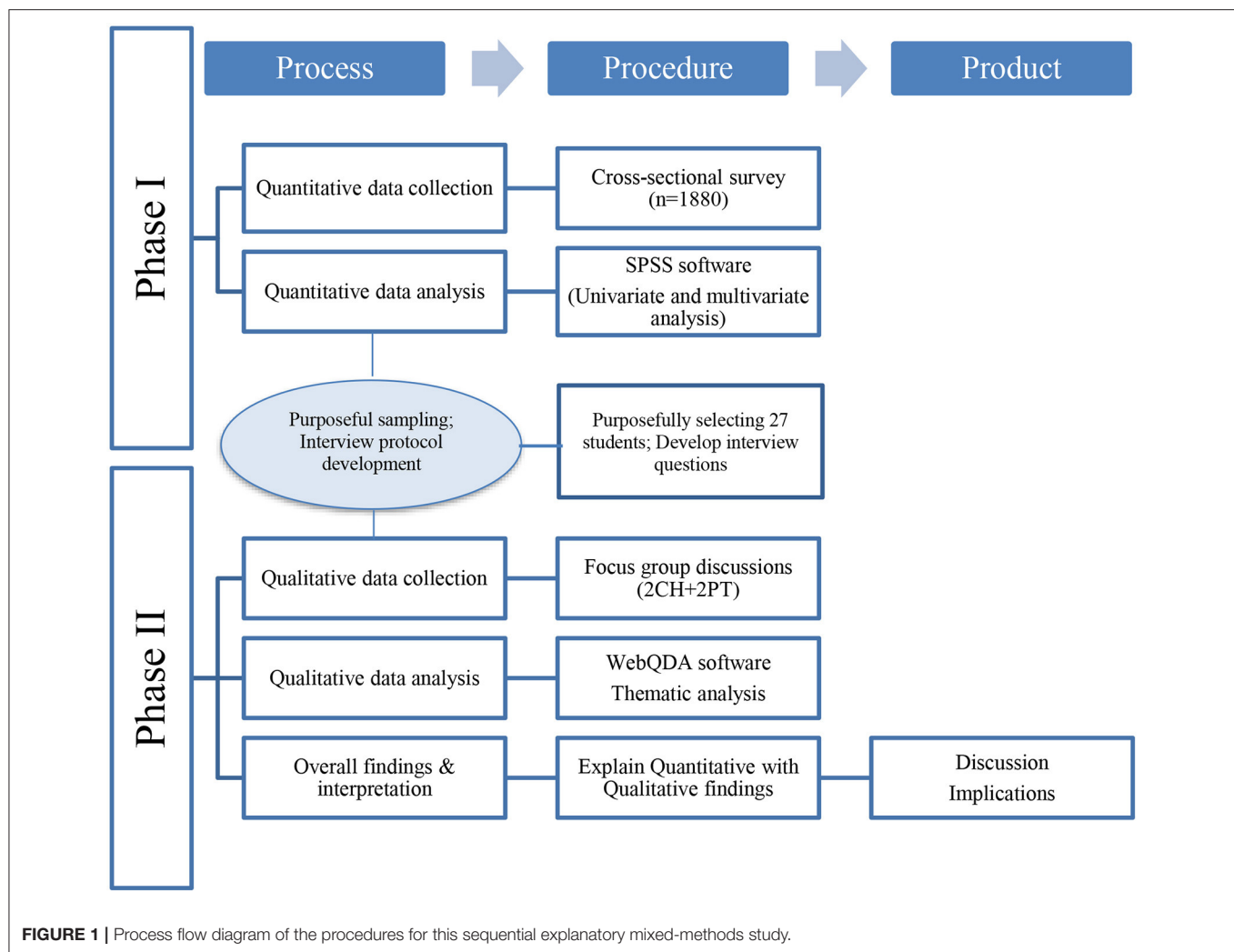
Ethical approval to conduct this study was obtained from the Ethics committee in Portugal (CE/IPLEIRIA/22/2020) and Switzerland (swissethics/CER-VD-2020-02889). Informed consent was obtained from all individual participants included in the study.

## Phase I: Quantitative Phase

### Data Collection

This cross-sectional study involved students from Portuguese and Swiss higher-education institutions. Adults enrolled in education levels above high school, including undergraduate and graduate programs, were considered eligible. The age composition of students in this type of programs is very heterogeneous, reflecting actual aging societies and lifelong learning concept. For that reason, no age limit was imposed. Students participating in Erasmus or other mobility programs were excluded. Participants were recruited using convenience sampling. Email contacts of interested participants were recorded in phase I, so they might be invited to participate in the qualitative phase. The total target population of Portuguese and Swiss higher-education students (4 Portuguese institutions and 4 Swiss institutions) was estimated at 61,000 individuals (13). The minimum sample size ( $n = 385$ ) was calculated





considering the most conservative scenario (a proportion of 50%), a level of confidence of 95%, and an error margin of 5%. Data were collected between April 2020 and June 2021, via an online survey, sent by the institutions who participated in the study, including:

- Sociodemographic and health information: gender, age; marital status; level of studies; study area; employment (if applicable); household size; perceived health status (using a scale ranging from 0 [worst] to 100 [best] respondents rated their own physical/mental and overall health); and history of chronic disease.
- The Depression, Anxiety and Stress Scale-21 (DASS-21) (14), in Portuguese (15) and French (16), to assess psychological distress experienced in the preceding week, using recommended cut-off points (17). Internal consistency (Cronbach's alpha) in this study for depression, anxiety, and stress was 0.92, 0.90, and 0.92, respectively, indicating very good reliability.
- The Herth Hope Index (HHI), with 12 items designed to measure hope in adults, in Portuguese (18) and French (19).

Internal consistency (Cronbach's alpha) in this study was 0.97, indicating excellent reliability.

- The Brief Resilient Coping Scale (BRCS), a 4-point measure to assess an individual's tendency to cope adaptively (20). The Portuguese version was validated by Pais-Ribeiro and Morais (21), and the French version was translated by Ionescu (22). Cronbach's alpha for this study was 0.79.
- The Impact of Event Scale-Revised (IES-R) (23), with 22 items describing distress experienced in response to traumatic events. This reliable and valid measure was used in Portuguese (24) and French (25). Internal consistency in the present study was excellent (Cronbach's  $\alpha = 0.95$ ).

### Statistical Analysis

Data were analyzed using SPSS Version 28. Descriptive data analysis was performed. Associations and/or differences between variables were determined with univariate and multivariate analyses. A linear regression model was used to evaluate the predictive capabilities of the independent variables with respect

to the corresponding decision variables (anxiety, stress, and depression). A 0.05 level of significance was used.

## Phase II: Qualitative Phase

### Data Collection

Phase II of this study was qualitative research to obtain additional insights into the online survey responses by carrying out Focus Group Discussions (FGDs). Before conducting the FGDs, the authors developed questions based on previous research (13, 26) enabling the acquisition of information regarding the strategies adopted by students to promote better psychological adjustment during the pandemic crisis (13). Participants who completed the anonymous online survey had the option to provide their contact information (e.g., email) if they were interested in participating in the FGDs. Eligible students were selected for the FGDs using a maximum-variation sampling method, creating a heterogeneous purposive sample. Four FGDs (two in each country) were conducted using Microsoft Teams and transcribed in full. In each country, the same non-directive moderating style was used to promote interactions between participants. Each FGD took approximately 60–90 min.

### Data Analysis

The data were coded and inductively analyzed using a thematic analysis approach (27). WebQDA software was used for qualitative data management (28). The research teams from each country examined qualitative data separately. Swiss and Portuguese data were then merged and analyzed together for common themes and patterns. Themes were identified inductively by two researchers from each country and discussed with the entire research team until consensus was reached. Verbatim quotes from participants were translated from the original into English by a bilingual researcher and used as examples when presenting results. Themes and subthemes were represented using coding trees to illustrate conceptual relationships between the emerging codes. Example extracts from participants were numbered according to FG (1–4), with nationality (PT/CH) in brackets.

### Validity

The validity of a mixed-method study depends on both the quantitative and qualitative phases. Potential validity threats were minimized by using a large sample size in the quantitative phase, by selecting maximal variety (based on results obtained in phase I) between the participants selected for the FGDs, and by focusing equally on the validity of the two phases (12). To ensure trustworthiness, the researchers were deeply involved in data handling and maintaining rigor during data analysis. The research team adopted a pragmatic stance, integrating the rationale of different methodological approaches (12), and including nurses involved in academic teaching and with practical nursing expertise (AQ, MAD, CL, FSM, TCN, and ZC), as well as a psychologist (DA) and a public health researcher (DC).

## RESULTS

### Quantitative Phase

#### Sociodemographic and Health-Related Characteristics of the Study Sample

Of the 1,880 participants in the survey, 1,522 were from Portugal and 358 from Switzerland (see **Table 1**). The mean age of participants was 23 years ( $SD = 6.5$ ) (range 18–59). Most participants were female (88.6%) and single (over 91.2%). Regarding the level of studies, 81.3% ( $n = 1,528$ ) were currently undergraduate students (Bachelor's degree), 38.4% in the field of health area, and 27.6% ( $n = 518$ ) declared being employed. The majority declared no chronic illness, but 13.4% (Switzerland) and 26.3% (Portugal) indicated they lived with elderly or chronically ill people.

Regarding sociodemographic and health-related variables, statistically significant differences were found between the participants from both countries of origin, except for marital status ( $p = 0.123$ ). A comparison of perceived health status, psychological impact, hope, and coping between the two countries is shown in **Table 2**. Portuguese respondents reported higher levels of perceived health status compared to Swiss students. However, the severity of psychological impact appeared to be worse in Portuguese students compared to Swiss students ( $p < 0.001$ ). The overall sample had a mean depression score of  $7.0 \pm 5.6$ , mean anxiety of  $5.2 \pm 5.3$ , and mean stress of  $8.2 \pm 5.6$ . Students from Portugal reported higher levels of stress and anxiety, but lower depression levels compared to Swiss respondents ( $p < 0.001$ ; with negligible Cohen's effect size).

The overall mean hope score (HHI) was 35 ( $SD = 6.4$ ) (range, 12–48). The BRCS score shows that 1,129 (60.1%) participants had low, 485 (25.8%) moderate, and 263 (14%) high resilient levels of coping. Compared with the Portuguese sample, Swiss participants had significantly higher resilient coping scores, but lower global hope scores ( $p < 0.001$  in all cases).

The IES-R global mean score was  $31.7 \pm 19.3$  (range, 0–88). Statistically significant differences between the two groups emerged for this scale, with the Portuguese sample reporting higher psychological impact compared with the Swiss sample ( $p < 0.001$ ; with a small Cohen's effect size).

#### Prevalence and Severity of Mental Health Symptoms and Psychological Impact

The results of the IES-R were as follows (see **Table 3**): no impact in 37.6%, mild psychological impact in 16.3%, moderate in 5.6%, and severe in 40.5%. Compared to the Swiss sample, Portuguese students had significantly higher scores on the IES-R scale with  $p$ -values  $< 0.001$ .

According to DASS-21, students with clinically significant anxiety were 44% of the total sample. The sum of clinically significant stress was 34.1%. Those with clinically significant depression were 31.7%. Among Swiss participants, respectively 31.2, 21.6, and 45.6% had symptoms of stress, anxiety, and depression above the normal range. More than half of the Portuguese students (64.3%) had normal scores on the stress

**TABLE 1** | Association between the sociodemographic/health variables and participants country of origin ( $n = 1,880$ ).

		CH ( $n = 358$ )		PT ( $n = 1,522$ )		$\chi^2/t$	$p$
		$n$	%	$n$	%		
Age (mean/SD)		23.70	4.64	22.85	6.95	2.197 <sup>†</sup>	0.028
Gender	Male	127	35.5	379	24.9	15.939	<0.001
	Female	231	64.5	1,143	75.1		
Marital status	Single	337	94.1	1,388	91.2	5.778	0.123
	Married	17	4.8	118	7.7		
	Divorced	4	1.1	13	0.9		
	widowed	0	0	3	0.2		
Live with elderly or chronically ill people	No	310	86.6	1,121	73.7	26.692	<0.001
	Yes	48	13.4	401	26.3		
Level of studies you attend	Graduation	323	90.2	1,205	79.2	69.210	<0.001
	Post-graduation	17	4.7	15	1.0		
	Master's Degree	16	4.5	154	10.1		
	Other	2	0.6	148	9.7		
Working student	No	196	54.7	1,166	76.6	69.389	<0.001
	Yes	162	45.3	356	23.4		
Study area	Health area	176	49.3	545	35.8	22.258	<0.001
	Other areas	181	50.7	977	64.2		
Diagnosed with a chronic illness?	No	335	93.6	1,285	84.4	19.588	<0.001
	Yes	23	6.4	237	15.6		

<sup>†</sup>Student *t*-test.**TABLE 2** | Comparison of perceived health status, psychological impact, hope and coping between the two countries (Portugal vs. Switzerland;  $n = 1,880$ ).

Variables	CH ( $n = 358$ )		PT ( $n = 1,522$ )		$t$	$p$	Effect size*
	Mean	SD	Mean	SD			
Mental health state, with reference to the last month	42.72	24.76	61.57	21.36	-14.55	<0.001	22.04
Physical health state, with reference to the last month	49.36	22.61	65.09	19.89	-13.09	<0.001	20.44
Overall state of health -with reference to the last month	49.51	21.34	66.86	17.92	-15.86	<0.001	18.62
DASS-Stress	7.54	5.24	8.42	5.75	-2.65	0.008	5.66
DASS-Anxiety	3.61	4.21	5.68	5.48	-6.67	<0.001	5.26
DASS-Depression	9.10	5.52	6.57	5.61	7.67	<0.001	5.59
HHI	32.73	8.19	35.52	5.92	-7.34	<0.001	6.40
BRCS	13.60	2.98	12.50	3.47	5.46	<0.001	3.39
IES-R	21.56	15.90	34.08	19.26	-11.4	<0.001	18.67

\*Cohen's effect size.

subscale, but 29.7% were in the mild range, and 6% could be classified as moderate. Regarding anxiety, 63.8% of the total sample had symptoms in the normal range; 12.5% were mild; 15.4% were moderate; 6.6% were severe; and 1.6% were extremely severe. A normal level of depressive symptoms was present in 71.5%, mild in 11.4%, moderate in 16.2%, and severe in 1% of the total sample.

As indicated in **Table 3**, in almost all the variables under study (except for stress), the COVID-19 pandemic had a more negative impact on Portuguese students than on Swiss students; these differences were statistically significant ( $p < 0.001$ ).

### Factors Affecting Depression, Anxiety, and Stress Among Students

As shown in **Table 4**, the perception of mental health state and hope were negatively correlated with stress in both samples. Similarly, perception of mental health state and hope were negatively correlated with depression. In Portuguese students, resilience ( $\beta = 0.161$ ,  $p < 0.001$ ) played a protective role relative to depression. Anxiety, perception of mental health ( $\beta = -0.98$ ,  $p < 0.001$ ), and hope ( $\beta = -0.182$ ,  $p < 0.001$ ) were negatively correlated with depression in the Portuguese sample. In Swiss students, hope and overall state of health were negatively

**TABLE 3 |** Prevalence of mental health symptoms and psychological impact between the two countries (Portugal vs. Switzerland;  $n = 1,880$ ).

		CH ( $n = 358^*$ )		PT ( $n = 1,522$ )		$\chi^2$	$p$	Odds-Ratio (95%)	$p$
		$n$	%	$n$	%				
IES_R	Normal (0–23)	216	60.3	490	32.2	117.620	0.001	3.204 (2.526–4.062)	<0.001
	Mild psychological impact (24–32)	63	17.6	243	16.0				
	Moderate psychological impact (33–36)	12	3.4	94	6.2				
	Severe psychological impact (>37)	67	18.7	695	45.6				
DASS-Stress	Normal stress (0–10)	245	68.8	978	64.3	5.769	0.056	1.206 (0.943–1.543)	<0.001
	Mild stress (11–18)	100	28.1	452	29.7				
	Moderate stress (19–26)	11	3.1	92	6.0				
DASS-Anxiety	Normal (0–6)	279	78.4	962	63.2	36.523	0.001	2.056 (1.568–2.695)	<0.001
	Mild anxiety (7–9)	38	10.7	196	12.9				
	Moderate anxiety (10–14)	30	8.4	227	14.9				
	Severe anxiety (15–19)	9	2.5	107	7				
DASS-Depression	Extremely severe anxiety (20–42)	0	0	30	2	39.391	0.001	0.472 (0.373–0.597)	<0.001
	Normal (0–9)	194	54.5	1088	71.5				
	Mild depression (10–12)	59	16.6	173	11.3				
	Moderate depression (13–20)	96	27.0	246	16.2				
	Severe depression (21–27)	7	2.0	15	1.0				

\*Two missing cases for DASS-21 subscales.

associated with anxiety, while resilience ( $\beta = 0.166$ ,  $p = 0.035$ ) was a positive predictor of good mental health. Hope was found to be a significant explanatory variable for all mental health symptoms, in students of both countries.

In the Swiss sample, the model showed a predictive capacity ranging from 25.1% for anxiety to 49% for depression symptoms. In the Portuguese sample, explained variance ranged from 25.4% for anxiety to 44.2% for depression. Both models proved satisfactory (29) presenting F values with high statistical significance ( $p < 0.001$ ); and all  $t$ -test values were significant at  $p < 0.001$ .

## Qualitative Phase

The four FGDs relied on a total of 27 participants (Switzerland: 15 participants for 2 FGDs; Portugal: 12 participants for 2 FGDs). Using thematic analysis, 13 subthemes were extracted and classified into three main themes – or spheres – concerning the adjustment strategies adopted by students (see Table 5).

The first theme was related to the personal sphere, where students developed the most adjustment strategies in both countries. They referred to an opportunity for personal growth and adaptability. Portuguese students talked about a “window of opportunity” to be involved in academic and professional projects, although students in Switzerland did not mention this point. Focusing on work-life balance was a strategy mentioned in both countries, mostly by organizing and separating work from private life. Self-care through the adoption of healthy lifestyles was also important and was mostly related to physical activity and/or eating habits. Being compassionate with others emerged as a strategy that helped put things into perspective and remain

aware of one's role in helping and protecting others, either directly through volunteer work or indirectly by staying at home and avoiding contacts. Students reported feeling overwhelmed by the quantity of information from different media and felt the need to select the most useful sources. Compliance with sanitary measures was an essential strategy that emerged in both countries with some differences, especially concerning the different waves of the pandemic.

In the social sphere, students evoked new ways of communicating via digital networking to compensate for the lack of physical proximity and stay in safe contact with friends and relatives. Portuguese students mentioned new ways of being physically close, such as communicating through a window or from a balcony, while students in Switzerland found alternative ways of socializing by going for physically distanced walks with friends. A strategy that was greatly discussed in all FGs was the importance of being with family and friends. Students felt more aware of the importance of cultivating these relationships and giving value to time passed with loved ones.

In the contextual sphere, students of both countries talked about the importance of adapting the “teaching/learning” environment. They found themselves in a new situation and had to adapt almost constantly to new ways of studying and learning online. Even in difficult situations, advantages were perceived by some students, such as not having to commute to the university. Tailored teaching support was a significant strategy, especially in maintaining their motivation. Portuguese students brought up that school support services helped them deal with certain difficulties, but this was not mentioned by students in Switzerland.



**TABLE 4 |** Multivariate logistic regression analysis associated with student stress, anxiety, and depression ( $n = 1,880$ ).

Dependent variable	Independent variable	CH					PT				
		$\beta$	$p$	$R^2$	$R^2_{Adjusted}$	F (p)	B	$p$	$R^2$	$R^2_{Adjusted}$	F (p)
Stress	State of mental health	-0.098	<0.001	0.361	0.358	98.218 <0.001	-0.122	<0.001	0.290	0.290	348.80 <0.001
	Hope	-0.134	<0.001				-0.174	<0.001			
Anxiety	State of mental health	N/A					-0.098	<0.001	0.255	0.254	259.82 <0.001
	Hope	-0.174	<0.001	0.257	0.251	39.941 <0.001	-0.182	<0.001			
	Overall state of health	-0.059	<0.001				N/A				
	Resilience	0.166	<0.035				N/A				
Depression	State of mental health	-0.093	<0.001	0.493	0.490	168.670 <0.001	-0.092	<0.001	0.443	0.442	402.86 <0.001
	Hope	-0.264	<0.001				-0.452	<0.001			
	Resilience	N/A					0.161	<0.001			

## DISCUSSION

This study set out to investigate the psychological and mental health responses of higher education students during the COVID-19 pandemic, and the coping strategies patterns they used to manage or deal with the pandemic. We found that 31.7, 44.0, and 34.1% of the participants had depression, anxiety, and stress symptoms, respectively. These rates were lower than in previous studies. For example, a meta-analysis (30) found a higher prevalence of anxiety and depression in pandemic-affected college students. In Switzerland, a survey conducted in April-May 2020 found that 85.8% of surveyed undergraduate students reported symptoms of anxiety, although in most cases the symptoms were mild (63.3%) (31). Another study, with 1,075 Portuguese and Spanish undergraduate students in April-May 2020, revealed high levels of perceived stress (51.9%) (32).

These differences may be related to when data was collected. Higher levels of depression in Switzerland and of anxiety and stress in Portugal suggest timing of data collection is relevant when investigating the prevalence of mental health symptoms. Recent findings seem to indicate that feelings of overwhelming, stress and anxiety were higher in the early months of the pandemic (33, 34). This evidence confirms the relevance of our results from students in Portugal, where data collection started 1 month after the outbreak of the pandemic. However, depressive symptoms, which include feelings of sadness, loss of interest and pleasure in activities, as well as disruptions of daily life, may remain high or even increase during a pandemic due to social isolation and physical distancing (35). This may explain why the Swiss students in our study had higher depressive symptoms: their data collection began 12 months after the start of pandemic.

Our results show that the COVID-19 pandemic had a worse impact on Portuguese than Swiss students. We hypothesize that this may be related to cultural differences. The Portuguese population is predominantly Catholic, with a close-knit family ethic, and experienced the pandemic as markedly disruptive, breaking family ties due to social restrictions, and highlighting

rooted fatalistic values (36). Although Switzerland generally scores highly on individualism, Swiss society is also characterized by adherence to rules – a characteristic linked to federalism (a defining attribute of the Swiss political system) and a collective mind-set (37). In such a cultural setting, individuals may attribute high value to the group, thus reducing the personal negative impact of external adverse events. Finally, trust toward scientists is higher in Portugal than in Switzerland (37); such trust may not have been an advantage in the initial phases of a pandemic that caught most scientists by surprise.

Resilience and hope feature prominently in our study, but to our knowledge they have rarely been used when investigating student reactions to the COVID-19 pandemic. Our research stresses the protective role of hope in the mental health status of students. Similar results have highlighted the protective benefits of hope on cognitive abilities in uncertain times (38, 39) and that hope can be a predictor of active coping styles adopted by students (40). Nevertheless, most of our participants had low levels of resilient coping. A possible reason is that the pandemic led to increases in anxiety and depression, but also undermined personal resilience (41).

Our qualitative findings in both countries showed that students developed adjustment strategies mostly in the personal sphere. Confinement and isolation may have made students more introspective, leading to solitude and, in turn, to the development of such strategies. As shown by Höglinger and Heiniger (42), feelings of solitude have been reported as being difficult to manage through the different pandemic waves. The adjustment strategies reported in our study are consistent with coping strategies reported by authors such as Shanahan et al. (43) and Burton-Jeangros et al. (26), who found that frequent use of strategies like keeping a daily routine, reappraisal/reframing, engaging in hobbies and activities and staying connected with others were associated with reduced distress (26, 43). Such approaches are needed to boost resilience factors protecting the individual against psychological distress (6).

**TABLE 5 |** The coding structure of main themes, subthemes and quoting passages.

Themes	Subthemes	Extracted codes
Personal sphere	Personal growth and adaptability	FGD1 (PT) "it's a learning process and it's great to see the <b>ability of human beings to adapt to new circumstances</b> , but at the same time, it also brings us [...] some insecurities [...]." FGD2 (CH) "[...] it's mainly the key words of <b>adaptation, change, fear and awareness</b> of our environment, but also of ourselves. And then from my point of view, it also allowed us to take <b>time for ourselves...</b> "
	"Window of opportunity" to be involved in academic and professional projects	FGD1 (PT) "[...] it was also a <b>window of opportunity</b> , also because I <b>managed to get involved in other projects that I would never achieve in terms of geographical distance.</b> "
	Focus on Work-life balance	FGD1 (PT) " <b>Structuring a timetable is very important [...].</b> Sometimes we lose a little bit of the notion that <b>we're working, the brain is working and it's tiring and that we're not taking any time for ourselves.</b> " FGD2 (CH) " <b>For me I tried to keep a fairly fixed timetable</b> , I need to know what is going to happen, to have everything planned out [...] <b>I am doing my routine</b> like when I was going to school [...]."
	Self-care through the adoption of healthy lifestyles	FGD1 (PT) "At the beginning of the pandemic, I also <b>dedicated myself more to sport</b> and now I ended up becoming a federated athlete, because, really, it was a great escape for me." FGD2 (CH) "[...] during the first wave, we had all the time in the world to <b>do sports</b> with videos in the garden and all that, [...] to cook again, and <b>I took a lot of time to cook</b> , which was very good at the time [...]."
	Being more compassionate to others	FGD4 (PT) "I felt I shouldn't be sad because <b>there were people worse than me and I felt I wanted to help.</b> However, I think I ended up realizing, a bit like my colleague, that our role was to stay at home effectively and try to make others aware of what we could do within our possibilities and within our training [...]." FGD1 (CH) "For my part, during the whole of the first period, the first wave, <b>I worked 100% in home care as a back-up because they really needed people</b> , whether it was to replace people who were COVID-19 positive."
	Selecting useful information about the pandemics	FGD1 (CH) "[...] being nice about the news and social networks, <b>after a while you don't have to read too much because</b> (laughs) otherwise I think we'd spend our day getting angry [...] so I think <b>having stopped watching it has helped me a lot.</b> " FGD1 (PT) "[...] I felt the issue of <b>selecting the news</b> I see was very important. [...] at the beginning, I saw everything and was even afraid to go to the door, and then <b>I started to select a little bit the news I read to be able to continue to have a normal life.</b> "
	Compliance with the sanitary measures	FGD2 (CH) "I think that during the first wave there were a lot more people who paid attention, who <b>were more inclined to respect the rules [...]</b> during the second wave, even now, <b>which still has some [...]</b> that many people are fed up and think that the rules are no longer important [...]." FGD4 (PT) " <b>Of course, there are things that stick, hand sanitizing whenever we touch something when we're in public spaces; wearing the mask in public spaces and using it to cover your nose and not put it on your chin [...].</b> "
Social sphere	New ways of communication – digital networking	FGD2 (CH) "[...] with my friends, we did quite a lot of " <b>skypero</b> " as we used to call it, an <b>aperitif in front of Skype</b> , to take our minds off things, have a laugh." FGD1 (PT) " <b>this group of friends that meets online every day ended up giving me a great escape.</b> So, we ended up accompanying each other, supporting each other and that was also one of the great pillars for managing to cope with all this stress."
	New ways of being physically close	FGD1 (PT) "[...] although there was no physical contact, in the pandemic, <b>they were on a balcony and I was down here on time because this contact is very, very, important, at least for me.</b> " FGD2 (CH) "[...] <b>I had to recreate a social thing because otherwise I knew I was really going to fall to the bottom.</b> So, I had to [...] in the end I went for a walk with friends, I invited friends for a drink from time to time, things like that, because otherwise I felt I wouldn't be able to hold on."
	Prioritise and valorise "being with my family and friends"	FGD2 (PT) " <b>Sometimes we do not give due value to our family [...]</b> what I want is, from now on, to enjoy every moment. Whenever there are opportunities, instead of creating obstacles for us to have these contacts." FGD1 (CH) "But then, now, with my behaviour, I say to myself that I have to enjoy it more. <b>Maybe I'll make more contact with colleagues, with the family, to make sure they're okay. I think it's a bit of a change from all that [...].</b> "

(Continued)

TABLE 5 | Continued

Themes	Subthemes	Extracted codes
Contextual sphere	Adaptation of the "teaching / learning" environment	FGD2 (CH) "[...] it brought a lot of positive things, also <b>distance learning, for journeys for example, organisation of the days</b> , sometimes there are those who prefer to work in the evening for example [...]."
	School support services	FGD1 (PT) "I think that the pandemic, in a way, <b>also made us develop some skills of adaptation to new contexts</b> . Without doubt! We had to restructure our way of organising ourselves, of living together, of learning, mainly at university level."
	Tailored teaching support	FGD1 (PT) "The school had a volunteer service. There was a student who also went shopping for me, I also had friends who went shopping for me. ... <b>It was good to have had that support and also to feel that I wasn't alone.</b> " [...] <b>That kind of support</b> (school support service) <b>helped me a lot, even to create study methods, methods to decrease anxiety.</b> " FGD1 (PT) "I was about to give up. Luckily Professor X insisted with me and didn't let that happen. <b>Luckily, he was always around, he encouraged me, he motivated me, he always met with me, whenever I needed him.</b> " FGD1 (CH) "[...] <b>the teachers, they used more direct contacts uh I mean more messages shared on Teams more ... well they made themselves very quickly easily available</b> on Teams or on the other platforms by mails [...]."

Students reported using social media and technology to maintain contact with family members and find information, an important coping strategy to deal with the pandemic lockdown found on other studies (34, 42, 44). This fits well within the concept of digital natives (45): many of today's students feel comfortable with technology from an early age and consider it an integral and necessary part of their lives. Our study supports this concept, especially the positive aspects of social media exposition, such as social connectedness, normalization of behaviors, compliance with government directives and access to support groups. Unsurprisingly, students mainly had a positive attitude toward online teaching and learning activities (46). Nevertheless, some scholars (45, 47) point out negative consequences such as loneliness, psychological distress, sleep deprivation, emotional anxiety, the spread of misinformation, and difficulty to discern facts from fiction.

The findings of this study suggest that the COVID-19 pandemic had a mild to moderate impact concerning most of the evaluated mental health variables. Nevertheless, the students reacted and mobilized positive short-term strategies that should be reinforced in order to protect them from long-term psychological harm. Furthermore, these strategies help students to stay mentally healthy and mitigate delayed-onset post-traumatic stress disorder during the COVID-19 pandemic (48).

## Implications for Practice, Research, and Policy

At a practical level, we suggest that higher education institutions reorganize teaching methods that provide greater consideration for student psychosocial functioning. Goal 3 of the 2030 Agenda for Sustainable Development (49) underlines the importance of new learning methodologies to promote self-care and personal knowledge for good mental health. Other recommendations include increasing social support (e.g., peer support system and professional mediation), which have the potential to alleviate the mental health burden. We also suggest designing or tailoring university-based interventions (e.g. psychoeducation, emotional

self-regulation, positive mental health promotion) to address student biopsychosocial needs (50).

At a research level, it is necessary to anticipate future crises and prepare for the transition to the post-COVID-19 world. We need to understand the implications of pandemics on the development of the academic, professional, and personal paths of students. Generally, our understanding of student health must integrate knowledge of their pre-existing health conditions. Future research would benefit from a prospective study with a comparison group that would help understand the longer-term impact of epidemics on the development of psychopathological symptoms. Also, studies investigating longitudinal data on risk and protective factors (e.g., substance use, coping strategies, satisfaction with life, social support, family and peer relationships dynamics) would be helpful.

At a policy level, we believe countries should introduce new forms of mental health support, including information materials (mostly online) and mental health support phone lines. It may be worthwhile to shift some mental health services to a telemedicine format and increase investment in mental health (51). Moreover, the COVID-19 has provided opportunities to build on positive innovations: the flexibility of community-based care, digital healthcare, and the connection of physical and mental health (52).

## Strengths and Limitations

Our results provide a theoretical basis for a broad audience of educators and researchers and may add to a better understanding of the impact of COVID-19 on higher education. Another strength is the mixed-methods research design and the use of valid and reliable instruments. The multicentric online survey provided broad ecological validity, while the focus groups brought explorative depth and consistency, and raised factors that could potentially mitigate some of the negative impacts. Despite these strengths, this study has some limitations. First, data collection did not occur at the same time in each country, because each was submitted to separate ethics committees

that did not operate under the same rules or at the same speed. Second, there is an absence of information on pre-existing mental health conditions, which we suggest should be included in future research on the topic. Third, the use of non-probability sampling procedures and self-reporting measures limit the representativeness of the study. Fourth, the sample lacks homogeneous criteria since most of the participants were female with Portuguese nationality. Lastly, our conclusions are based on cross-sectional data, so we are not able to report on changes over time and establish causality.

## CONCLUSION

Our findings support the idea that the COVID-19 pandemic has a significant impact on the mental health of higher education students. In the future, it would be desirable to focus on positive ways of coping and the potential of hope in this regard. Based on our results, positive coping and hope should be integrated into the standard training of students across all study areas. Indeed, a greater focus on protective factors may be a promising way to prepare students – and others – for future hardships, at individual, community, and societal levels.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## REFERENCES

- Giannopoulou I, Galinaki S, Kollintza E, Adamaki M, Kypourouopoulos S, Alevyzakis E, et al. COVID-19 and post-traumatic stress disorder: the perfect “storm” for mental health (review). *Exp Ther Med.* (2021) 22:1162. doi: 10.3892/etm.2021.10596
- Browning M, Larson LR, Sharaievska I, Rigolon A, McAnirlin O, Mullenbach L, et al. Psychological impacts from COVID-19 among university students: risk factors across seven states in the United States. *PLoS ONE.* (2021) 16:e0245327. doi: 10.1371/journal.pone.0245327
- Li Y, Wang A, Wu Y, Han N, Huang H. Impact of the COVID-19 pandemic on the mental health of college students: a systematic review and meta-analysis. *Front Psychol.* (2021) 12:669119. doi: 10.3389/fpsyg.2021.669119
- Liyanage S, Saqib K, Khan AF, Thobani TR, Tang WC, Chiarot CB, et al. Prevalence of anxiety in University students during the COVID-19 pandemic: a systematic review. *Int J Environ Res Public Health.* (2021) 19:62. doi: 10.3390/ijerph19010062
- McQuaid RJ, Cox SML, Ogunlana A, Jaworska N. The burden of loneliness: Implications of the social determinants of health during COVID-19. *Psychiatry Res.* (2021) 296:113648. doi: 10.1016/j.psychres.2020.113648
- Manchia M, Gathier AW, Yapici-Eser H, Schmidt MV, de Quervain D, van Amelsvoort T, et al. The impact of the prolonged COVID-19 pandemic on stress resilience and mental health: a critical review across waves. *Eur Neuropsychopharmacol.* (2022) 55:22–83. doi: 10.1016/j.euroneuro.2021.10.864
- Xiong JQ, Lipsitz O, Nasri F, Lui LMW, Gill H, Phan L, et al. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord.* (2020) 277:55–64. doi: 10.1016/j.jad.2020.08.001
- Biggs A, Brough P, Drummond S. *Lazarus and Folkman's Psychological Stress and Coping Theory. The Handbook of Stress and Health.* New Jersey: John Wiley & Sons Ltd. (2017). p. 349–64.
- Obbarius N, Fischer F, Liegl G, Obbarius A, Rose M, A. Modified version of the transactional stress concept according to Lazarus and Folkman was confirmed in a psychosomatic inpatient sample. *Front Psychol.* (2021) 12:584333. doi: 10.3389/fpsyg.2021.584333
- Reupert A. A socio-ecological framework for mental health and well-being. *Advances in Mental Health.* (2017) 15:105–7. doi: 10.1080/18387357.2017.1342902
- World Health Organization (WHO). *Coronavirus (COVID-19) Dashboard.* Available online at: <http://www.covid19.who.int> (accessed 20 March, 2022).
- Creswell J, Plano Clark V. *Designing and Conducting Mixed Methods Research.* 3rd ed. Thousand Oaks: SAGE Publications. (2017).
- Querido A, Aïssaoui D, Dixe M, Schwander-Maire F, Cara-Nova T, Charepe Z, et al. Psychological Impacts of the COVID-19 pandemic among portuguese and swiss higher-education students: protocol for a mixed methods study. *JMIR Res Protoc.* (2021) 10:e28757. doi: 10.2196/28757
- Lovibond PF, Lovibond SH. The structure of negative emotional states - comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behav Res Ther.* (1995) 33:335–43. doi: 10.1016/0005-7967(94)00075-U
- Apóstolo JL, Mendes AC, Azeredo ZA. Adaptation to portuguese of the depression, anxiety and stress scales (DASS). *Rev Lat Am Enfermagem.* (2006) 14:863–71. doi: 10.1590/S0104-11692006000600006
- Ramasawmy L. *Validation of the “French Depression Anxiety Stress Scales” (DASS-21) and Predictors of Depression in an Adolescent Mauritian Population. (Doctoral Dissertation), Aix-Marseille, France (2015).*
- Psychology C. *DASS 21 Scoring Instructions.* Available from: <http://comprehensivepsychology.com.au> (accessed 20 February 2022).
- Viana A, Querido A, Dixe M, Barbosa A. Avaliação da esperança em cuidados paliativos: Tradução e adaptação transcultural do Herth Hope index. *Int J Dev Educ Psychol.* (2010) 607–16.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee in Portugal (CE/IPLEIRIA/22/2020) and Switzerland (swissethics/CER-VD-2020-02889). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

The study was conceived and designed by AQ, MD, and CL in Portugal and by FS-M and TC-N in Switzerland. Jointly, all five set up an international collaboration, completed the study plan and obtained funding. Data collection and data analysis were carried out by DA, FS-M, and TC-N in Switzerland and by AQ, CL, MD, and ZC in Portugal. DC and CL drafted the first version of the manuscript. All authors contributed to the article and approved the submitted version.

## FUNDING

This work is funded by CCISP-HES.SO Collaborative Research, through: for Portugal, FCT and Fundação para a Ciência e a Tecnologia, I.P. (UIDB/05704/2020 and UIDP/05704/2020) and under the Scientific Employment Stimulus-Institutional Call—[CEECINST/00051/2018]; for Switzerland, HES-SO Rectorat-Impulsions. Call Swiss-Portuguese Projects (103744/R-PORTUG20-08).



19. Aissaoui D, Gronier G, Schwander F, Cara-Nova T. Validation of the French translation of the Herth Hope Index assessment (HHI-F). *Res Squ.* (2021).doi: 10.21203/rs.3.rs-753291/v1
20. Sinclair VG, Wallston KA. The development and psychometric evaluation of the brief resilient coping scale. *Assessment.* (2004) 11:94–101. doi: 10.1177/1073191103258144
21. Pais Ribeiro J, Morais R. Adaptação portuguesa da escala breve de coping resiliente. *Psicol Saúde Doenças.* (2010) 11:5–13.
22. Ionescu S. *Traité de Résilience Assistée.* Paris: Presses universitaires de France (2011).
23. Weiss D, Marmar C. The impact of event scale – revised. In: Wilson, JP; Keane, TM, editors. *Assessing Psychological Trauma and PTSD.* New York: Guilford Press (1997).p. 399–411.
24. Vieira CP, Paixão R, da Silva JT, Vicente HT. *Portuguese Version of The Impact of Event Scale – Revised (IES-R).* Lisboa: Centro de Investigação em Psicologia Universidade Autónoma de Lisboa. (2020).
25. Chiasson M, Lapierre S, Balbinotti MAA, Desjardins S, Vasiliadis HM. Validation de contenu de la version francophone du questionnaire impact of event scale-revised selon les critères du DSM-5. *Prat Psychol.* (2018) 24:21–34. doi: 10.1016/j.prps.2017.02.002
26. Burton-Jeangros C, Duvoisin A, Lachat S, Consoli L, Fakhoury J, Jackson Y. The impact of the Covid-19 pandemic and the lockdown on the health and living conditions of undocumented migrants and migrants undergoing legal status regularization. *Front Public Health.* (2020) 8:596887. doi: 10.3389/fpubh.2020.596887
27. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol.* (2006) 3:77–101. doi: 10.1191/1478088706qp063oa
28. Souza FN, Costa AP, Moreira A, Souza DN, Freitas F. *WebQDA: Manual de Utilização Rápida.* Aveiro: UA Editora. (2016).
29. Pestana MH, Nunes Gageiro J. *Análise de Dados para Ciências Sociais.* 6th ed. Lisboa: Edições Sílabo. (2014).
30. Chang JJ, Ji Y, Li YH, Pan HF, Su PY. Prevalence of anxiety symptom and depressive symptom among college students during COVID-19 pandemic: a meta-analysis. *J Affect Disord.* (2021) 292:242–54. doi: 10.1016/j.jad.2021.05.109
31. Lischer S, Safi N, Dickson C. Remote learning and students' mental health during the Covid-19 pandemic: a mixed-method enquiry. *Prospects.* (2021) 5:1–11. doi: 10.1007/s11125-020-09530-w
32. Laranjeira C, Querido A, Marques G, Silva M, Simões D, Gonçalves L, et al. COVID-19 pandemic and its psychological impact among healthy Portuguese and Spanish nursing students. *Health Psychol Res.* (2021) 9:24508. doi: 10.52965/001c.24508
33. Hawes MT, Szenczy AK, Olino TM, Nelson BD, Klein DN. Trajectories of depression, anxiety and pandemic experiences; a longitudinal study of youth in New York during the spring-summer of 2020. *Psychiatry Res.* (2021) 298:113778. doi: 10.1016/j.psychres.2021.113778
34. Sameer AS, Khan MA, Nissar S, Banday MZ. Assessment of mental health and various coping strategies among general population living under imposed COVID-lockdown across world: a cross-sectional study. *Ethics Med Public Health.* (2020) 15:100571. doi: 10.1016/j.jemep.2020.100571
35. Loades ME, Chatburn E, Higson-Sweeney N, Reynolds S, Shafran R, Brigden A, et al. Rapid systematic review: the impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. *J Am Acad Child Adolesc Psychiatry.* (2020) 59:1218–39.e3. doi: 10.1016/j.jaac.2020.05.009
36. Sousa V. O equívoco da Portugalidade. In: Baptista MM, Franco JE, Cieszyńska B. *Europa das Nacionalidades. Imaginários, Identidades e Metamorfoses Políticas.* Available online at: <http://hdl.handle.net/1822/40123> (accessed February 16, 2022).
37. Götz FM, Ebert T, Rentfrow PJ. Regional cultures and the psychological geography of Switzerland: person–environment–fit in personality predicts subjective well-being. *Front Psychol.* (2018) 9:517. doi: 10.3389/fpsyg.2018.00517
38. Yu M, Tian F, Cui Q, Wu H. Prevalence and its associated factors of depressive symptoms among Chinese college students during the COVID-19 pandemic. *BMC Psychiatry.* (2021) 21:66. doi: 10.1186/s12888-021-03066-9
39. Hicks E, McFarland C. Hope as a protective factor for cognitive difficulties during the COVID-19 pandemic. *Front Womens Health.* (2020) 5:186. doi: 10.15761/FWH.1000186
40. Cheng LN, Guo XY, Liu HJ, Chen Q, Cui RS. Hope, death anxiety and simplified coping style scores of nursing students during the outbreak of COVID-19 a cross-sectional study. *Medicine (Baltimore).* (2021) 100:e27016. doi: 10.1097/MD.00000000000027016
41. Chen T, Lucock M. The mental health of university students during the COVID-19 pandemic: an online survey in the UK. *PLoS ONE.* (2022) 17:e0262562. doi: 10.1371/journal.pone.0262562
42. Höglinger M, Heiniger S. The Covid-19 social monitor: a panel study providing evidence about the social and public health impact of the pandemic. *Bulletin of the Swiss Sociological Association.* (2020) 157:14–9. doi: 10.1371/journal.pone.0242129
43. Shanahan L, Steinhoff A, Bechtiger L, Murray AL, Nivette A, Hepp U, et al. Emotional distress in young adults during the COVID-19 pandemic: evidence of risk and resilience from a longitudinal cohort study. *Psychol Med.* (2020) 52:1–10. doi: 10.1017/S003329172000241X
44. Lutz A, Gendre A, Duperrex O, Zürcher K. *Projet de Recherche Covidelphi. Promotion de la Santé et Prévention en Période de Pandémie et de Confinement.* Lausanne: Unisanté. (2021).
45. Haddad JM, Macenski C, Mosier-Mills A, Hibara A, Kester K, Schneider M, et al. The impact of social media on college mental health during the COVID-19 pandemic: a multinational review of the existing literature. *Curr Psychiatry Rep.* (2021) 23:70. doi: 10.1007/s11920-021-01288-y
46. Wang CY, Zhang YY, Chen SC. The empirical study of college students' e-learning effectiveness and its antecedents toward the COVID-19 epidemic environment. *Front Psychol.* (2021) 12:573590. doi: 10.3389/fpsyg.2021.573590
47. Daniels M, Sharma M, Batra K. Social media, stress, and sleep deprivation: a triple “S” among adolescents. *J Health Soc Sci.* (2021) 6:159–66. doi: 10.19204/2021/sclm3
48. Liao Z, Zhang X, Wang Y, Wang T, Li X, Zhao M, et al. Delayed-onset PTSD and coping strategies of Chinese college students during the COVID-19 pandemic. *Front Sociol.* (2021) 6:734738. doi: 10.3389/fsoc.2021.734738
49. UN General Assembly. *Transforming our world: the 2030. Agenda for Sustainable Development. A/RES/70/1.* Available online at: <http://www.refworld.org/docid/57b6e3e4.html> (accessed 12 February 2022).
50. Salazar de Pablo G, De Micheli A, Solmi M, Oliver D, Catalan A, Verdino V, et al. Universal and selective interventions to prevent poor mental health outcomes in young people: systematic review and meta-analysis. *Harv Rev Psychiatry.* (2021) 29:196–215. doi: 10.1097/HRP.0000000000000294
51. OECD. *Tackling the Mental Health Impact of the COVID-19 Crisis: An Integrated, Whole-of-Society Response.* Available online at: <https://www.oecd.org/coronavirus/policy-responses/tackling-the-mental-health-impact-of-the-covid-19-crisis-an-integrated-whole-of-society-response-0ccafa0b/> (accessed 20 March 2022).
52. McCartan C, Adell T, Cameron J, Davidson G, Knifton L, McDaid S, et al. A scoping review of international policy responses to mental health recovery during the COVID-19 pandemic. *Health Res Policy Syst.* (2021) 19:58. doi: 10.1186/s12961-020-00652-3

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Schwander-Maire, Querido, Cara-Nova, Dixe, Aissaoui, Charepe, Christie and Laranjeira. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Intention to Screen for Hepatitis C Among University Students: Influence of Different Communicative Scenarios

Pierluigi Diotaiuti\*, Stefania Mancone, Lavinia Falese, Maria Ferrara, Fernando Bellizzi, Giuseppe Valente, Stefano Corrado and Francesco Misiti

Department of Human Sciences, Society and Health, University of Cassino and Southern Lazio, Cassino, Italy

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Kyriakos Souliotis,  
University of Peloponnese, Greece  
Raoh-Fang Pwu,  
Ministry of Health and Welfare, Taiwan

### \*Correspondence:

Pierluigi Diotaiuti  
p.diotaiuti@unicas.it

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

Received: 10 February 2022

Accepted: 06 April 2022

Published: 11 May 2022

### Citation:

Diotaiuti P, Mancone S, Falese L,  
Ferrara M, Bellizzi F, Valente G,  
Corrado S and Misiti F (2022)  
Intention to Screen for Hepatitis C  
Among University Students: Influence  
of Different Communicative Scenarios.  
Front. Psychiatry 13:873566.  
doi: 10.3389/fpsy.2022.873566

This study aimed to evaluate the influence of different narrative scenarios regarding students' intentions to undergo diagnostic screening for hepatitis C, and whether gender identification with the characters of the scenario could influence the students' intentions to undergo a medical test. A sample of 600 participants was administered three narrative scenarios with different frames (positive, negative, and ambivalent), including two gender options (male and female) for the main character of the story. A statistically significant three-way interaction between scenario, gender identification, and time resulted. There were significant simple main effects on the intention to have a diagnostic test for hepatitis C for the scenarios with the protagonist of the same gender as the participant and after the administration of the negative scenario. The use of a negative scenario with the same gender character was always more effective than the use of a positive framed scenario, even though there was a high level of knowledge regarding the disease. Personal diagnostic testing was not directly associated with knowledge regarding the infection. The findings of this study can ultimately help policymakers develop communication campaigns adapted to target populations such as college students, in order to raise awareness of the risk, promote prevention and behavioral change, and encourage medical screening.

**Keywords:** hepatitis C, risk perception, early detection intention, narrative scenarios, gender identification, effective communication, university students

## INTRODUCTION

Hepatitis C is a major health problem that consists of the inflammation of the liver caused by hepatitis C virus (HCV) infection. HCV can have both acute and chronic consequences, and it is one of the leading causes of cirrhosis and hepatocellular carcinoma (1, 2). New HCV infections are usually asymptomatic, or the symptoms can take up to 30 years to appear (3). The consequence of this gap is that approximately 70% of infected people are not aware that they are infected, so they do not follow therapies or treatments, and the transmission takes place very easily (4, 5).

Hepatitis C is present throughout the world, with a high prevalence in European countries. The World Health Organization (WHO) estimates 58 million people are affected by chronic HCV and 290,000 deaths in 2019 (6). Italy appears to be one of the European countries with the highest number of patients with hepatitis C. Epidemiological data show an estimated prevalence

of the chronic disease in about 3% of the population (1.5 million people), with a very variable geographical distribution. The frequency of infection is higher in the center and south of Italy than in the north (7, 8). A study promoted by Doxa Pharma, “Italians and Hepatitis C,” has highlighted citizens’ lack of knowledge regarding this disease. The study found that 69% of respondents knew little or nothing about hepatitis C and tended to underestimate its severity (9).

Today, the major risk factors for getting infected are surgery, blood transfusions, organ transplants, percutaneous exposure during cosmetic treatments, unprotected sexual relations, and intravenous drug use (3). Piercing and tattoos are also risk factors for hepatitis C infection when these practices are performed with non-sterile instruments and in unsafe environments (10). Even manicures or pedicures performed with non-sterilized or disposable instruments represent a significant danger of infection. Many practices related to the transmission of the virus can be considered more common among young people. Scientific evidence shows that risky behaviors are widespread among young people and requires particular attention and adequate measures, not only because of the serious health and psycho-social implications but also because of the association with multiple risk behaviors (10, 11).

For this reason, we decided to carry out research on this specific age target, focusing on university students.

Health promotion among university students has not always been considered a priority in targeting preventive policies and actions because students are assumed to be in a relatively healthy phase of their life. However, this period is very critical, since it is known to be a dynamic transition from childhood to adulthood. During this time, young people should gradually learn to assume responsibility for their own health, but they often adopt unhealthy behaviors and habits (poor eating habits, little rest, physical inactivity, smoking, alcohol and drug abuse, and risky sexual behaviors) that can negatively affect health in the short, medium, and long term (12, 13). The university environment can stimulate students to assume risky lifestyles for various reasons: the first time away from families and their rules; personality traits; experience of rebel models or just adult models; and self-challenge. Unconstrained freedom mixed with a sense of invulnerability and a strong desire for exploration can lead to the development of behaviors that are not always healthy (14, 15).

Since there is no effective vaccination against the hepatitis C virus, information and health education represent the best preventive strategy (16). Increasing the level of awareness and knowledge can reduce the risk of transmission and lead to healthier behaviors (17, 18). Other studies have shown that the lack of knowledge and a low level of awareness are also big barriers to HCV screening (19, 20), and the early diagnosis can be the keystone in virus management (21). A group of experts interviewed to discuss relevant aspects and open issues of chronic hepatitis C in Italy and concluded that one of the main barriers to HCV care is the low screening rate (22).

Health and screening programmes often lack information regarding the benefits and harms of screening tests and do not favor the decision-making process by individuals (23). In the past, to achieve public health objectives and induce behavioral

changes, traditional health communication mostly reported statistics and probabilities; however, recently, new forms of narrative communication are spreading, demonstrating efficacy if properly addressed (24).

Previous research examined the framing effect on individual choices in terms of prevention and health treatments, identifying different modalities such as the framing of attributes, objectives, and risky choices (25, 26).

The application of a narrative scenario approach has been used in sociology, communication, and marketing research (27, 28) and recently in health psychology as well (29–31).

Narrative scenarios create a simulation of a possible future that can be experienced as a realistic, consistent, and compelling plot, allowing the person to explore a possible reaction (32). According to Campi and Garatti (33), fictionalized scenarios are experiments conceived with a high degree of imagination and realism as they explore, in particular, the human and social dimensions in the setting of everyday life.

The purpose of this study was to assess the influence of different narrative scenarios on university students’ intentions to undergo diagnostic testing for hepatitis C and to investigate whether gender identification also influences the outcomes.

## Hypotheses

a) The use in a preventive communication intervention of a narrative frame with different content orientation (positive, negative, and ambivalent) can affect the propensity (immediate, medium term, long term, and null) to perform a diagnostic test for hepatitis C.

b) Gender identification with the protagonists of each narrative frame can also influence the propensity to perform a diagnostic test.

## METHODS

### Participants

The study was voluntarily attended by 600 university students in central Italy: 300 male (50%) and 300 female (50%); aged between 18 and 32;  $M_{age} = 25$ ; and  $SD = 5.8$ . The inclusion criterion in the study allowed participation of all generic regular undergraduate adult students who aged 18 years and above, and who were present at the time of data collection. Students who gave consent for the study were recruited. The study participants who were blind and severely ill were excluded from the study. Participants were assured anonymity and the use of data in aggregate form for research purposes only. Tools administration took place upon release and signing of the form for informed consent of participation in accordance with the Declaration of Helsinki. Among all those who were willing to participate in the study, there were no drop-outs or incomplete deliveries of materials. **Table 1** reports the characteristics of the participants.

### Tools

- 1) A socio-personal data questionnaire and collection of participants’ knowledge on hepatitis C;
- 2) Evaluation of the importance attributed to performing personal diagnostic screening measured by means of an item

**TABLE 1** | Characteristics of the participants.

Gender	Males = 300 Females = 300
Study course	Economy = 66 (11.0%) Foreign languages = 36 (6.0%) Pedagogical sciences = 72 (12.0%) Motor sciences = 54 (9.0%) Law = 90 (15.0%) Humanities = 54 (9.0%) Communication sciences = 30 (5.0%) Engineering = 108 (18.0%) Nursing sciences = 24 (4.0%) Social work = 66 (11.0%)
Year of course	First = 157 (26.1%) Second = 149 (24.8%) Third = 116 (19.3%) Fourth = 92 (15.3%) Fifth = 65 (10.8%) Out-of-course = 21 (3.5%)
Father's education	Primary school = 32 (5.4%) Secondary school = 127 (21.1%) High school diploma = 276 (46.0%) University degree = 165 (27.5%)
Mother's education	Primary school = 45 (7.5%) Secondary school = 148 (24.6%) High school diploma = 264 (43.9%) University degree = 143 (24.0%)
If one or both parents work in health professions	Yes = 95 (15.8%) No = 505 (84.2%)

on a Likert scale 1–5 ranging from 1 (not at all) to 5 (very much);

3) Three narrative scenarios with different values (positive, negative, and ambivalent), including two gender options (male and female) in the textual character:

- *Positive scenario*: e.g., “Francesca is a 25-year-old girl. Three years ago, following a check-up, she discovered she was suffering from hepatitis C. After the discovery of the disease she immediately started the course of treatment. Today Francesca is married, has a child and leads a normal and satisfying life. For Francesca the timeliness of the check-up and the beginning of the therapy were decisive in order to prevent the disease from becoming chronic and causing serious consequences to the liver system.”
- *Negative scenario*: e.g., “Francesca is a 25-year-old girl who was referred to visit her family doctor following the appearance of worrying symptoms such as jaundice (yellowish complexion of the skin and eyes), nausea, vomiting and abdominal pain. The check-up revealed the existence of chronic hepatitis C. The onset of the infection dated back to 5 years before. During this time, Francesca did not undergo any tests. Today, despite having cured the infection, Francesca has suffered serious damage to her liver system, affecting the quality of life and life expectancy.”
- *Ambivalent scenario*: e.g., “Marco is a 25-year-old boy. After a medical check-up he had a year ago, he discovered that he had hepatitis C. He went to a specialist and was informed about the existence of the latest cure using a drug called “sofosbuvir,” which eliminates the disease

**TABLE 2** | Research sample distribution.

Category variable	Modalities	Sub-modalities	Randomized distribution	Relative size
Gender	Male			300
	Female			300
	Positive	Male character	administered to 50 males and 50 females	100
		Female character	administered to 50 males and 50 females	100
Scenario	Negative	Male character	administered to 50 males and 50 females	100
		Female character	administered to 50 males and 50 females	100
	Ambivalent	Male character	administered to 50 males and 50 females	100
		Female character	administered to 50 males and 50 females	100
				Total $N = 600$

permanently without significant side effects. Unfortunately, the treatment is extremely expensive, about 60,000.00 Euros and is not provided by the national health service. At this point, Marco was forced to access older treatments, which have little effect and serious side effects.”

4) Evaluation of the propensity to undergo diagnostic screening, measured with multiple response items 1–6, ranging from 0 (“I have no intention to undergo screening”) to 6 (“I intend to undergo screening immediately”).

## Design

Participants (balanced by gender) were randomly assigned to different groups depending on the experimental condition. To verify the hypothesis that both the scenario used and the identification (based on gender) have some effect on the propensity for diagnostic screening, the groups which were given the scenario with the protagonist of the same gender as the participant were compared with the groups which were given the scenario with the protagonist of the opposite gender to the participant. Before and after the administration of the scenario, the participant was asked to estimate his or her intention to have a diagnostic check for hepatitis C. Therefore, the research involved a  $3 \times 2 \times 2$  model: a total of six groups with the distribution of three scenarios and two options of identification with the gender of the protagonist (same sex/opposite sex) (between-subjects factors) and a pre-post evaluation of the intention to have a diagnostic check-up (within factor). **Table 2** shows the participants' randomized distribution among the groups.

## Procedure

The protocol therefore provided in sequence:



- 1) Collection of personal data in anonymous form (gender, age, course of study, year of course, parents' level of education);
- 2) Administration of a form to detect (a) knowledge possessed by the participants regarding hepatitis C and potential risk behaviors; (b) estimate of the risk of personal infection; (c) national epidemiological estimate on hepatitis C; and (d) direct knowledge of cases of hepatitis C. **Table 3** shows the list of requests in the form.
- 3) Assessment of personal intention to carry out a diagnostic control using an item (Likert 1–6) to measure the (timely or procrastinating) propensity of the participants to undergo a diagnostic test for hepatitis C, ranging from 0 (“I have no intention to undergo a check”) to 6 (“I intend to undergo a check immediately, within a week”). **Table 4** shows the personal screening intention form.
- 4) Administration (33.3%,  $N = 200$ ) of a form with the *Positive Therapeutic Scenario* (early detection of infection and early therapeutic treatment with effective results).
- 5) Administration (33.3%,  $N = 200$ ) of a form with the *Negative Therapeutic Scenario* (description of treatments with heavy and ineffective side effects).
- 6) Administration (33.3%,  $N = 200$ ) of a form with the *Ambivalent Scenario* (description of new drugs with high efficacy and low side effects, “sofosbuvir,” but not accessible due to high costs).
- 7) Administration (the whole sample) of the item (Likert 1–6) to remeasure (timely or procrastinating) the intention of the participants to undergo a diagnostic test for hepatitis C, ranging from 0 (“I have no intention to undergo a check”) to 6 (“I intend to undergo a check immediately, within a week”).

## Statistical Analysis

The data were processed using the statistical software SPSS version 26. The main analyses performed were: descriptive statistics to illustrate socio-demographic information and participants' knowledge of hepatitis C; Pearson bivariate correlations between risk perception and value attributed to personal diagnostic screening, significant at  $p < 0.001$ , two-tailed; one-way ANOVA to assess whether the estimated spread of the disease could be significantly associated with the value attributed to personal screening. The verification of the assumptions of univariate normality has been conducted using the procedure for the standardization of the variables, by inspection of a boxplot, and using Shapiro-Wilk's normality test. The homogeneity of variances was assessed by Levene's test. To assess the effects between narrative scenario types and gender identification in the scenarios, a three-way repeated measures ANOVA was run with three independent variables (scenario  $\times$  gender identification  $\times$  time) and one dependent variable (intention to carry out a diagnostic test for hepatitis C). As the number of participants was balanced in the groups, in order to determine the interaction between the variables, Pillai's criterion rather than Wilks' lambda was used, as it is more robust to unequal covariance matrices (34). Following the study by Cohen (35), partial eta squared was used to assess effect size (0.01 = small, 0.06 = medium, and 0.13 = large). The level of significance was set at  $p < 0.05$ , while for

**TABLE 3 |** Knowledge form about hepatitis C.

Have you ever been checked for hepatitis?	yes; no
Which hepatitis is more dangerous?	Hepatitis A; Hepatitis C
Hepatitis damages:	Heart; Pancreas; Liver; Kidneys; Lungs
Hepatitis C can be contracted through:	
- Sexual intercourse	yes; no
- Ingesting seafood or raw fish	yes; no
- Eating raw frozen berries	yes; no
- Cosmetic treatments	yes; no
- Blood transfusions	yes; no
- Contact with saliva and sweat	yes; no
- Drinking contaminated water	yes; no
- Piercing	yes; no
- Drinking alcohol and hard liquor	yes; no
- Hugs	
- Sneezing	
- Dental treatment	
- Tattooing	
- Swapping syringes	
- Snorting cocaine	
How many people do you think are affected by hepatitis C in Italy?	Approximately 30,000; Approximately 400,000; Approximately 1,000,000; Approximately 6,000,000
How likely is it for a university student to contract hepatitis C?	very unlikely; unlikely; probable; very probable; highly probable
Most affected by hepatitis C:	Men; Women
Are there any categories of people at higher risk of infection?	yes; no
If yes, which?	Indicate
How many people do you know who have hepatitis C?	None; at least one; more than one
What check(s) should be performed to detect hepatitis C?	
- Urine test	yes; no
- Blood test	yes; no
- Stool test	yes; no
- Liver biopsy	yes; no
- X-ray examination	yes; no
How important do you think it is for you to be checked for hepatitis?	very little; a little; somewhat; quite a lot; very much

testing the multiple univariate interaction effects, a Bonferroni adjustment has been introduced by dividing the declared level of statistical significance by the number of dependent variables:  $p < 0.025$  (i.e.,  $p < 0.05/2$ ).

## RESULTS

### Descriptive Analysis

In total, 28.6% of participants stated that they had already taken a hepatitis C test in the past; 14.7% had one or both parents working in healthcare; 14.7% knew at least one person with

**TABLE 4 |** Diagnostic screening intention form.

The Department of Human Sciences, Society and Health would like to propose to the University that a service be made available to students for free and anonymous testing for the hepatitis C virus. To set up this service, students need to book in advance.

When would you like the check-up to take place?

- In one week
- In one month
- In three months
- In six months
- In nine months
- I have no intention of carrying out any checks

I don't want to carry out the check at the presidium set up by the University, but I still intend to carry out a check privately:

- In one week
- In one month
- In three months
- In six months
- In nine months
- I have no intention of carrying out any checks

hepatitis C; and 5.5% said they knew two or more people with hepatitis C. Neither the level of education nor the profession of the parents had any influence on the importance attributed to undergoing a diagnostic test for hepatitis C. The assessment of the students' knowledge on hepatitis C was carried out by summing up the exact answers to the questionnaire. The analysis of the distribution of the answers indicated that out of 19 questions proposed, the average of the correct answers was 12.8 ( $SD = 2.61$ , minimum 4 and maximum 17, skewness:  $-0.392$ , and kurtosis:  $-0.207$ ). About half of the sample (53.3%) showed that they had a low to medium level of general knowledge on hepatitis C.

Comparing the students' national estimated spread of hepatitis C with their value placed on medical screening, it was found that those who tended to underestimate the incidence of the infection, considering it in  $\sim 30,000$  ( $M_1$ ) or  $\sim 400,000$  ( $M_2$ ) cases estimated in Italy, had significantly lower averages of value attribution to medical checks, while those who indicated the real official estimation of  $\sim 1,000,000$  ( $M_3$ ) in Italy or overestimated the prevalence with more than 6,000,000 ( $M_4$ ) cases, attributed greater value to personal medical checks:  $F(3,599) = 10.091$ ;  $p = 0.001$ ;  $\eta^2 = 0.04$ ;  $OP = 0.98$ ;  $M_1 = 3.43$ ,  $SD = 0.07$ ;  $M_2 = 3.45$ ,  $SD = 0.05$ ;  $M_3 = 3.78$ ,  $SD = 0.05$ ;  $M_4 = 3.85$ ,  $SD = 0.12$ ; 95% CI [3.55, 3.70].

A slightly positive correlation was found ( $r = 0.162^{**}$ ) between the attribution of value on diagnostic screening and the probability of risk attributed to the category of university students (to which the participants of the study belonged). However, 38.9% believed that a university student becoming infected with hepatitis C is unlikely or completely improbable. When asked whether there are categories of people at higher risk of infection, 50.8% said yes, and **Table 5** illustrates the categories indicated in the descending order of frequency.

Of note, 34.9% stated that men are more exposed to hepatitis C, 7.5% believed that women are more exposed, while 57.5% indicated that the risk affects both genders equally.

**TABLE 5 |** People believed to be at a higher risk of infection.

Drug addicts	86 (14.3 %)
Homosexuals	74 (12.3 %)
Prostitutes	68 (11.3 %)
People with low immunity	60 (10.0%)
Health care personnel	53 (8.8 %)
Patients requiring transfusions	35 (5.8 %)
People practicing unsafe sex	30 (5.0 %)
People with serious illnesses	26 (4.3 %)
The elderly	24 (4.0 %)
Alcoholics	21 (3.5 %)
People with an irregular lifestyle	21 (3.5 %)
People with poor hygiene	20 (3.3 %)
HIV positives	16 (2.7 %)
Pregnant women	16 (2.7 %)
People with a predisposition to the disease	15 (2.5 %)
People who travel a lot to high-risk countries	15 (2.5 %)
People with an irregular diet	10 (1.7 %)
People who are not vaccinated	10 (1.7 %)

## The Effect of Narrative Scenarios and Gender Identification on the Propensity for Medical Screening

A three-way repeated measures ANOVA ( $3 \times 2 \times 2$ ) was conducted to examine both the effects of scenarios and gender identification on the intention to have a diagnostic test for hepatitis C. Residual analysis was performed to test the assumptions of the three-way repeated measures ANOVA. Outliers were assessed by visual inspection of a boxplot. Normality was assessed using Shapiro-Wilk's normality test for each cell in the design, and homogeneity of variances was assessed by Levene's test. There were no outliers, residuals were normally distributed ( $p > 0.05$ ), and there was homogeneity of variances ( $p = 0.859$ ). A statistically significant three-way interaction between scenario, gender identification, and time resulted,  $F(1, 99) = 6.399$ ,  $p < 0.01$ . Statistical significance was accepted at the  $p < 0.025$  level for simple two-way interactions and simple main effects. There were statistically significant simple two-way interactions between gender identification and time,  $F(1, 299) = 18.141$ ,  $p < 0.025$ ; scenario and time,  $F(1, 199) = 14.056$ ,  $p < 0.025$ ; and scenario and gender identification,  $F(1, 99) = 4.270$ ,  $p < 0.025$ .

As regards the first interaction, there was a statistically significant simple main effect on the intention to have a diagnostic test for hepatitis C for the scenarios with the protagonist of the same gender as the participant,  $F(1, 299) = 22.808$ ,  $p < 0.025$ . A Bonferroni adjustment was applied. For the scenarios with the protagonist of the same gender as the participant, the mean intention to have a diagnostic test before the scenarios administration was 3.53 ( $SE = 0.51$ ), while after the scenarios administration was 4.10 ( $SE = 0.11$ ). There was a statistically significant mean difference in the intention to have a diagnostic test between the two moments of  $-0.566$ ;

95% CI ( $-0.799, -0.333$ ),  $p < 0.025$ ,  $\eta^2 = 0.067$ . For the scenarios with the protagonist of the opposite gender as the participant, the simple main effect between the two moments was non-significant:  $p = 0.515$ , i.e.,  $> 0.025$ .

As regards the second interaction, there was a statistically significant simple main effect on the intention to have a diagnostic test for hepatitis C after the administration of the negative scenario,  $F(1, 199) = 76.305$ ,  $p < 0.025$ . For participants inserted in the group with the negative scenario, the mean intention to have a diagnostic test before the scenario administration was 3.53 ( $SE = 0.50$ ), while after the scenario administration was 4.47 ( $SE = 0.09$ ). There was a statistically significant mean difference in the intention to have a diagnostic test between the two moments of  $-0.942$ ; 95% CI  $[-1.15, -0.730]$ ,  $p < 0.025$ ,  $\eta^2 = 0.183$ . For the positive and the ambivalent scenarios, the simple main effect between the two moments was non-significant:  $p = 0.344$  and  $p = 0.186$ , i.e.,  $> 0.025$ .

As regards the third interaction, there was a statistically significant simple main effect on the intention to have a diagnostic test for hepatitis C after the administration of the negative scenario where there was identification with the gender of the protagonist,  $F(1, 99) = 25.712$ ,  $p < 0.025$ . For this condition, the mean intention to have a diagnostic test before the scenario administration was 4.89 ( $SE = 0.12$ ), while after the scenario administration was 3.63 ( $SE = 0.20$ ). There was a statistically significant mean difference in the intention to have a diagnostic test between the two moments of 1.261; 95% CI  $[0.768, 1.75]$ ,  $p < 0.025$ ,  $\eta^2 = 0.189$ . For the positive and the ambivalent scenarios, the simple main effect related to the use of a same or an opposite gender identification was not significant:  $p = 0.061$  and  $p = 0.644$ , i.e.,  $> 0.025$ .

**Figures 1, 2** show the trends in the intention to carry out a diagnostic test for hepatitis C, before and after scenarios administration, also considering gender identification with the protagonist of the scenarios.

After the administration of the scenarios, it was found, as shown in **Figure 2**, that the intention to undergo a diagnostic screening was significantly higher in the group that had received the negative scenario with the character of the same gender as the participant.

## DISCUSSION

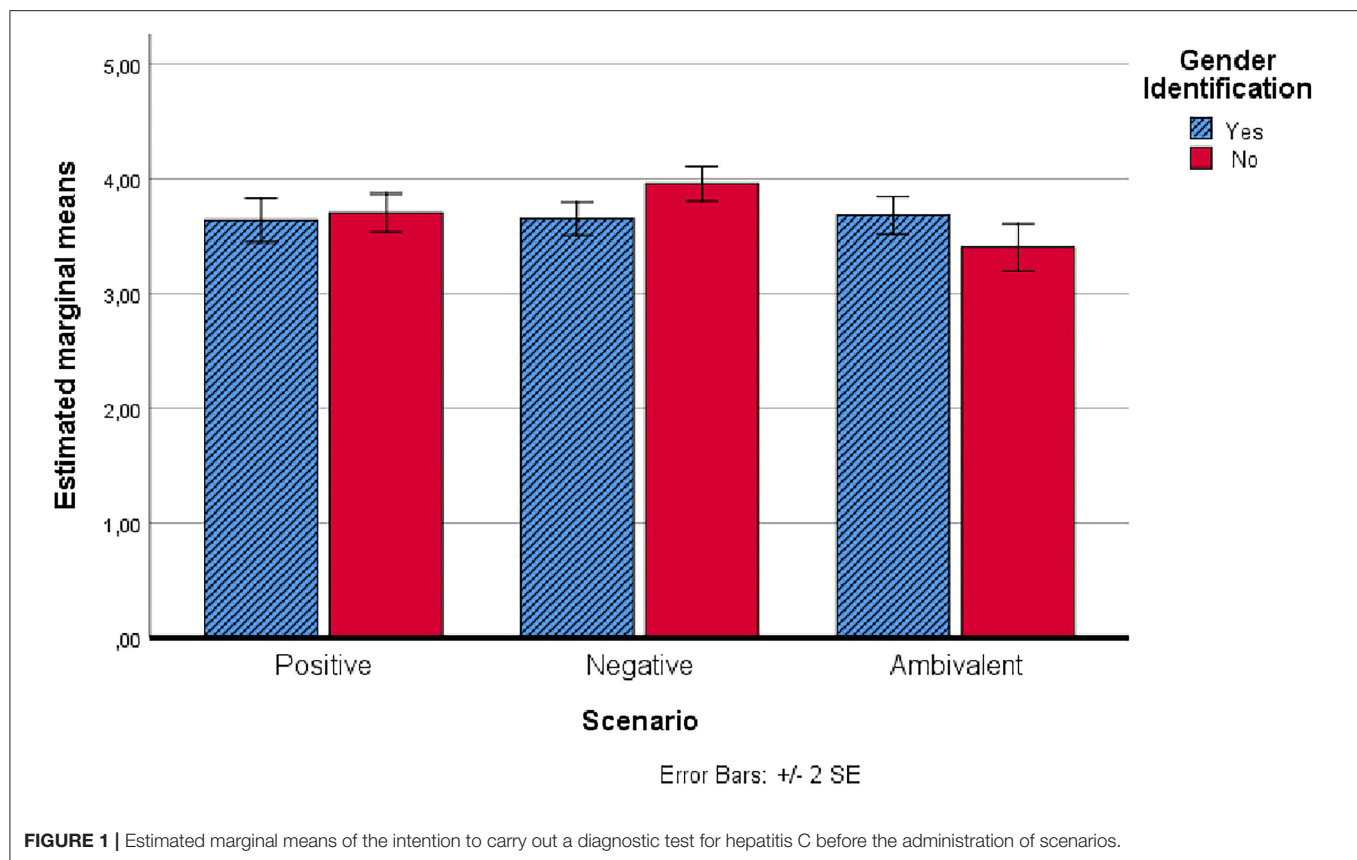
For more than half of the sample in the study, the level of general knowledge about hepatitis C infection was medium to high, with only 9% of the sample providing  $<10$  out of 19 correct answers to the questionnaire administered. This result is similar to what was found in the study by Daniali et al. (16), although in that case, the sample was made up of students from the medical-health area, where a greater average knowledge and awareness of the risks related to such infections was likely to be expected (16). A common result between our study and the one mentioned above was the absence of positive correlation between the level of knowledge and behavioral intention of prevention. The level of knowledge was not associated with

the socio-cultural level of belonging, suggesting that there are other sources of information (presumably school, friends, direct, and indirect contact with infected people). In total, 30% of the sample had already undergone a hepatitis C test, and 20.2% had direct knowledge of people with hepatitis C. The importance given to personal diagnostic testing was not directly associated with the level of specific knowledge about the infection but was rather proportionate to the estimated spread of hepatitis C throughout the country. Those who tended to underestimate the spread of infection consequently attached less value to medical monitoring (31, 36).

However, we found an association between the importance attributed to diagnostic screening and the level of risk attributed to the category of university students (to which the participants belonged). These results appear consistent with Kasperson et al. (37).

With regard to the effect of the use of narrative scenarios on the propensity for diagnostic screening, it was found that the group presented with the negative scenario reported significantly higher levels of propensity for screening, especially compared to the group with the positive scenario. It was likely that the positive scenario had reassuring effects that limited the participants' propensity for screening: an early diagnosis was followed by an adequate course of treatment that allowed the protagonist to lead a substantially normal life; while the negative scenario increased the levels of fear: a late diagnosis was followed by a progressive worsening of health conditions and a heavy impact of drugs and their side effects on the protagonist's quality of life. In the ambivalent scenario, it was probably possible to activate simultaneously different emotional states, such as fear, anger, and resignation. The placement of the level of propensity for screening in an intermediate position with respect to the groups with positive and negative scenarios suggests that the activating effect of fear could have received moderation from any feelings of anger and resignation induced by the representation of such a scenario.

On the importance of eliciting emotions through the use of narratives to motivate changes in attitudes, intentions, and behaviors related to health issues, the contribution of Dunlop et al. (38) should certainly be considered. Self-referent emotional responses are expected to have a direct effect in motivating behavior change, particularly as they are likely to be associated with an increase in perceived personal risk. Message-referent and plot-referent emotional responses are proposed to have indirect effects on the individual, primarily by stimulating self-referent emotions, and prompting interpersonal discussion about the message. Hoeken and Sinkeldam (39) also pointed out that identification with a story character can evoke emotions that subsequently influence the audience's attitude. In their study, they reported on the mediating role of emotions in narrative persuasion and how identification can evoke these emotions. Liu and Yang (40), in a study using different frames of narrative persuasion to curb e-cigarette use among university students, reported that in a gain-framed narrative, the elicitation of a negative emotion such as anger was associated with an increasing risk perception and decreasing intention to use e-cigarettes. Some recent studies testing the effect of negative emotions such as



fear, anger, and sadness in narrative persuasion interventions for health were conducted by Lillie et al. (41, 42), Jensen et al. (43), and Krakow et al. (44). They demonstrated that story outcome (e.g., whether the main character lives or dies) can impact audience behavior. Death narratives generated greater fear, anger, and sadness. Fear was related to greater behavioral intention and reading flow and diminished counterarguing. Sadness had the opposite effect. Anger produced a mixed persuasive effect, increasing both counterarguing and reading flow.

In our study, the positive and ambivalent scenarios, however, suggested that there is a cure and they probably lower the fear of the disease; with regard to the ambivalent scenario, we can hypothesize the stimulation of anger or resignation as the last emotion the person came into contact with, when the information passed on stated that the cure existed but was not available due to economic reasons. The recent study by Scherr et al. (45) showed that anger solicitation in the use of persuasive scenarios lowers the intention to follow the desired directions of the preventive campaign.

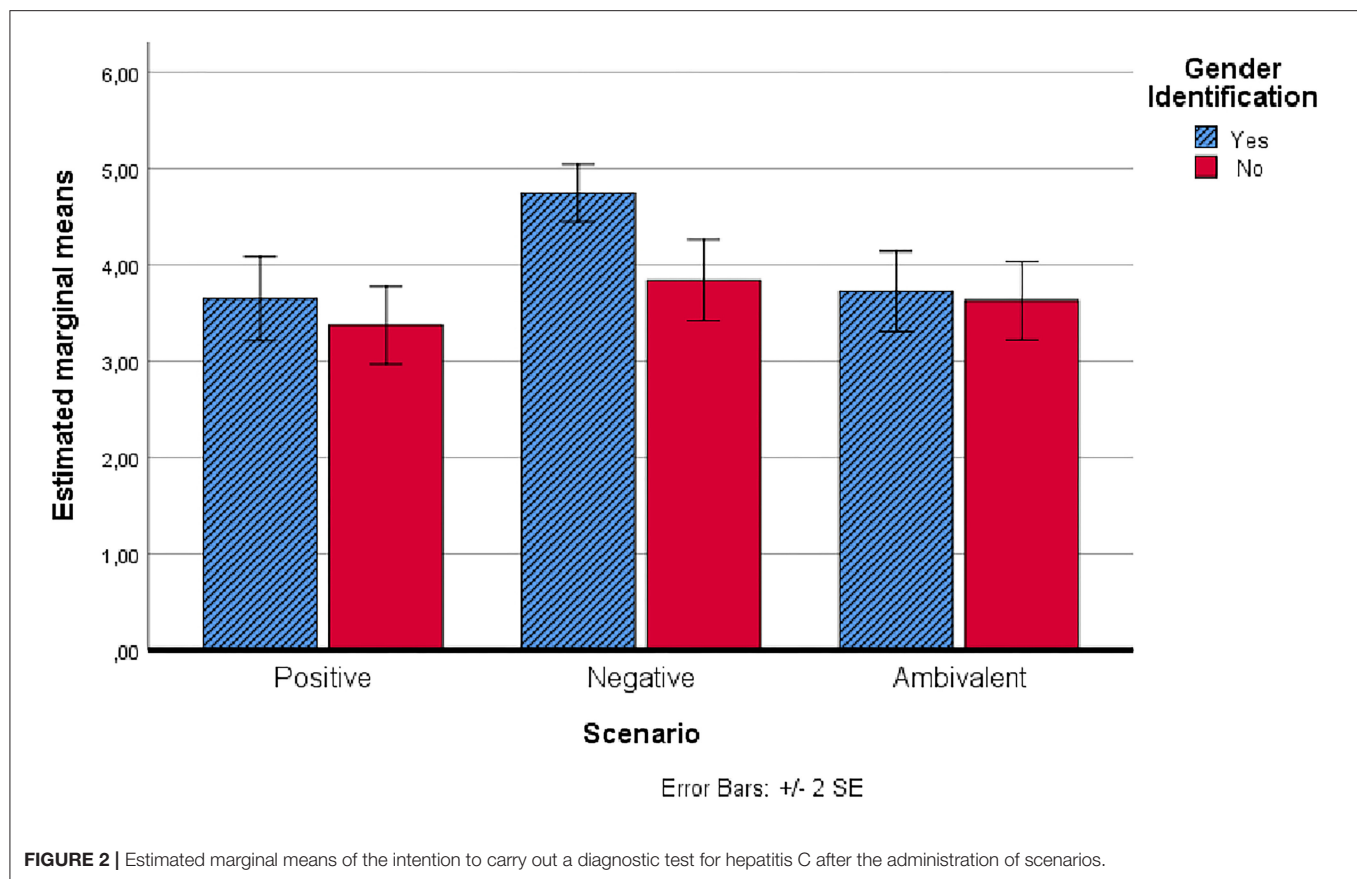
Compared to the research hypothesis, we would have expected that scenarios would play a greater role in stimulating the idea of undergoing diagnostic investigation to facilitate early diagnosis. In this case, we hypothesized that the third-person scenario had a reassuring or defensive role for the participant, since a change of perspective probably occurs by moving from a subjective self-referencing point of view to an external hetero referent point of view. Indeed, this observation is consistent with the review by De

Graaf et al. (30), where they state that a first-person perspective is a promising feature in terms of effectiveness. The results of our study showed that, at least in the youth population, even if the level of awareness of the disease is medium-high, the propensity for diagnostic screening is positively associated with the use of a negative scenario, which leverages fear as a motivating emotion (46, 47).

The results also showed that in addition to the use of a negative scenario, the presence of a character of the same gender as the participant leads to a more effective outcome in terms of intention to screen. When scenarios do not present a possibility of gender identification, they may be less effective. The propensity to be more involved with characters, whose gender role is similar to one's own, has already been reported in several previous studies (48–53).

As highlighted by Metwally et al. (54), in addition to raising awareness about the disease and risk behavior for hepatitis C infection, communication campaigns should focus on promoting appropriate behavior and changing potentially dangerous practices. Therefore, the main result of our study shows that the use of a communication strategy that employs specific narrative scenarios and exploits the principle of gender identification can increase early diagnostic screening behavior, which especially among young people, given the extended incubation interval of the disease, is of fundamental importance to intervene promptly with pharmacological administration to contain further spread of the virus.





A further strength of the study is the awareness-raising intervention for university students with no medical background. This age group is particularly exposed to experimentation, unruliness, promiscuity, and sometimes superficiality in assessing the medium- and long-term consequences of their actions (55–57).

Another element that emerged in the study is the presence of stereotyped beliefs or prejudices that lead young learners to believe that risk concerns specific categories and therefore they are convinced that they are not affected by the problem. Effective educational interventions should aim at dismantling such misconceptions and evaluative distortions in order to induce a more cautious and responsible attitude.

If we consider the data relating to direct knowledge of at least one infected with hepatitis C, 14.7%, added to the 5.5% of those who declared they knew two or more infected with hepatitis C, it clearly emerges that the infection in question is by no means a marginal occurrence in the current Italian framework, as confirmed by official statistics (7, 58).

Compared to other countries (59–62), Italy does not currently have any specific awareness campaigns on the risk of hepatitis C for university students. Instead, more preventive actions should be promoted through programmes organized in the form of lectures, symposia, conferences, radio programmes, and health talks using all kinds of public platforms and social media, and also through appropriate communication styles that can foster greater interpersonal responsiveness and empathic involvement

(63–67). Several studies show that health promotion actions in university settings through active involvement methodologies can produce significant effects in terms of prevention and behavioral change (68–73).

The work should of course be seen in the light of some limitations. One aspect to note is the use of paper-based text scenarios and therefore the failure to evaluate the possibility of using multimedia and digital tools from which young people can be more stimulated. A further limitation was the direct administration of the tools without an articulated discussion of the problems of infection and without having planned group involvement activities through possible peer education actions. Another aspect to be noted is the lack in the experimental design of an efficacy comparison on the intention of diagnostic screening between narrative scenarios with an identification option and a control group that used simple popular and informative material on hepatitis infection.

A future study, which could overcome the above-mentioned limitations, i.e., measuring also the effectiveness of the use of digital tools, including in the protocol a final discussion in the groups in order to collect with qualitative methods a more in-depth feedback on the solicitations perceived during the intervention and to evaluate more carefully the possible changes of attitude and behavioral intentions, adding also a control group in the intervention design, could contribute to a further advancement in the knowledge of the most effective factors and characteristics to be used in the health narrative persuasion. A

further line of research could investigate the relationship between frequency of pro-health behaviors in university students and the temporal perspective, since in recent literature there seems to be converging evidence in support of this hypothesis (74–77).

However, we believe that the results of this study, related to hepatitis C prevention, can help policymakers develop communication campaigns aimed at raising awareness and promoting screening according to specific populations, as also suggested by the WHO in the document “Global Health Sector Strategy on Viral Hepatitis, 2016–2021” (17). Better-targeted interventions aimed at enhancing HCV disease risk awareness may ultimately help reduce barriers and increase HCV screening uptake.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## REFERENCES

- Lingala S, Ghany MG. Natural history of hepatitis C. *Gastroenterol Clin North Am.* (2015) 44:717–34. doi: 10.1016/j.gtc.2015.07.003
- Baumert TF, Jühling F, Ono A, Hoshida Y. Hepatitis C-related hepatocellular carcinoma in the era of new generation antivirals. *BMC Med.* (2017) 15:52. doi: 10.1186/s12916-017-0815-7
- World Health Organization. *Hepatitis C - Key Facts 2021.* (2021). Available online at: <https://www.who.int/news-room/fact-sheets/detail/hepatitis-c> (accessed July 28, 2021).
- Mitchell AE, Colvin HM, Palmer Beasley R. Institute of medicine recommendations for the prevention and screening of hepatitis B and C. *Hepatology.* (2010) 51:729–33. doi: 10.1002/hep.23561
- Smith BD, Jorgensen C, Zibbell JE, Beckett GA. Centers for disease control and prevention initiatives to prevent hepatitis C virus infection: a selective update. *Clin Infect Dis.* (2012) 55:49–53. doi: 10.1093/cid/cis363
- World Health Organization. *Hepatitis C. 27 July 2020.* Available online at: <http://www.who.int/news-room/fact-sheets/detail/hepatitis-c> (accessed April 22, 2022).
- Buonomo AR, Scotto R, Pinchera B, Coppola N, Monari C, Macera M, et al. Epidemiology and risk factors for hepatitis C virus genotypes in a high prevalence region in Italy. *New Microbiol.* (2018) 41:26–9.
- Mancusi RL, Andreoni M, d'Angela D, Sarrecchia C, Spandonaro F. Epidemiological burden estimates for pathologies with a nonconstant risk: an application to HCV in Italy according to age, metavir score, and genotype: a systematic review and meta-analysis. *Medicine.* (2016) 95:e5143. doi: 10.1097/MD.00000000000005143
- Doxa Pharma. *Gli Italiani e l'Epatite C.* Abbvie Srl (2015). Available online at: [http://www.sosfegato.it/camo/onlus/all/unamalattiaconlac/Ricerca\\_DOXA\\_Pharma.pdf](http://www.sosfegato.it/camo/onlus/all/unamalattiaconlac/Ricerca_DOXA_Pharma.pdf) (accessed April 22, 2022).
- Carney K, Dhalla S, Aytaman A, Tenner CT, Francois F. Association of tattooing and hepatitis C virus infection: a multicenter case-control study. *Hepatology.* (2013) 57:2117–23. doi: 10.1002/hep.26245
- Leyva Y, Page K, Shiboski S, Hahn JA, Evans J, Erhardt E. Per-contact infectivity of hepatitis C virus acquisition in association with receptive needle sharing exposures in a prospective cohort of young adult people who inject drugs in San Francisco, California. *Open Forum Infect. Dis.* (2020) 7:1–8. doi: 10.1093/ofid/ofaa092
- Bauman Z. *The Individualized Society.* Cambridge, MA: Polity Press (2001).
- Bennasar-Veny M, Yañez AM, Pericas J, Ballester L, Fernandez-Dominguez JC, Tauler P, et al. Cluster analysis of health-related lifestyles in university students. *Int J Environ Res Public Health.* (2020) 17:1776. doi: 10.3390/ijerph17051776
- de-Mateo-Silleras B, Camina-Martin MA, Cartujo-Redondo A, Carreño-Enciso L, de la Cruz-Marcos S, Redondo del Rio P. Health perception according to the lifestyle of university students. *J Community Health.* (2019) 44:74–80. doi: 10.1007/s10900-018-0555-4
- Toda M, Kawai T, Takeo K, Rokutan K, Morimoto K. Parental rearing attitudes and health-related lifestyle of university students. *Soc Behav Pers.* (2008) 36:551–8. doi: 10.2224/sbp.2008.36.4.551
- Daniali SS, Bakhtiari MH, Nasirzadeh M, Aligol M, Doaei S. Knowledge, risk perception, and behavioral intention about hepatitis C, among university students. *J Educ Health Promot.* (2015) 4:93. doi: 10.4103/2277-9531.171807
- Sultan NY, Yacoub Mayet A, Alaqeel SA, Al-Omar HA. Assessing the level of knowledge and available sources of information about hepatitis C infection among HCV-infected Egyptians. *BMC Public Health.* (2018) 18:747. doi: 10.1186/s12889-018-5672-6
- Kwiatkowski CF, Fortuin Corsi K, Booth RE. The association between knowledge of hepatitis C virus status and risk behaviors in injection drug users. *Addiction.* (2002) 97:1289–94. doi: 10.1046/j.1360-0443.2002.00208.x
- Shehata N, Austin T, Ha S, Timmerman K. Barriers to and facilitators of hepatitis C virus screening and testing: a scoping review. *Can Commun Dis Rep.* (2018) 44:166–72. doi: 10.14745/ccdr.v44i78a03
- Trinh J, Turner N. Improving adherence to hepatitis C screening guidelines. *BMJ Open Quality.* (2018) 7:e000108. doi: 10.1136/bmjopen-2017-000108
- Applegate TL, Fajardo E, Sacks JA. Hepatitis C virus diagnosis and the holy grail. *Infect Dis Clin North Am.* (2018) 32:425–45. doi: 10.1016/j.idc.2018.02.010
- Andreone P, Di Marco V, Gaeta GB, Fagioli S, Vukotic R, Craxi A. Current and forthcoming perspectives in linkage to care of hepatitis C virus infection: assessment of an Italian focus group. *Dig Liver Dis.* (2019) 51:915–21. doi: 10.1016/j.dld.2019.03.033
- Entwistle VA, Carter SM, Trevena L, Flitcroft K, Irwig L, McCaffery K, et al. Communicating about screening. *BMJ.* (2008) 337:a1591. doi: 10.1136/bmj.a1591
- Hinyard LJ, Kreuter MW. Using narrative communication as a tool for health behavior change: a conceptual, theoretical, and empirical overview. *Health Educ Behav.* (2007) 34:777–92. doi: 10.1177/1090198106291963
- Gallagher KM, Updegraff JA. Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Ann Behav Med.* (2012) 43:101–16. doi: 10.1007/s12160-012-9446-6
- Rasmussen LB. The narrative aspect of scenario building. How storytelling may give people a memory of the future. In Gill S, editor. *Cognition, Communication and Interaction. Human-Computer Interaction Series.* London: Springer-Verlag London Limited (2008).

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board (IRB) of the University of Cassino and Southern Lazio. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

PD, GV, and SM designed the study. PD, GV, LF, FB, SC, and SM analyzed the data and discussed the results. PD, FB, and SM drafted the manuscript. LF, MF, and FM revised the manuscript. All authors approved the final manuscript. Finally, the authors have agreed to be accountable for all aspects of the manuscript in ensuring that questions related to the accuracy or integrity of any part of it are appropriately investigated and resolved.

27. Bondos I, Lipowski M. Podejście scenariuszowe w badaniach marketingowych – zastosowanie i ograniczenia. *Marketing i Zarządzanie*. (2017) 3:9–17. doi: 10.18276/miz.2017.49-01
28. Parker J. Stories, narratives, scenarios in Medicine. *Arts Humanit. High. Educ.* (2018) 17:3–19. doi: 10.1177/1474022217740300
29. Nielsen L. *Engaging Personas and Narrative Scenarios*. (PhD Series, 17). Samfundslitteratur (2004).
30. de Graaf A, Sanders J, Hoeken H. Characteristics of narrative interventions and health effects: a review of the content, form, and context of narratives in health-related narrative persuasion research. *Rev Commun Res.* (2016) 4:88–131. doi: 10.12840/issn.2255-4165.2016.04.01.011
31. Grannan S. Understanding patient perceptions and risk for hepatitis C screening. *J Viral Hepat.* (2017) 24:631–5. doi: 10.1111/jvh.12692
32. Steinhilber K. Narrative scenarios as an analytical instrument. In Peperhove R, Steinhilber K, Dienel HL, editors. *Envisioning Uncertain Futures. Zukunft und Forschung*. Springer VS (2018).
33. Campi M, Garatti S. *Introduction to the Scenario Approach*. Philadelphia: SIAM (2018).
34. Olson CL. On choosing a test statistic in multivariate analysis of variance. *Psychol Bull.* (1976) 83:579. doi: 10.1037/0033-2909.83.4.579
35. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. London: Routledge. (2013).
36. Wald NJ. Screening and preventive medication. *J Med Screen.* (2017) 24:169. doi: 10.1177/0969141316650712
37. Kasperon RE, Renn O, Slovic P, Brown HS, Emel J, Goble R, et al. The social amplification of risk: a conceptual framework. *Risk Anal.* (1988) 8:177–87. doi: 10.1111/j.1539-6924.1988.tb01168.x
38. Dunlop S, Wakefield M, Kashima Y. Can you feel it? negative emotion, risk, and narrative in health communication. *Media Psychol.* (2008) 11:52–75. doi: 10.1080/15213260701853112
39. Hoeken H, Sinkeldam J. The role of identification and perception of just outcome in evoking emotions in narrative persuasion. *J Commun.* (2014) 64:935–55. doi: 10.1111/jcom.12114
40. Liu S, Yang JZ. Incorporating message framing into narrative persuasion to curb E-cigarette use among college students. *Risk Analysis.* (2020) 40:1677–90. doi: 10.1111/risa.13502
41. Lillie HM, Jensen JD, Pokharel M, Upshaw SJ. Death narratives, negative emotion, and countering: testing fear, anger, and sadness as mechanisms of effect. *J Health Commun.* (2021) 6:586–95. doi: 10.1080/10810730.2021.1981495
42. Lillie HM, Pokharel M, John KK, Christy KR, Upshaw SJ, Giorgi EA, et al. Does it matter if a story character lives or dies?: A message experiment comparing survivor and death narratives. *Psychol Health.* (2022) 37:419–39. doi: 10.1080/08870446.2021.1873337
43. Jensen JD, Yale RN, Krakow M, John KK, King AJ. Theorizing foreshadowed death narratives: examining the impact of character death on narrative processing and skin self-exam intentions. *J Health Commun.* (2017) 22:84–93. doi: 10.1080/10810730.2016.1252816
44. Krakow M, Yale RN, Pérez Torres D, Christy KR, Jensen JD. Death narratives and cervical cancer: impact of character death on narrative processing and HPV vaccination. *Health Psychol.* (2017) 36:1173–80. doi: 10.1037/hea0000498
45. Scherr CL, Lillie H, Ratcliff CL, Krakow M, Liu M, Jensen JD. Are some narratives better than others?: The impact of different narrative forms on adolescents' intentions to text and drive. *Risk Anal.* (2022) 1–13. doi: 10.1111/risa.13878
46. Paek HJ, Oh SH, Hove T. How fear-arousing news messages affect risk perceptions and intention to talk about risk. *Health Commun.* (2016) 31:1051–62. doi: 10.1080/10410236.2015.1037419
47. Oh SH, Paek HJ, Hove T. Cognitive and emotional dimensions of perceived risk characteristics, genre-specific media effects, and risk perceptions: the case of H1N1 influenza in South Korea. *Asian J Commun.* (2015) 25:14–32. doi: 10.1080/01292986.2014.989240
48. Jose PE. The role of gender and gender role similarity in readers' identification with story characters. *Sex Roles.* (1989) 21:697–713. doi: 10.1007/BF00289178
49. Woods S, Hall L, Dautenhahn K, Wolke D. Implications of gender differences for the development of animated characters for the study of bullying behavior. *Comput Hum Behav.* (2007) 23:770–86. doi: 10.1016/j.chb.2004.11.018
50. Bortolussi M, Dixon P, Sopčák P. Gender and reading. *Poetics.* (2010) 38:299–318. doi: 10.1016/j.poetic.2010.03.004
51. De Graaf A, Hoeken H, Sanders J, Beentjes JW. Identification as a mechanism of narrative persuasion. *Commun Res.* (2012) 39:802–23. doi: 10.1177/0093650211408594
52. Igartua JJ, Fiuza D. Persuading with narratives against gender violence. Effect of similarity with the protagonist on identification and risk-perception. *Palabra Clave.* (2018) 21:499–523. doi: 10.5294/pacla.2018.21.2.10
53. Shaffer VA, Brodney S, Gavaruzzi T, Zisman-Ilani Y, Munro S, Smith SK, et al. Do personal stories make patient decision aids more effective? an update from the international patient decision aids standards. *Med Decis Making.* (2021) 41:897–906. doi: 10.1177/0272989X211011100
54. Metwally AM, Elmosalami DM, Elhariri H, El Etreby LA, Aboulghate A, El-Sonbaty MM, et al. Accelerating hepatitis C virus elimination in Egypt by 2030: a national survey of communication for behavioral development as a modelling study. *PLoS ONE.* (2021) 16:e0242257. doi: 10.1371/journal.pone.0242257
55. Ohringer AR, Serota DP, McLean RL, Stockman LJ, Watt JP. Disparities in risk perception and low harm reduction services awareness, access, and utilization among young people with newly reported hepatitis C infections in California, 2018. *BMC Public Health.* (2021) 21:1–10. doi: 10.1186/s12889-021-11492-3
56. Spinazze PA, Kasteleyn MJ, Aardoom JJ, Car J, Chavannes NH. Cross-sectional analysis of university students' health using a digitised health survey. *Int J Environ Res Public Health.* (2020) 17:3009. doi: 10.3390/ijerph17093009
57. Keller S, Maddock JE, Hannöver W, Thyrian JR, Basler HD. Multiple health risk behaviors in German first year university students. *Prev Med.* (2008) 46:189–95. doi: 10.1016/j.ypmed.2007.09.008
58. Piselli P, Serraino D, Fusco M, Girardi E, Pirozzi A, Toffolutti F, et al. Hepatitis C virus infection and risk of liver-related and non-liver-related deaths: a population-based cohort study in Naples, southern Italy. *BMC Infect Dis.* (2021) 21:667. doi: 10.1186/s12879-021-06336-9
59. Ara A, Inder D, Kumar P, Akhtar K. Knowledge, attitude and practices for HBV and HCV (Hepatitis B virus and Hepatitis C virus) among the students of a central university in South Delhi (India) and strategies for prevention of disease. *Int J Integr Health Sci.* (2021) 9:20. doi: 10.4103/ijhs.ijhs\_2\_21
60. Kumar M. Awareness regarding hepatitis C among dental students in Bangalore, India: a cross-sectional survey. *Saudi J Med.* (2021) 6:414–8.
61. Islam M, Sheba NH, Rahman M, Hossain S, Hussain M, Islam S, et al. Determinants of hepatitis B virus (HBV) infection among university students in Central Bangladesh. *J Community Health.* (2021) 1:7. doi: 10.1007/s10900-021-01025-9
62. Dehghani B, Dehghani A, Sarvari J. Knowledge and awareness regarding hepatitis B, hepatitis C, and human immunodeficiency viruses among college students: a report from Iran. *Int Q Community Health Educ.* (2020) 41:15–23. doi: 10.1177/0272684X19896727
63. James T, Cinelli B. Exploring gender-based communication styles. *J Sch Health.* (2003) 73:41–2. doi: 10.1111/j.1746-1561.2003.tb06559.x
64. Hess J, Whelan JS. Making health literacy real: adult literacy and medical students teach each other. *J Med Libr Assoc.* (2009) 97:221–4. doi: 10.3163/1536-5050.97.3.012
65. Brown T, Williams B, Boyle M, Molloy A, McKenna L, Palermo C, et al. Communication styles of undergraduate health students. *Nurse Educ Today.* (2011) 31:317–22. doi: 10.1016/j.nedt.2010.06.006
66. Diotauiuti P, Valente G, Mancone S, Grambone A. Psychometric properties and a preliminary validation study of the Italian brief version of the communication styles inventory (CSI-B/I). *Front Psychol.* (2020) 11:1421. doi: 10.3389/fpsyg.2020.01421
67. Diotauiuti P, Valente G, Mancone S, Grambone A, and Chirico A. Metric goodness and measurement invariance of the Italian brief version of interpersonal reactivity index: a study with young adults. *Front Psychol.* (2021) 12:773363. doi: 10.3389/fpsyg.2021.773363
68. Mallia L, Chirico A, Zelli A, Galli F, Palombi T, Bortoli L, et al. The implementation and evaluation of a media literacy intervention

- about PAES use in sport science students. *Front Psychol.* (2020) 11:368. doi: 10.3389/fpsyg.2020.00368
69. Cassidy C, Steenbeek A, Langille D, Martin-Misener R, Curran J. Designing an intervention to improve sexual health service use among university undergraduate students: a mixed methods study guided by the behaviour change wheel. *BMC Public Health.* (2019) 19:1–12. doi: 10.1186/s12889-019-8059-4
  70. Vozikis A, Drivas K, Milioris K. Health literacy among university students in Greece: determinants and association with self-perceived health, health behaviours and health risks. *Arch Public Health.* (2014) 72:15. doi: 10.1186/2049-3258-72-15
  71. Glassman T, Haughton N, Wohlwend J, Roberts S, Jordan T, Yingling F, et al. A health communication intervention to reduce high-risk drinking among college students. *J Stud Aff Res Pract.* (2013) 50:355–72. doi: 10.1515/jsarp-2013-0026
  72. Wang WL, Wang CJ, Tseng HF. Comparing knowledge, health beliefs, and self-efficacy toward hepatitis B prevention among university students with different hepatitis B virus infectious statuses. *J Nurs Res.* (2009) 17:10–9. doi: 10.1097/JNR.0b013e3181999ca3
  73. Rittenour CE, Booth-Butterfield M. College students' sexual health: Investigating the role of peer communication. *Qual Res Rep Commun.* (2006) 7:57–65. doi: 10.1080/17459430600965858
  74. Daugherty JR, Brase GL. Taking time to be healthy: Predicting health behaviors with delay discounting and time perspective. *Pers Individ Differ.* (2010) 48:202–7. doi: 10.1016/j.paid.2009.10.007
  75. Hall PA, Fong GT, Sansone G. (2015). Time perspective as a predictor of healthy behaviors and disease-mediating states. In: *Time Perspective Theory: Review, Research and Application*. Cham: Springer, 339–52.
  76. Sobol M, Blachnio A, Przepiórka A. Time of pandemic: Temporal perspectives related to compliance with public health regulations concerning the COVID-19 pandemic. *Soc Sci Med.* (2020) 265:113408. doi: 10.1016/j.socscimed.2020.113408
  77. Diotaiuti P, Valente G, Mancone S. Validation study of the Italian version of Temporal Focus Scale: psychometric properties and convergent validity. *BMC Psychol.* (2021) 9:1–13. doi: 10.1186/s40359-020-00510-5

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Diotaiuti, Mancone, Falese, Ferrara, Bellizzi, Valente, Corrado and Misiti. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





# Social Capital and Lifestyle Impacts on Mental Health in University Students in Colombia: An Observational Study

Lina Sotaquirá<sup>1</sup>, Insa Backhaus<sup>2,3</sup>, Paula Sotaquirá<sup>1</sup>, Mónica Pinilla-Roncancio<sup>1</sup>, Catalina González-Uribe<sup>1</sup>, Raquel Bernal<sup>4</sup>, Juan José Galeano<sup>5</sup>, Natalia Mejía<sup>1</sup>, Giuseppe La Torre<sup>3</sup>, Elena M. Trujillo-Maza<sup>1</sup>, Daniel E. Suárez<sup>1</sup>, John Duperly<sup>1</sup> and Andrea Ramirez Varela<sup>1\*</sup>

<sup>1</sup> School of Medicine, Universidad de los Andes, Bogotá, Colombia, <sup>2</sup> Centre for Health and Society, Institute of Medical Sociology, Medical Faculty, University of Düsseldorf, Düsseldorf, Germany, <sup>3</sup> Department of Public Health and Infectious Diseases, Sapienza University of Rome, Rome, Italy, <sup>4</sup> School of Economics, Universidad de los Andes, Bogotá, Colombia, <sup>5</sup> School of Economics, Universidad del Rosario, Bogotá, Colombia

## OPEN ACCESS

### Edited by:

Agnes Lai,  
The University of Hong Kong,  
Hong Kong SAR, China

### Reviewed by:

Assis Kamu,  
Universiti Malaysia Sabah, Malaysia  
Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### \*Correspondence:

Andrea Ramirez Varela  
an-rami2@uniandes.edu.co

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 21 December 2021

**Accepted:** 12 April 2022

**Published:** 12 May 2022

### Citation:

Sotaquirá L, Backhaus I, Sotaquirá P, Pinilla-Roncancio M, González-Uribe C, Bernal R, Galeano JJ, Mejía N, La Torre G, Trujillo-Maza EM, Suárez DE, Duperly J and Ramirez Varela A (2022) Social Capital and Lifestyle Impacts on Mental Health in University Students in Colombia: An Observational Study. *Front. Public Health* 10:840292. doi: 10.3389/fpubh.2022.840292

**Introduction:** For young adults, the first year of higher education represents a transition period into adulthood associated with an increased risk of developing depression, anxiety, and stress, contributing to deteriorating physical and mental health. The present study aimed to analyze the relationship between depressive symptoms and social capital and lifestyles among Colombian university students.

**Methods:** In 2020, a longitudinal repeated measures study was conducted on first year students at Universidad de los Andes in Bogotá, Colombia. The study was conceptualized and approved by the university before the COVID-19 pandemic appeared. Each student completed a self-administered questionnaire including questions on sociodemographic characteristics, depressive symptoms, perceived stress, social capital, and lifestyles. The study's pilot was conducted in November 2019, and the two measurement points were in January 2020 (wave 1, before the COVID-19 pandemic was declared) and in August 2020 (wave 2, during the COVID-19 pandemic). A binary logistic regression analysis was performed to assess the relationship between depressive symptoms, perceived stress, social capital, and lifestyles.

**Findings:** A total of 609 first year students (response rate = 58.11%) participated in wave 1, and 42% of the participants showed signs of clinically relevant depressive symptoms. In wave 2, despite the difficulties encountered in collecting data due to the COVID-19 pandemic, 216 students from wave 1 participated (35.47%). An increase in a sedentary lifestyle was observed (31.49%). We found that cognitive and behavioral social capital levels decreased by 12.03 and 24.54%, respectively. In addition, we observed a 6.5% increase in students with clinically relevant depressive symptoms compared to wave 1. A low level of behavioral [OR: 1.88; 95% CI (1.16, 3.04)] social capital was associated with clinically relevant depressive symptoms.

**Conclusion:** The health of university students continues to be a public health concern. The study suggests that social capital may play an important role in preventing depressive symptoms. Therefore, universities should put effort into programs that bring students together and promote the creation of social capital.

**Keywords:** social capital, mental health, depressive symptoms, lifestyles, university students

## INTRODUCTION

It is widely recognized that first year university students are exposed to various stressors when leaving the parental home and starting a new independent life (1). Generally, beginning college is associated with increased responsibilities and is coupled with a period of rising insecurities and emotional pressure (2, 3). Many students also experience a change in their overall lifestyles and social activities, including a decrease in physical activity, frequent use of alcohol, changes in diet, and increased stress levels (2). Furthermore, students often face a competitive environment and the need to create new social networks (4). These factors shape the student population and increase their susceptibility to mental health problems (2, 5).

With the onset of the COVID-19 pandemic, a potential additional stressor arose for students. In Colombia, for instance, a state of emergency was declared on March 17, 2020, after the first COVID-19 cases were detected on March 6, 2020, which resulted in university life changing immediately. Students were asked to stay away from campus, study remotely, and attend virtual classes. The measures taken to contain the spread of the virus have impacted everyone worldwide, but one of the most affected groups was probably the student population (6, 7). The closures of educational institutions and the shift to online education have caused changes in students' social life and lifestyles due to social isolation and fewer activities with peers (8, 9). Recent data show that slightly more than half of the college students experienced worsening mental health in 2020, including increased stress, anxiety, and depression (10).

Several factors have been proposed to reduce the effect of crises on health. One crucial factor discussed is social capital (11). For instance, Pitas and Ehmer (11) demonstrate that communities with high social capital respond more effectively than those with low levels of social capital. Social capital, however, has not only been shown to have beneficial effects on health during crises, but also in general. The above is consistent with what is proposed in the social determinants of health model, which explains how social, economic, and environmental factors determine the health status of individuals or populations (12, 13).

Regarding social capital, there is a growing literature showing that higher levels of social capital can benefit health (14–16). Studies that have analyzed the association between social capital and lifestyles, for instance, have shown that strengthening social networks can eradicate risky behaviors in the general population (14). In addition, higher levels of cognitive social capital have been associated with a lower risk of developing major depression (15) and with higher levels of regular, moderate, or vigorous physical activity (14–16).

Studies assessing the association between social capital and young adults' health, especially first year university students, are currently limited globally and in Colombia (17). Furthermore, most studies on mental health and social capital have been done in school, and adult populations in developed countries, and only a very few studies have evaluated this association in developing countries, such as Colombia (18–22). Additionally, most studies used cross-sectional data, which does not allow to make inferences about causality. Therefore, the present study aimed to explore the relationship between depressive symptoms and social capital and lifestyles through a repeated measure study, including two measurements 6 months apart during the first year of university studies. The COVID-19 pandemic started in the middle of our first wave of data collection.

## RESEARCH METHODS

### Study Design

A longitudinal repeated measures study was performed to analyze the relationship between depressive symptoms, social capital, and lifestyles (stress, physical activity, alcohol consumption, smoking, diet, and sleep) in first year students at Universidad de los Andes Bogotá, Colombia. This study was conceptualized and approved by the university before the COVID-19 pandemic appeared. This is one of the sites of the SPLASH “Social Capital And Students' Health—An international two-wave panel study” multicentric multinational study, that involves since 2018 Germany, Australia, Brazil, China, South Korea, United States, Malaysia, Switzerland, Italy, Oman, and Taiwan (17).

### Study Setting

Data collection was conducted in South America in Bogota, Colombia's capital city. The pilot study was in November 2019. Data were collected at the beginning and the end of the first semester. An academic semester in a Colombian university lasts 6 months; therefore, this is the reason for selecting the start and end of this period to conduct the study assessments. The first wave of data collection was carried out in person from January 21 to February 24, 2020. A self-administered questionnaire was provided to first-year students with the accompaniment of the research team in their classrooms.

Data collection for wave two was scheduled for August 2020, and the same methodology used for wave one was to be employed. However, due to the COVID-19 pandemic, it was necessary to adjust this methodology because all classes were online, and the country was in lockdown. Therefore, an e-mail including a survey link was sent to all participants with weekly

reminder e-mails. The second study wave was conducted from August 12 to November 27, 2020.

## Sample Size

The study aimed to evaluate the relationship between depressive symptoms and social capital. The sample size was calculated based on the prevalence of depressive symptoms in Colombia (26%) (23). Thus, based on this data, and with a sensitivity of 95%, a margin of error of no more than  $\pm 5\%$ , the minimum sample size required for this study was 290 students, adjusted for 20% of incomplete responses, and 30% loss to follow-up rate, the final minimum required sample size was 580 students.

## Participants

The target population consisted of 1,048 first year students from Universidad de los Andes. For participant selection, an e-mail was sent to each of the 43 academic program coordinators with detailed information about the project, requesting permission to talk to students during class and inviting them to participate in the study. Twenty-five coordinators responded and allotted 30 min in the introductory courses to administer the questionnaire. Participants were aged between 15 and 24 years, were in their first semester, had begun their studies at the Universidad de los Andes in the 2020–2021 academic period, and were enrolled full-time. Participants who had re-entered the university were excluded from the study. In the first contact with the students, the study procedures were explained in detail and the importance of their participation in both surveys one at the beginning and another at the end of the semester was mentioned.

## Variables and Measurements

Students were invited to complete a 58-question self-administered questionnaire lasting 25–30 min. It assessed four components: sociodemographic characteristics, social capital, mental health, and lifestyles. Previously validated questionnaires were obtained from a rigorous review of the literature, which has also been used in the annual international survey or SPLASH that examines mental health and related factors among university students worldwide. All were translated into Spanish to be applied to students. Where applicable, we used the same questions as applied in the study by Backhaus et al. (17), allowing for comparisons between our study and the study of Backhaus et al. (17). A detailed description of each of the variables is presented below.

### Dependent Variable

#### *Depressive Symptoms*

The simplified Beck Depression Inventory (BDI-S) was used (24, 25). The BDI-S or BDI-V measures the frequency of depressive symptoms (e.g., hopelessness, irritability) as well as physical symptoms (e.g., fatigue, loss of appetite). The modified inventory has 20 questions and measures the severity of depressive symptoms through a 6-point Likert scale ranging from 0 (never) to 6 (almost always). The inventory asks how current life feels with statements such as “I am sad” or “I look discouraged toward the future.” The score ranges from 0 to 100 (25). According to

the established cut-off points, a BDI-S score  $\geq 35$  suggests the presence of clinically relevant depressive symptoms (24, 25). The assessment of suicidal thinking was based on item 9 of the BDI-S, which asks if the person has had suicidal thoughts and has been considered a robust predictor of suicide attempts (26).

### Independent Variables

#### *Sociodemographic Characteristics*

This component had 13 questions, inquiring about the participant's age, nationality, marital status, the program in which he/she was enrolled, data on the participant's parents. Regarding socioeconomic status, the socioeconomic stratum of the participant's place of residence and perception of sufficient income to cover monthly expenses were asked. These components were evaluated to determine their effect on the other study variables (27).

#### *Social Capital*

We assessed two dimensions of cognitive and behavioral social capital using the Integrated Questionnaire for Measuring Social Capital by the World Bank (28). Cognitive social capital was composed of five questions, evaluating the components of trust, solidarity, lending, and cooperation. The questions were measured on a 5-point Likert scale (0 = strongly agree and 5: strongly disagree) and one with binary option (0 = you cannot be too careful and 1 = people can be trusting). Behavioral social capital was composed of nine questions of binary choice (yes or no) or Likert scale, assessing the components of Groups and networks, collective action, and cooperation. The obtained scores were divided into low and high levels of social capital. The behavioral score ranged from 0 to 10, with low levels being a score of  $< 5$ . The cognitive score ranged from 0 to 22, with low levels being  $< 12$ .

#### *Self-Rated Health*

Students were asked how they perceived their health. Answers were divided into fair/poor health vs. good/very good/excellent.

#### *Perceived Stress*

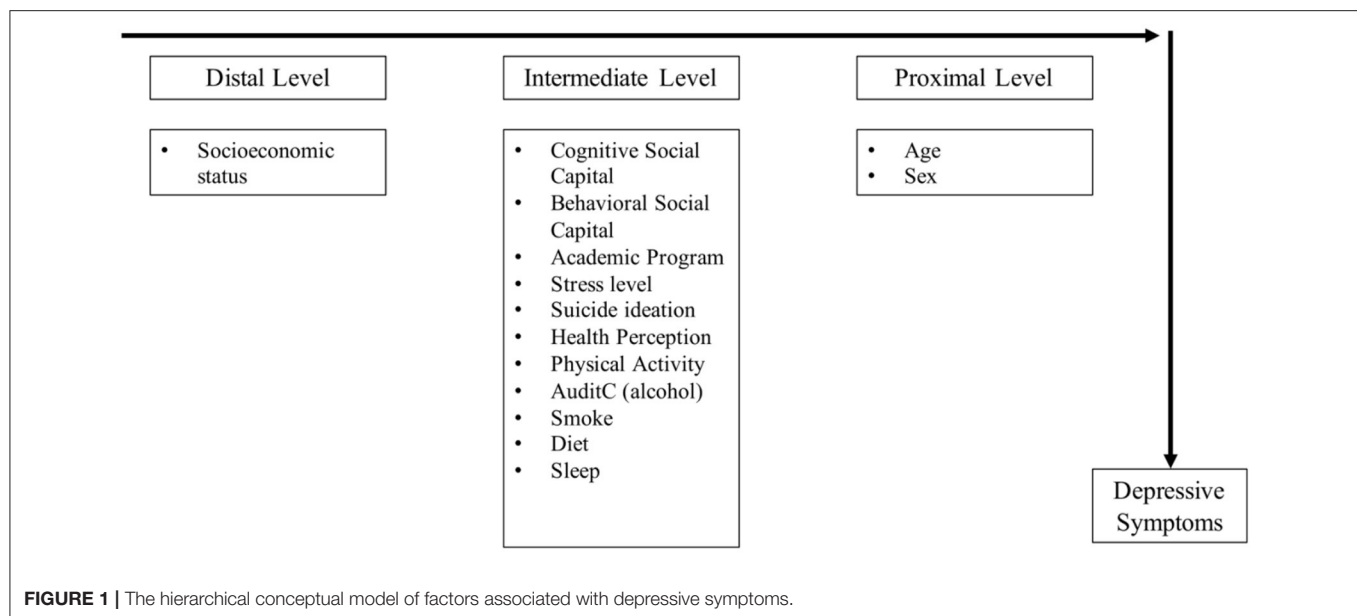
Perceived stress was measured using the Cohen Perceived Stress Scale, a 10-item scale that assesses the extent to which a respondent finds life situations stressful. The questions focus on how respondents find their lives unpredictable, uncontrollable, and overloaded. It uses a 5-point Likert response format ranging from 0 (*never*) to 4 (*very often*). Scores ranged from 0 to 40, with lower stress levels  $< 14$ , moderate levels from 14 to 26, and high levels  $> 27$  (29).

#### *Lifestyles*

*Alcohol Consumption.* Alcohol consumption was measured using the Audit-C questionnaire (30). The Audit-C consists of three questions, which assess the frequency with which participants consume alcoholic beverages. Score can range from 0 to 12 with higher scores indicating hazardous drinking (30).

#### *Smoking*

Smoking status was assessed by using six questions developed by the WHO. These questions asked whether the participant



smoked, and if so, how often, in what way, and whether he or she had reduced or stopped smoking. For the analysis students were divided into non-smokers and smokers (31).

### Physical Activity

The validated IPAQ instrument was used, which consisted of seven questions that evaluated the frequency with which the participants performed physical activity of low, moderate, and vigorous intensity. For the analysis, we calculated the METs score, and based on their score, determined whether a student performed low, moderate, or vigorous physical activity. Students with a score of <600 MET were classified as performing low-intensity physical activity, between 600 and 2,999 MET, moderate physical activity, and  $\geq 3,000$  MET vigorous physical activity (32).

### Eating and Sleeping

This questionnaire included two questions that evaluated if the participant's diet was balanced and if the participant slept well. It uses a 5-point Likert-type response format ranging from 0 (almost never) to 4 (almost always).

## Data Analysis Strategy

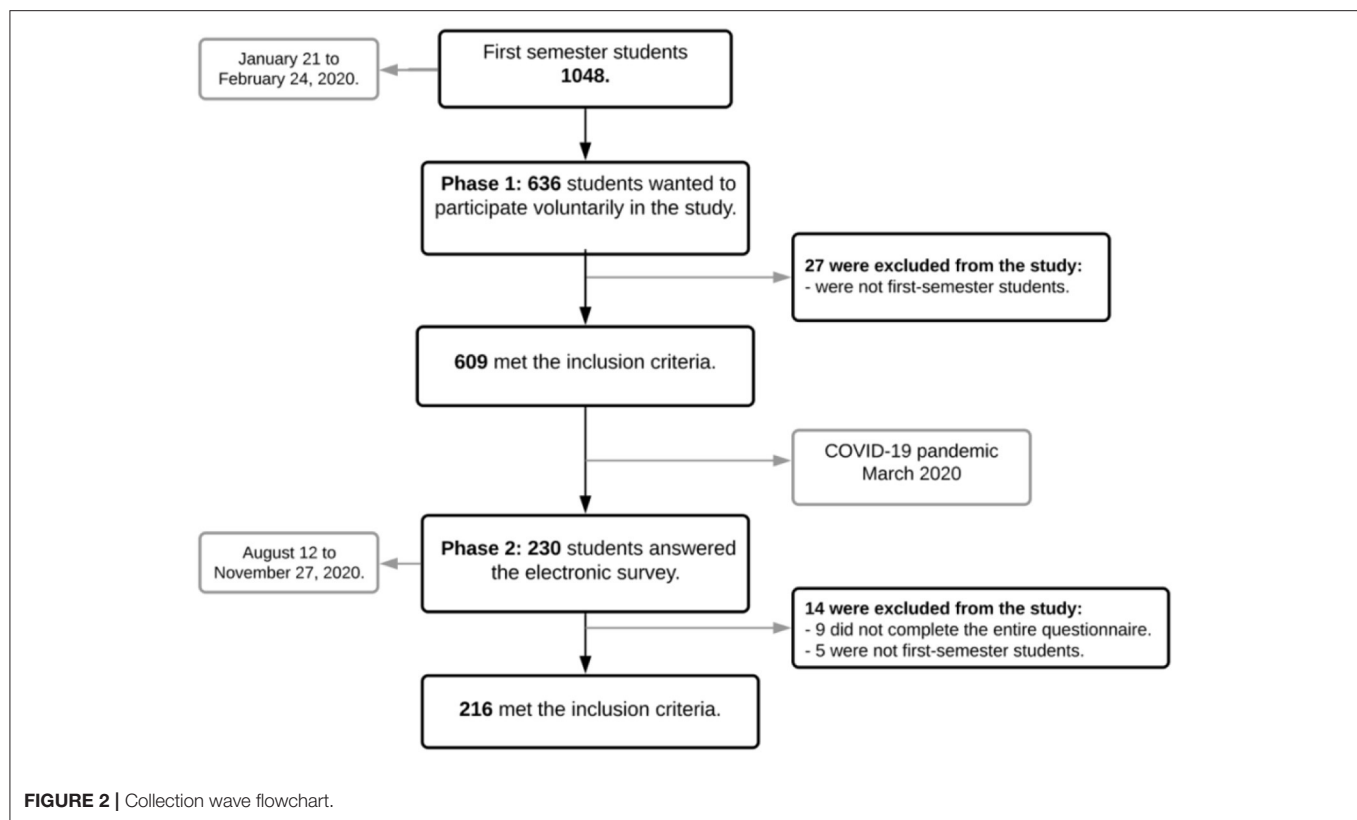
Descriptive analyses were conducted. The main outcome was dichotomized according to BDI-S scores: not clinically depressed (<35) vs. clinically relevant depression ( $\geq 35$ ). Statistical analysis was carried out using Stata 16 software. A descriptive analysis of each variable was performed to characterize the sample and determine the levels of social capital, depressive symptoms, perceived stress, and lifestyles in the sample evaluated. The variables associated with depressive symptoms were analyzed using Pearson's chi-square test, presenting relative and absolute frequencies. The null hypothesis was that the independent variables did not have

a statistically significant association with the dependent variable of depressive symptoms, which was rejected if the  $p$ -value was  $\leq 0.05$ .

A binary logistic regression was carried out to estimate the association between clinically relevant depressive symptoms, social capital, perceived stress, and other lifestyles variables. The relationship between clinically relevant depressive symptoms and independent variables: Demographic data, levels of social capital, stress, and lifestyles (physical activity, alcohol, and tobacco consumption, diet, and sleep) were estimated using a hierarchical conceptual model with backward elimination of the variables. At each level of analysis, variables with a  $p$ -value  $\leq 0.20$  were retained in the model. The final model included variables that were statistically associated with the outcome (see **Figure 1**). The level of significance was set at 0.05, and a confidence level of 95% was chosen.

The data set collected in wave 1, and 2 was analyzed as a panel data, which consists of repeated observations over time, in this case, observations of each of the participants at two points in time, wave 1 and wave 2. To assess changes in outcomes between waves 1 and 2, we applied McNemar's test for categorical variables paired with two categories and the adjusted McNemar's test, Symmetry (asymptotic), for categorical variables paired with more than two categories. This was intended to test the hypothesis that the changes observed between waves 1 and 2 were not due to chance. The level of significance was set at 0.05. Changes in mental health, lifestyles, and social capital were obtained by analyzing the panel data from the participants' first and second waves. A least-squares model with fixed effects was chosen to control for any individual-specific attributes that do not vary across time. Coefficients with 95% confidence intervals were obtained. The significance level was set at 0.05.





## FINDINGS

### Sample Characteristic of Participants: Wave 1 and Wave 2

In the study's first wave, 630 students participated; 21 students had to be excluded as they did not meet the inclusion criteria (i.e., non-first year students). One student did not answer questions related to behavioral social capital and was subsequently removed from the analysis. In wave 2, 230 students participated; 14 students had to be excluded (9 did not complete the entire questionnaire, and five did not meet the inclusion criteria). Unlike wave 1, the questionnaire could not be applied in person but had to be sent by mail due to the pandemic. Thus, 609 data from wave 1 (response rate = 58.11%) and 216 from wave 2 (representing 35.47% of respondents from wave 1) were used for the statistical analysis (Figure 2). Due to the loss of follow-up in wave 2, the results of longitudinal changes have to be interpreted with caution.

The mean age of the participants in wave 1 was 17.25 (SD:  $\pm 1$ ), and more men (63.22%) than women participated. Most of the students were enrolled in an engineering program. The percentage of students living at home with their parents was 54.19%. A BDI-S above 35, indicating the presence of clinically relevant depressive symptoms, was observed in 42.20% of participants in wave 1, and 24.14% of these students indicated that they have thought about suicide at least once (Table 1).

### Factors Associated With Depressive Symptoms

Tables 2, 3 show the results of the unadjusted and adjusted regression model. Some of the findings are described below. Being female [OR: 1.90, 95% CI (1.30, 2.75)] low levels of behavioral social capital [OR: 1.88, 95% CI (1.16, 3.04)] fair/poor health [OR: 6.68, 95% CI (2.46, 18.18)], and high levels of stress [OR: 4.04, 95% CI (1.78, 9.17)], were associated with clinically relevant depressive symptoms. Among lifestyle factors, not sleeping well [OR: 3.09, 95% CI (2.07, 4.60)] was a significant risk factor. Regarding physical activity, moderate [OR: 0.66, 95% CI (0.45, 0.97)] physical activity was a protective factor for the presence of depressive symptoms.

### Longitudinal Changes

Due to COVID-19 pandemic lockdowns and mobility restrictions, the data collection methodology for wave 2 had to be changed from in person to virtual. As mentioned above, the response rate decreased, impeding us from estimating the associations with adequate statistical power. Therefore, the following results have to be interpreted with caution and in light of the valuable information that was collected during an unprecedented global public health crisis such as the COVID-19 pandemic.

Table 4 presents the Sociodemographic Characteristics and Health-Related Behaviors of the 216 students who participated in the two waves. The average age of the students was 17.76 (SD:  $\pm 1$ ), 57.41% of the students were men, 52.31% had a high

**TABLE 1 |** Sociodemographic characteristics and lifestyles of university students with and without depressive symptoms.

	Total sample		Not clinically relevant (BDI-S < 35)		Clinically relevant (BDI-S ≥ 35)		p-value
	n	%	n	%	n	%	
Total	609	100	352	57.80	257	42.20	
Sex							<0.001*
Male	385	63.22	250	64.94	135	35.06	
Female	224	36.78	102	45.54	122	54.46	
Age							0.276
15–17	407	66.83	229	56.27	178	43.73	
18–24	202	33.17	123	60.89	79	39.11	
Socioeconomic status							0.847
Low	265	43.51	152	57.36	113	42.64	
High	344	56.49	200	58.14	144	41.86	
Housing first wave							0.025
Parents' home	330	54.19	205	62.12	125	37.88	
Relative's house	72	11.82	30	41.67	42	58.33	
University residence	95	15	51	53.68	44	46.32	
Rented house	90	14.78	52	57.78	38	42.22	
Other	22	3.61	14	63.64	8	36.36	
Program							<0.001*
Engineering	351	57.64	231	65.81	120	34.19	
Social sciences	150	24.63	69	46.00	81	54.00	
Sciences	38	6.24	16	42.11	22	57.89	
Health sciences	37	6.08	22	59.46	15	40.54	
Directed studies	30	4.93	12	40.00	18	60.00	
Architecture and arts	3	0.49	2	66.67	1	33.33	
IPAQ physical activity categories							0.001*
Low physical activity level	335	55.01	171	51.04	164	48.96	
Moderate physical activity level	231	37.93	151	65.37	80	34.63	
Vigorous physical activity level	43	7.06	30	69.77	13	30.23	
Sedentariness: time spent sitting in a working day							0.003*
1–4 h	184	30.21	121	65.76	63	34.24	
5–9 h	327	53.69	187	57.19	140	42.81	
10 h or more	98	16.09	44	44.90	54	55.10	
Heavy episodic drinking							0.533
Low-risk drinkers	430	70.61	252	58.60	178	41.40	
High-risk drinkers	179	29.39	100	55.87	79	44.13	
Smoking status							0.225
Non-smoker	595	86.04	308	58.78	216	41.22	
Ever smoker	85	13.96	44	51.76	41	48.24	
Balanced diet							<0.001*
Yes	369	60.59	243	65.85	126	34.15	
No	240	39.41	109	45.42	131	54.58	
Sleep: do you sleep well and feel rested?							<0.001*
Yes	212	34.81	158	74.53	54	25.57	
No	397	65.19	194	48.87	203	51.13	
Self-rated health							<0.001*
Good	574	94.25	347	60.45	227	39.55	
Fair/poor	35	5.75	5	14.29	30	85.71	
Suicide ideation							<0.001*
No suicidal ideation	462	75.86	325	70.35	137	29.65	

(Continued)

TABLE 1 | Continued

	Total sample		Not clinically relevant (BDI-S < 35)		Clinically relevant (BDI-S ≥ 35)		p-value
	n	%	n	%	n	%	
Yes, at least once	147	24.14	27	18.37	120	81.63	<0.001*
Perceived stress							
Low stress	7	1.15	6	85.71	1	14.29	
Moderate stress	562	92.28	337	59.96	225	40.04	
High stress	40	6.57	9	22.50	31	77.50	0.01*
Social capital: cognitive dimension							
Low cognitive social capital level	204	33.50	103	50.49	101	49.51	
High cognitive social capital level	405	66.50	249	61.48	156	38.52	
Social capital: behavioral dimension <sup>a</sup>							0.001*
Low behavioral social capital level	106	17.43	46	43.40	60	56.60	
High behavioral social capital level	502	82.57	305	60.76	197	39.24	
Bonding bridging							
Bridging social capital	407	66.83	228	56.02	179	43.98	0.207
Bonding social capital	202	33.17	124	61.39	78	38.61	

N = 609.

<sup>a</sup>The total does not add up to 609 due to missing data.

\*p ≤ 0.05.

socioeconomic status, and 53.24% were from the engineering program. When comparing these students' responses with those of wave 1, the proportion of students with clinically relevant depressive symptoms increased by almost 7%. The proportion of students living at home with their parents increased by 29.16%.

Regarding lifestyles, there was a 13% increase in the number of students who reported doing low-intensity physical activity and a 31.49% increase in students who reported sitting for 10 h or more. Clinically relevant depressive symptoms increased by 6.49%, and stress levels increased by only 1.38%. Concerning the levels of social capital, cognitive capital decreased by 12.03%, and behavioral capital decreased by 24.54%.

Evaluating the results of the least-squares model with fixed effects, we found that only two of the assessed variables showed a statistically significant association with depressive symptoms. While sleeping well decreased the risk of suffering from depressive symptoms by 14 percentage points, smoking increased the risk of suffering from depressive symptoms by 23 percentage points (see Table 5).

## DISCUSSION

This is the first longitudinal study assessing clinically relevant depressive symptoms and the relationship with levels of social capital and lifestyles among university students. Data collection had to be held during the COVID-19 pandemic. The main results included a clinically relevant depressive symptom rate of 42.2%, an 88% higher risk of depressive symptoms among participants with low levels of behavioral social capital, 90% higher risk in women, 300% higher risk in participants with high levels of perceived stress, and 200% higher risk in participants who do not sleep well. Regular moderate physical activity was a protective factor against depressive symptoms, sleeping well decreased the

risk of suffering depressive symptoms by 14%, and smoking increased that risk by 23%.

When comparing results with the study of Backhaus et al. (17) and the prevalence rates of other countries, the rate of depressive symptoms in Colombia is not as low as in Belgium (22%) and not as high as Brazil's (86%) but similar to rate detected in Oman (41%) and Taiwan (40%).

Being a female student, having lower behavioral social capital, high levels of perceived stress, and suffering from poor sleep quality significantly increased the risk of depressive symptoms. The findings regarding social capital are in line with previous findings demonstrating the beneficial effect of social capital on mental health (17, 33–35). Individuals with high behavioral social capital levels may receive more outstanding social support from their social networks. Therefore, it is possible that experiencing less social isolation results in a lower risk of depression (35, 36). Based on some published studies, high levels of social capital have been a protective factor for mental health by preventing not only depression but also anxiety and by favoring healthy lifestyles such as regular physical activity, a balanced diet, and less substance use (21, 33, 37). The literature also highlights the protective role of social capital in reducing stress levels, a known risk factor for depression (38).

The finding regarding gender differences also corresponds with those reported in other studies which suggested that, due to sociocultural factors, women are more likely to express their emotions and, therefore, more readily admit when they have depressive feelings (36).

Another factor associated with clinically relevant depressive symptoms was perceived stress. We found that most of the sample (98.85%) reported having moderate to high stress levels. Of the students who reported high stress levels, 77.50% had a BDI-S ≥ 35. Students often experience stress related to their

**TABLE 2 |** Binomial logistic regression showing the crude risk of depressive symptoms among university students.

	Clinically relevant depressive symptoms (BDI-S ≥ 35)		<i>p</i> -value
	Unadjusted <i>OR</i>	95% <i>CI</i>	
Proximal level: sociodemographic characteristics			
Sex			
Female	2.21	(1.58, 3.09)	<0.001*
Male	1.00		
Age			
15–17	1.21	(0.86, 1.70)	0.277
18–24	1.00		
Socioeconomic status			
Low	1.03	(0.75, 1.43)	0.847
High	1.00		
Social capital: cognitive dimension			
Low cognitive social capital level	1.57	(1.11, 2.20)	0.010*
High cognitive social capital level	1.00		
Social capital: behavioral dimension <sup>a</sup>			
Low behavioral social capital level	2.02	(1.32, 3.09)	0.001*
High behavioral social capital level	1.00		
Intermediate level			
Self-rated health			
Fair/poor	9.17	(3.51, 23.99)	<0.001*
Good	1.00		
Perceived stress			
Low stress	0.25	(0.30, 2.09)	0.200
Moderate stress	1.00		
High stress	5.16	(2.41, 11.04)	<0.001*
Smoking status			
Ever smoker	1.32	(0.84, 2.10)	0.226
Non-smoker	1.00		
Heavy episodic drinking			
High-risk drinkers	1.12	(0.79, 1.59)	0.533
Low-risk drinkers	1.00		
Sleep: do you sleep well and feel rested?			
No	3.06	(2.12, 4.42)	<0.001*
Yes	1.00		
IPAQ physical activity categories			
Low physical activity level	1.00		
Moderate physical activity level	0.55	(0.39, 0.78)	0.001*
Vigorous physical activity level	0.45	(0.23, 0.90)	0.023*

*N* = 609.

OR, odds ratio.

<sup>a</sup>The total does not add up to 609 due to missing data.

\**p* ≤ 0.05.

academic careers, such as lack of time to complete academic activities, exposure to classwork, and academic overload (39). These academic stressors are a subset, among other factors that generate high stress levels in this population. First year students, in particular, are more likely to report higher stress rates due to lack of time for other activities and academic overload. Although upper-level university students continue to perceive these factors as stressors, they attenuate to some extent over time (38).

Regarding lifestyle results, we found that <10% of the students reported participating in vigorous exercise. Of the participants who only engaged in a low-intensity activity, such as walking, almost half (48.96%) reported having depressive symptoms, indicating that moderate and vigorous physical exercise can be a protective factor. These findings are consistent with those reported in the SPLASH study (17). When comparing the results of wave 1 and wave 2, we observed a decrease in physical



**TABLE 3 |** Results for binomial logistic regression, displaying adjusted odds ratios and 95% confidence intervals for depressive symptoms.

	Model		<i>p</i> -value
	Adjusted <i>OR</i>	95% <i>CI</i>	
Proximal level: sociodemographic characteristics			
Social capital: cognitive dimension			
Low cognitive social capital level	1.25	(0.86, 1.83)	0.244
High cognitive social capital level	1.00		
Social capital: behavioral dimension <sup>a</sup>			
Low behavioral social capital level	1.88	(1.16, 3.04)	0.010*
High behavioral social capital level	1.00		
Age			
15–17	1.12	(0.76, 1.65)	0.594
18–24	1.00		
Sex			
Male	1.00		
Female	1.90	(1.30, 2.75)	0.001*
Intermediate level			
Self-rated health			
Good	1.00		
Fair/poor	6.68	(2.46, 18.18)	<0.001*
Perceived stress			
Low stress	0.26	(0.28, 2.31)	0.225
Moderate stress	1.00		
High stress	4.04	(1.78, 9.17)	0.001*
Sleep: do you sleep well and feel rested?			
Yes	1.00		
No	3.09	(2.07, 4.60)	<0.001*
IPAQ physical activity categories			
Low physical activity level	1.00		
Moderate physical activity level	0.66	(0.45, 0.97)	0.032
Vigorous physical activity level	0.59	(0.28, 1.26)	0.175
Intraclass correlation coefficient	0.21	(0.13, 0.35)	<0.001*

*N* = 609.

OR, odds ratio.

<sup>a</sup>The total does not add up to 609 due to missing data.

\**p* ≤ 0.05.

activity among participants and a corresponding increase of 31.49% who reported sitting for more than 10 h a day. This shift from an active to a sedentary lifestyle could be explained by the impact that this pandemic has had on the routines of individuals. In general, social confinement and working and studying virtually have caused this population to remain more sedentary than it is normally (10). A meta-analysis conducted to evaluate the factors involved in the relationship between physical activity and depression showed a biological component (1). Also, physical activity decreases stress levels, and attending the gym or participating in exercise groups provides new social connections. Hence, the importance of promoting physical activity directly impacts physical and mental health and contributes to increasing the levels of social capital, which in turn is a protective factor against the development of clinically relevant depressive symptoms (35).

Analysis of the paired data showed that tobacco use was found to increase the risk of depression. A study of Korean college students showed that smoking was associated with depression and suicidal behavior, at least partly because adolescents are more vulnerable to nicotine sensitivity, which is associated with effects on cognitive function (40). In this study, a decrease in alcohol and tobacco consumption was suggested in students from wave 1 to wave 2; this could be explained because, during the confinement, establishments were closed, such as restaurants, discos, where young people were accustomed to drinking alcohol regularly (41). Also, as evidenced in this study, most students had to return to live at home with their parents (29.16%), which also explains the decrease in tobacco consumption. In this sense, the influence of context on substance use has been investigated, and contextual changes, such as “moving back home,” could represent an opportunity to facilitate cessation (42).

**TABLE 4 |** Sociodemographic characteristics and health-related behaviors of university students with and without depressive symptoms.

	Wave 1		Wave 2		Difference	p-value <sup>a</sup>
	n	%	n	%		
<b>Total</b>	<b>216</b>	<b>100</b>	<b>216</b>	<b>100</b>		
Sex						
Male	124	57.41	124	57.41		
Female	92	42.59	92	42.59		
Age	17.19 ± 0.85 <sup>b</sup>	15–21 <sup>c</sup>	17.76 ± 0.92 <sup>b</sup>	16–22 <sup>c</sup>	0.57 ± 0.80 <sup>b</sup>	<0.001*
15–17	154	71.30	97	44.91		
18–24	62	28.70	119	55.09	26.39	<0.001*
Socioeconomic status						
Low	103	47.69	103	47.69		
High	113	52.31	113	52.31		
Housing						
Parents' home	117	54.17	180	83.33	29.16	<0.001*
Relative's house	24	11.11	21	9.72	–1.39	
University residence	35	16.20	2	0.93	–15.27	
Rented house	33	15.28	13	6.02	–9.26	
Other	7	3.24			–3.24	
Program						
Engineering	115	53.24	115	53.24		
Social sciences	60	27.78	60	27.78		
Sciences	20	9.26	20	9.26		
Health sciences	13	6.02	13	6.02		
Directed studies	6	2.78	6	2.78		
Architecture and arts	2	0.93	2	0.93		
IPAQ physical activity categories						
Low physical activity level	124	57.41	152	70.37	12.96	0.001*
Moderate physical activity level	84	38.89	60	27.78	–11.11	
Vigorous physical activity level	8	3.70	4	1.85	–1.85	
Sedentariness: time spent sitting in a working day						
1–4 h	50	23.15	11	5.09	–18.06	<0.001*
5–9 h	124	57.41	95	43.98	–13.43	
10 h or more	42	19.44	110	50.93	31.49	
Heavy episodic drinking						
Low-risk drinkers	164	75.93	182	84.26	8.33	0.004*
High-risk drinkers	52	24.07	34	15.74		
Smoking status						
Non-smoker	195	90.28	205	94.91	4.63	0.018*
Ever smoker	21	9.72	11	5.09		
Balanced diet						
Yes	132	61.11	150	69.44	8.33	0.016*
No	84	38.89	66	30.56		
Sleep: do you sleep well and feel rested?						
Yes	69	31.94	70	32.41	0.47	0.908
No	147	68.06	146	67.59		
Self-rated health						
Good	204	94.44	205	94.91	0.47	0.763
Fair/poor	12	5.56	11	5.09		
Depressive symptoms						
Not clinically relevant (BDI-S < 35)	110	50.93	96	44.44		

(Continued)

TABLE 4 | Continued

	Wave 1		Wave 2		Difference	p-value <sup>a</sup>
	n	%	n	%		
<b>Total</b>	<b>216</b>	<b>100</b>	<b>216</b>	<b>100</b>		
Clinically relevant (BDI-S $\geq 35$ )	106	49.07	120	55.56	6.49	0.061
Suicide ideation						
No suicidal ideation	156	72.22	155	71.76	0.46	0.869
Yes, at least once	60	27.78	61	28.24		
Perceived stress						
Low stress	2	0.93	2	0.93		0.891
Moderate stress	192	88.89	189	87.50	-1.39	
High stress	22	10.19	25	11.57	1.38	
Social capital: cognitive dimension						
Low cognitive social capital level	60	27.78	86	39.81	12.03	0.001*
High cognitive social capital level	156	72.22	130	60.19		
Social capital: behavioral dimension						
Low behavioral social capital level	42	19.44	95	43.98	24.54	<0.001*
High behavioral social capital level	174	80.56	121	56.02		
Bonding bridging						
Bridging social capital	147	68.06	186	86.11	18.05	<0.001*
Bonding social capital	69	31.94	30	13.89		

N = 216.

<sup>a</sup>McNemar test for paired categorical variables with two categories and adjusted McNemar test, Symmetry (asymptotic) for paired categorical variables with more than two categories.<sup>b</sup>Mean  $\pm$  SD.<sup>c</sup>Range.\*p  $\leq 0.05$ .

On the other hand, getting a good night's sleep was a protective factor for the development of depression. It has been shown that sleep, especially in young people, is fundamental for maintaining normal body functions. So young people with poor sleep will negatively impact their neurocognitive functions and emotional wellbeing, which can aggravate academic difficulties (43). Thus, it is important to promote the importance of a healthy lifestyle for its potential to prevent the development of depression (44).

The World Health Organization states that mental disorders are important causes of morbidity and mortality globally, noting that one in four people will develop a mental disorder at some point in their lives (1). It is also essential to highlight the impact that the COVID-19 pandemic has had on the general population. It altered the daily routines of all people globally, which is reflected in the observed increase in mental illnesses and unhealthy lifestyles during the pandemic (45).

We discovered other interesting findings when comparing the results of wave 1 with those of wave 2. Almost 30% of the students returned to live at home with their parents due to the pandemic. Of this group, nearly 38% reported depressive symptoms, which was lower than those who lived at a relative's home, college residence, or in a rented house. A survey conducted among university students in India reported that living at home with parents favored mental health due to the family environment and good relationships with parents (10). In contrast, students who move out of their family homes have to socialize with new

people and establish a new social network, which may increase their stress levels and affect their mental health (9).

Our findings suggest that the mental health of university students may have been substantially affected during the COVID-19 pandemic.

## IMPLICATIONS

Our study shows significant findings on the mental health of Universidad de Los Andes students and their health behaviors. It also shows the value of mental health protective factors, such as social capital. It is necessary to provide opportunities that favor social interaction and promote the creation of interest groups among students, thus strengthening their support networks and levels of social capital. In turn, encourage the practice of sports or activities that promote a healthy lifestyle and help with stress management, positively impacting the mental health of these young people.

In addition, the COVID-19 pandemic has impacted the lives of young adults across the globe. Before the pandemic, university students comprised a population considered particularly vulnerable to mental health problems (36). The COVID-19 pandemic has brought unprecedented stress to students. Our findings corroborate recent studies that high levels of

**TABLE 5 |** Results of the least-squares model with fixed effects, showing coefficients and 95% confidence intervals for depressive symptoms.

	Model		<i>p</i> -value
	Coefficient	95% CI	
Proximal level: sociodemographic characteristics			
Social capital: cognitive dimension			
High cognitive social capital level	0.03	(−0.09, 0.16)	0.600
Social capital: behavioral dimension			
High behavioral social capital level	−0.08	(−0.20, 0.46)	0.220
Age			
18–24	0.05	(−0.10, 0.19)	0.530
Intermediate level			
Self-rated health			
Good	−0.01	(−0.31, 0.28)	0.933
Perceived stress			
Moderate stress	−0.13	(−0.62, 0.36)	0.608
High stress	0.06	(−0.45, 0.57)	0.814
Sleep: do you sleep well and feel rested?			
Yes	−0.15	(−0.26, −0.03)	0.012
IPAQ physical activity categories			
Moderate physical activity level	−0.11	(−0.26, 0.04)	0.144
Vigorous physical activity level	0.19	(−0.12, 0.50)	0.227
Smoking status			
Ever smoker	0.23	(−0.01, 0.47)	0.051
Intraclass correlation coefficient	0.71	(0.14, 1.28)	0.015*

N = 216.

\*p ≤ 0.05.

social capital have contributed to some populations being less affected by the measures used to cope with this pandemic (10, 11, 46).

Universidad de los Andes has some general guidelines to promote student wellness. It has a variety of services available, such as counseling, advising, academic support, and leisure time strategies focused on positively impacting the health and wellbeing of students. In this institution, a culture of wellness is promoted throughout the campus. The directors and professors are trained in mental health issues not to diagnose and prescribe but to operate under a wellness mentality in every interaction and detect risks that can be referred to on time. Increasing the availability of places that favor socialization and the practice of sports or other activities that promote a healthy lifestyle will remain fundamental to mitigate the impact of the transition to university life, in this case, aggravated by the current pandemic in our country and other university settings.

Furthermore, we need additional studies that evaluate the social capital in Latin American contexts to help determine the causes of poor health outcomes. We also need studies that contribute to developing and implementing interventions that strengthen social capital in different communities and strategies to promote healthy lifestyles in this population.

## STRENGTHS AND LIMITATIONS

This study has some limitations that must be acknowledged. First, the study and data collection fell right into the pandemic, and therefore, different recruitment approaches had to be applied. While the first wave was conducted in person during January and February 2020 and directly on the university campus, the second wave, which took place in August 2020, had to be entirely online. This has resulted in a much lower response rate than expected. Therefore, the results of longitudinal changes have to be interpreted with caution and take into account the potential loss of statistical power in light of the valuable information collected during an unprecedented global public health crisis such as the COVID-19 pandemic. Second, self-reported measures were used concerning questions investigating lifestyles and depressive symptoms, and we cannot exclude recall bias.

Despite these limitations, the present study has important strengths. It should be emphasized that our study is not a cross-sectional study, but uses a two-wave panel design that allows us to make early inferences about the directionality of the effects of social capital on mental health. Furthermore, this is the first study assessing the presence of clinically relevant depressive symptoms and the relationship with levels of social capital, perceived stress, and lifestyles among university students both before and during the COVID-19 pandemic. Therefore, the findings offer important information about the value of social capital and the importance of maintaining lifestyles during times of crisis.

## CONCLUSIONS

Our study showed relevant findings on the role of social capital in preventing depressive symptoms and promoting healthy lifestyles in this population. This study found that the proportion of first semester university students with clinically depressive symptoms was already elevated before the COVID-19 pandemic and may have increased even further during the pandemic, particularly among those with lower levels of social capital. Thus, students' health has to be prioritized and put at the top of public health agendas, and the implementation of measures strengthening social capital should be considered.

## DATA AVAILABILITY STATEMENT

The data set of this study is available upon request to the corresponding author.

## ETHICS STATEMENT

The Ethics Committee of the Universidad de los Andes approved this study (act number: 201909242). Written informed assent or consent was obtained, depending on whether participants were adolescents or young adults. Participants were guaranteed confidential treatment of their data and were given the possibility to withdraw from the study at any time. When participants reported having relevant depressive symptoms or suicidal ideas, they received psychological support from the university health services.



## AUTHOR CONTRIBUTIONS

LS, PS, and AR collected data at Universidad de los Andes (Colombia). LS, PS, AR, JG, and IB conducted the statistical analyses. All authors participated in revising the results and the manuscript and approved the final version.

## REFERENCES

1. Aceijas C, Waldhäusl S, Lambert N, Cassar S, Bello-Corassa R. Determinants of health-related lifestyles among university students. *Perspect Public Health*. (2017) 137:227–36. doi: 10.1177/1757913916666875
2. Eisenberg D, Hunt J, Speer N. Mental health in american colleges and universities: variation across student subgroups and across campuses. *J Nerv Ment Dis*. (2013) 201:60–7. doi: 10.1097/NMD.0b013e31827ab077
3. Moreno-Gómez C, Romaguera-Bosch D, Tauler-Riera P, Bannasar-Veny M, Pericas-Beltran J, Martinez-Andreu S, et al. Clustering of lifestyle factors in Spanish university students: the relationship between smoking, alcohol consumption, physical activity and diet quality. *Public Health Nutr*. (2012) 15:2131–9. doi: 10.1017/S1368980012000080
4. Lederer AM, Hoban MT, Lipson SK, Zhou S, Eisenberg D. More than Inconvenienced: the unique needs of U.S. college students during the COVID-19 pandemic. *Health Educ Behav*. (2021) 48:14–9. doi: 10.1177/1090198120969372
5. Varela-Arévalo MT, Ochoa-Muñoz AF, Tovar-Cuevas JR. Tipologías de estilos de vida en jóvenes universitarios. *Rev Univ y Salud*. (2016) 18:246–56. doi: 10.22267/rus.161802.35
6. Ihm L, Zhang H, van Vijfeijken A, Waugh MG. Impacts of the Covid-19 pandemic on the health of university students. *Int J Health Plann Manage*. (2021) 36:618–27. doi: 10.1002/hpm.3145
7. Ordorika I. Pandemia y educación superior. *Rev Educ*. (2020) 49:194. doi: 10.36857/resu.2020.194.1120
8. Díaz Palacios DF, Péndola Ferrada V, Orellana Sanhueza RA, Zúñiga Romero TP. Niveles de actividad física en estudiantes universitarios durante la pandemia asociada al COVID-19. (2020) (Bachelor's Thesis). Santiago, Chile: Universidad Andrés Bello. Available online at: [http://repositorio.unab.cl/xmlui/bitstream/handle/ria/17727/a131229\\_Diaz\\_D\\_Niveles\\_de\\_actividad\\_fisica\\_en\\_estudiantes\\_2020\\_Tesis.pdf?sequence=1&isAllowed=y](http://repositorio.unab.cl/xmlui/bitstream/handle/ria/17727/a131229_Diaz_D_Niveles_de_actividad_fisica_en_estudiantes_2020_Tesis.pdf?sequence=1&isAllowed=y)
9. Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: A longitudinal probability sample survey of the UK population. *Lancet Psychiatry*. (2020) 7:883–92. doi: 10.1016/S2215-0366(20)30308-4
10. Chaturvedi K, Vishwakarma DK, Singh N. COVID-19 and its impact on education, social life and mental health of students: a survey. *Child Youth Serv Rev*. (2021) 121:105866. doi: 10.1016/j.childyouth.2020.105866
11. Pitas N, Ehmer C. Social capital in the response to COVID-19. *Am J Heal Promot*. (2020) 34:942–4. doi: 10.1177/0890117120924531
12. Aguirre MV. Factores determinantes de la salud: Importancia de la prevención. *Acta Médica Peruana*. (2011) 28:237–41.
13. Viner RM, Ozer EM, Denny S, Marmot M, Resnick M, Fatusi A, et al. Adolescence and the social determinants of health. *Lancet*. (2012) 379:1641–52. doi: 10.1016/S0140-6736(12)60149-4
14. Valente TW, Gallaher P, Mouttapa M. Using social networks to understand and prevent substance use: a transdisciplinary perspective. *Subst Use Misuse*. (2004) 39:1685–712. doi: 10.1081/JA-200033210
15. Salmerón Ruiz MA, Casas Rivero J, Guerrero Alzola F. Problemas de salud en la adolescencia. Patología crónica y transición. *Pediatr Integr*. (2017) 21:245–53.
16. Balestrieri SG, DiGuseppi GT, Meisel MK, Clark MA, Ott MQ, Barnett NP. US college students' social network characteristics and perceived social exclusion: A comparison between drinkers and nondrinkers based on past-month alcohol use. *J Stud Alcohol Drugs*. (2018) 79:862–7. doi: 10.15288/jasad.2018.79.862

## ACKNOWLEDGMENTS

The authors would like to thank the first year students of Universidad de los Andes who participated in this study. We also want to thank the students of the master's degree in epidemiology at the Universidad de los Andes who helped in the collection wave.

17. Backhaus I, Ramirez Varela A, Khoo S, Sieffken K, Crozier A, Begotaraj E, et al. Associations between social capital and depressive symptoms among college students in 12 countries: results of a cross-national study. *Front Psychol*. (2020) 11:644. doi: 10.3389/fpsyg.2020.00644
18. Harpham T, Grant E, Rodriguez C. Mental health and social capital in Cali. *Colombia*. (2004) 58:2267–77. doi: 10.1016/j.socscimed.2003.08.013
19. Emmering SA, Astroth KS, Woith WM, Dyck MJ, Kim M. Social capital, health, health behavior, and utilization of healthcare services among older adults: a conceptual framework. *Nurs Forum*. (2018) 53:416–24. doi: 10.1111/nuf.12268
20. Ke Y, Jiang J, Chen Y. Social capital and the health of left-behind older adults in rural China: a cross-sectional study. *BMJ Open*. (2019) 9:e030804. doi: 10.1136/bmjopen-2019-030804
21. Mieziene B, Emeljanovas A, Novak D, Kawachi I. The relationship between social capital within its different contexts and adherence to a Mediterranean diet among Lithuanian adolescents. *Nutrients*. (2019) 11:1332. doi: 10.3390/nut11061332
22. Novak D, Doubova SV, Kawachi I. Social capital and physical activity among Croatian high school students. *Public Health*. (2016) 135:48–55. doi: 10.1016/j.puhe.2016.02.002
23. Barahona-Correa JE, Aristizabal-Mayor JD, Lasalvia P, Ruiz AJ, Hidalgo-Martínez P. Sleep disturbances, academic performance, depressive symptoms and substance use among medical students in Bogotá, Colombia. *Sleep Science*. (2018) 11:260–8. doi: 10.5935/1984-0063.20180041
24. Schmitt M, Beckmann M, Dusi D, Maes J, Schiller A, Schonauer K. Messgüte des vereinfachten Beck-Depressions-Inventars (BDI-V). *Diagnostica*. (2003) 49:147–56. doi: 10.1026/0012-1924.49.4.147
25. Sauer S, Ziegler M, Schmitt M. Rasch analysis of a simplified Beck Depression Inventory. *Pers Individ Dif*. (2013) 54:530–5. doi: 10.1016/j.paid.2012.10.025
26. Green KL, Brown GK, Jager-Hyman S, Cha J, Steer RA, Beck AT. The predictive validity of the beck depression inventory suicide item. *J Clin Psychiatry*. (2015) 76:1683–6. doi: 10.4088/JCP.14m09391
27. Caro DH, Cortés D. Measuring family socioeconomic status: an illustration using data from PIRLS 2006. *IERI Monogr Ser Issues Methodol Large Scale Assessments*. (2012) 5:9–33.
28. Grootaert C, Narayan D, Nyhan Jones V, Woolcock M. *Measuring Social Capital: An Integrated Questionnaire*. (2004). Washington, DC: The World Bank.
29. Andreou E, Alexopoulos EC, Lionis C, Varvogli L, Gnardellis C, Chrousos GP, et al. Perceived stress scale: reliability and validity study in Greece. *Int J Environ Res Public Health*. (2011) 8:3287–98. doi: 10.3390/ijerph8083287
30. Seth P, Glenshaw M, Sabatier JHE, Adams R, Du Preez V, DeLuca N, et al. AUDIT, AUDIT-C, and AUDIT-3: drinking patterns and screening for harmful, hazardous and dependent drinking in Katutura, Namibia. *PLoS ONE*. (2015) 10:e0120850. doi: 10.1371/journal.pone.0120850
31. de Bruin A, Picavet HSJ, Nossikov S. *Health Interview Surveys: Towards International Harmonization of Methods and Instruments*. Copenhagen: World Health Organization Regional Office for Europe (1996).
32. Hagströmer M, Oja P, Sjöström M. The International Physical Activity Questionnaire (IPAQ): a study of concurrent and construct validity. *Public Health Nutr*. (2006) 9:755–62. doi: 10.1079/PHN2005898
33. Kawachi I, Subramanian SV, Kim D. Social capital and health. In: Kawachi I, Subramanian S, Kim D, editors. *Social Capital and Health*. New York, NY: Springer (2008). p. 1–285.
34. Nielsen L, Koushede V, Vinther-Larsen M, Bendtsen P, Kjær Ersbøll A, Due P, et al. Does school social capital modify socioeconomic inequality in

- mental health? A multi-level analysis in Danish schools. *Soc Sci Med.* (2015) 140:35–43. doi: 10.1016/j.socscimed.2015.07.002
35. Silva M, Loureiro A, Cardoso G. Social determinants of mental health: a review of the evidence. *Eur J Psychiatry.* (2016) 30:259–92.
  36. Ngin C, Pal K, Tuot S, Chhoun P, Yi R, Yi S. Social and behavioural factors associated with depressive symptoms among university students in Cambodia: a cross-sectional study. *BMJ Open.* (2018) 8:1–13. doi: 10.1136/bmjopen-2017-019918
  37. Loch MR, de Souza RKT, Mesas AE, Martinez-Gómez D, Rodríguez-Artalejo F. Associação entre indicadores de capital social e estilo de vida em adultos brasileiros. *Cad Saúde Pública.* (2015) 31:1636–47. doi: 10.1590/0102-311X00132614
  38. Murayama H, Fujiwara Y, Kawachi I. Social capital and health: a review of prospective multilevel studies. *J Epidemiol.* (2012) 22:179–87. doi: 10.2188/jea.JE20110128
  39. García-Ros R, Pérez-González F, Pérez-Blasco J, Natividad LA. Evaluación Del Estrés Académico En Estudiantes de Nueva Incorporación a La Universidad. *Rev Latinoam Psicol.* (2012) 44:143–54.
  40. Lee Y, Lee K-S. Association of depression and suicidality with electronic and conventional cigarette use in South Korean adolescents. *Subst Use Misuse.* (2019) 54:934–43. doi: 10.1080/10826084.2018.1552301
  41. Villanueva VJ, Motos P, Isorna M, Villanueva V, Blay P, Vázquez-Martínez A. Impacto de Las Medidas de Confinamiento Durante La Pandemia de Covid-19 En El Consumo de Riesgo de Alcohol. *Rev Esp Salud Pública.* (2021) 95:1–13.
  42. Sokolovsky AW, Hertel AW, Micalizzi L, White HR, Hayes KL, Jackson KM. Preliminary impact of the COVID-19 Pandemic on smoking and vaping in college students. *Addict Behav.* (2020) 115:1–4. doi: 10.1016/j.addbeh.2020.106783
  43. Kabrita C, Hajjar-Muça T. Sex-specific sleep patterns among university students in Lebanon: impact on depression and academic performance. *Nat Sci Sleep.* (2016) 2016:189–96. doi: 10.2147/NSS.S104383
  44. Sarris J, O'Neil A, Coulson CE, Schweitzer I, Berk M. Lifestyle medicine for depression. *BMC Psychiatry.* (2014) 14:107. doi: 10.1186/1471-244X-14-107
  45. Valdivieso MA, Burbano VM, Burbano AS. Percepción de estudiantes universitarios colombianos sobre el efecto del confinamiento por el coronavirus, y su rendimiento académico. *Espacios.* (2020) 41:269–81. doi: 10.48082/espacios-a20v41n42p23
  46. Wong ASY, Kohler JC. Social capital and public health: responding to the COVID-19 pandemic. *Global Health.* (2020) 16:88. doi: 10.1186/s12992-020-00615-x

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Sotaquirá, Backhaus, Sotaquirá, Pinilla-Roncancio, González-Urbe, Bernal, Galeano, Mejía, La Torre, Trujillo-Maza, Suárez, Duperly and Ramirez Varela. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Improving University Students' Mental Health During the COVID-19 Pandemic: Evidence From an Online Counseling Intervention in Italy

Giovanna Celia<sup>1</sup>, Francesca Tessitore<sup>2\*</sup>, Elisa Cavicchiolo<sup>2</sup>, Laura Girelli<sup>2</sup>, Pierpaolo Limone<sup>3</sup> and Mauro Cozzolino<sup>2</sup>

<sup>1</sup> Department of Economics, Management and Territory, University of Foggia, Foggia, Italy, <sup>2</sup> Department of Humanities, Philosophy and Education, University of Salerno, Fisciano, Italy, <sup>3</sup> Department of Humanities, Literature and Cultural Heritage, University of Foggia, Foggia, Italy

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Rusly Hidayah,  
Surabaya State University, Indonesia  
Jose A. Piqueras,  
Miguel Hernández University of  
Elche, Spain

### \*Correspondence:

Francesca Tessitore  
ftessitore@unisa.it

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

**Received:** 28 February 2022

**Accepted:** 13 April 2022

**Published:** 17 May 2022

### Citation:

Celia G, Tessitore F, Cavicchiolo E,  
Girelli L, Limone P and Cozzolino M  
(2022) Improving University Students'  
Mental Health During the COVID-19  
Pandemic: Evidence From an Online  
Counseling Intervention in Italy.  
Front. Psychiatry 13:886538.  
doi: 10.3389/fpsy.2022.886538

**Background:** The mental health of university students is significantly affected when faced with public health emergencies and requires specific interventions to help support and prevent any long-lasting effects that the pandemic may have on their mental health status. This study aims to evaluate the impact of an online individual counseling intervention provided by the University of Foggia and carried out during the COVID-19 pandemic on the mental health status of a sample of university students.

**Methods:** 32 Italian undergraduate students took part in a one-group pretest-posttest research design. The data was gathered in two times: before the start of the counseling intervention (T1), positive and negative affect, satisfaction with life, global mental distress, anxiety, stress, and future time perspective were collected, at the end of the counseling intervention (T2), the same dimensions were measured. A one-way repeated measures multivariate analysis of variance (MANOVA) was performed, and single Bonferroni-corrected dependent *t*-tests were conducted on variables showing a significant change over time.

**Results:** The results showed that positive affect, subjective well-being, and future time perspective increased significantly after the intervention. In contrast, the participants reported significantly lower levels of negative affect, global mental distress, state and trait anxiety, as well as perceived stress over time.

**Conclusions:** The study demonstrates the promising impact of online counseling intervention and its efficient contribution in promoting the well-being of university students. The results contribute to the ongoing debate concerning the psychological impact of the COVID-19 pandemic on young adults, helping professionals develop more efficient clinical and psychological interventions.

**Keywords:** stress, anxiety, mental distress, time perspective, mind-body therapies, university students, COVID-19 pandemic, Italy

## INTRODUCTION

The impact of the COVID-19 pandemic on students' mental health represents a major concern for higher education institutions as well as for the mental health sector worldwide. In response to the pandemic, several governments around the world adopted extraordinary measures and containment efforts (e.g., lockdown) aimed to prevent the high risk of contagion and limit the COVID-19 outbreak. Consequently, universities across the nations rapidly closed, moving to remote methods of teaching and assessment. Although remote learning allowed students to maintain their academic routines (1), research around the world agreed that the COVID-19 pandemic negatively impacted university students' mental health status. Specifically, research showed an increase in depression, anxiety and stress (2–7), post-traumatic stress symptoms (8), somatic symptoms (9), substance use (10), and a worsening of existing mental illnesses (11). Increased suicidal thoughts were also reported (12), with a higher risk for females, and students who already had a history of self-injury and suicidal attempts (7, 13). A general decrease in terms of well-being, with an increase in quantity of sleep but a decrease in terms of quality, was also evidenced (14).

Among the risk and protective factors for mental health, having relatives or friends infected with COVID-19, massive media exposure with low quality and clarity of information, history of psychiatric follow-up, and female gender were considered major risk factors (7, 15–20), whereas, living in urban areas, family income stability, and high social support were protective factors against mental health problems (3, 19, 21).

In Italy, recent clinical assessments confirmed that, during the lockdown, university students experienced high levels of anxiety and depression (22–25), somatic complaints and aggressive behaviors (26), changes in sleep rhythms and symptoms of insomnia (27). However, prospective studies need to be further carried out in order to study the long-term effects of quarantine and the pandemic on mental health (28).

Overall, the scientific community agreed that the mental health of university students is significantly affected when faced with public health emergencies, and requires specific interventions to help, support and prevent any long-lasting effects of the pandemic on their mental health status.

University counseling services can play a fundamental role in offering support to university students. Due to the pandemic, and in order to reduce the high risk of contagion, digital psychological interventions and online counseling services have become even more widespread (29, 30). Literature has already shown that online counseling can be as efficient as face-to-face counseling (31) and that it can be successfully implemented for different mental health issues, such as depression, anxiety, stress, or post-traumatic stress disorders (32, 33). Research has also shown that, during the pandemic, online counseling has been effective and has helped alleviate the psychological suffering of the general population (34). The American Psychological Association also supported this approach by providing guidelines as well as suggesting states to guarantee human welfare and stop the spread of the virus. Considering university students' developmental challenges, the counseling intervention might be

particularly suitable for promoting their psychological well-being (35, 36). Harrer et al. (37) showed a significant small-to-moderate effect of internet interventions on university students' mental health in their meta-analysis. Moreover, Bolinski et al. (38) also suggested a promising direction for the effectiveness of e-mental health intervention on academic performances. Recently, Hadler et al. (39) reported that tele-mental health services present the advantage for students to reduce the barriers which they might face in reaching out for professional help, such as the perceived stigma (40, 41).

Research on the implementation of online counseling services for university students during the pandemic is still underdeveloped. Early findings on group interventions confirmed the effectiveness of online counseling compared to face-to-face counseling in decreasing anxiety levels (42, 43).

The current study aims to evaluate the effects of an online individual counseling intervention carried out during the COVID-19 pandemic on the levels of subjective well-being, global distress, emotional health (positive and negative affects and anxiety), and future time perspective in a sample of Italian university students. The variables of well-being, global distress, and emotional health status were chosen following the constructs widely investigated in literature for the mental health assessment of university students. Since the pandemic increased the feeling of uncertainty about the future (44), and the ability to foresee and plan for the future is crucial to young adults' well-being and motivation (45), the dimension of the future time perspective was also considered. We expected the following: a) a decrease in negative affect, perceived stress, global mental distress and anxiety; b) an increase in positive affect, subjective well-being and future time perspective.

## MATERIALS AND METHODS

### Participants and Procedures

In March 2020, when the COVID-19 pandemic was beginning to spread rapidly in Italy, the Psychological Counseling Service of the University of Foggia started to offer its entire university population (students, teaching staff and non-teaching personnel) a free online service for coping with stress, anxiety, social maladjustment, and negative affect. This counseling service had already been active, offering brief face-to-face psychological interventions that usually consisted of 3–5 sessions. Then, with the spread of the pandemic, it was moved to an online service. To access the psychological counseling service, individuals needed to send a request via email to the institutional account [counseling@unifg.it](mailto:counseling@unifg.it). The service manager would then view and respond to the emails by sending instructions to fill out a form relating to privacy and the authorization of data processing. Once the form was completed, a first welcoming interview was carried out, during which the general state of the individual, their personal and clinical history, previous therapeutic experiences and/or past or present use of drugs and medicine were examined. If psychiatric problems or risks for the person were glimpsed, they would be directed to the local health service.

The present study data were collected in late 2020 and 2021, around the end of the second wave of the COVID-19 pandemic



in Italy. In recruiting the sample, the following exclusion criteria were established: a) having a diagnosed psychiatric disorder; b) attending pharmacological therapy for psychiatric disorders. Inclusion criteria were: a) being a student of the University of Foggia; b) not having a diagnosed psychiatric disorder; c) not attending pharmacological therapy for psychiatric disorders.

A total of 56 students were invited to fill out a questionnaire at the beginning and at the end of the counseling intervention. At the time of the second data collection, 24 students could not be contacted for various reasons (e.g., they decided to no longer attend the counseling service) and they were therefore excluded from the study. Thus, the final sample for our study consisted of 32 students (65.6% females;  $M_{age} = 22.88$ ;  $SD_{age} = 2.09$ ). Before starting the research, all the participants were informed about the aims of the study and the pertinent contact modalities and persons. Participation was voluntary and confidentiality was assured before collecting the data, with each participant being assigned an anonymous alphanumeric code. All the students were asked to give their consent to participate in the research and the informed consent application form clearly specified that the participants could withdraw from the study at any time, without having to justify this decision and without incurring any consequences. All the procedures conducted in the study were in accordance with the ethical standards of the Italian Association of Psychology (AIP), as well as the 1964 Helsinki declaration and its subsequent amendments specifying the ethical principles that ensure the protection of individuals participating in medical research.

The study design was based on a one-group pretest-posttest research design. The participants were asked to fill out an on-line questionnaire sent via Google Form before the start and at the end of the counseling intervention, after a total of five counseling meetings. Therefore, the data was gathered in two phases: before the beginning of the counseling intervention, Time 1 (T1), the measures of positive and negative affect, satisfaction with life, global mental distress, anxiety, stress, and future time perspective were administered; at the end of the counseling intervention, Time 2 (T2), the same measures were administered.

The intervention provided to students by the Psychological Counseling Service of the University of Foggia works effectively and multidimensionally on the individual, also including “non-pathological” realities (42). The psychological interventions proposed are part of an integrated mind-body approach with strategic orientation (46–50). This approach arises from the need to convey, in a coherent and organized way, the contributions of several schools of thought in an operational, flexible, effective, efficient model (51). The counseling intervention is short with a maximum duration of 5 interviews. It is focal because it works in a targeted manner on the reported problems and is also configured as a strategic process that aims to consolidate the new equilibrium reached. Broadly, during the counseling sessions, the therapist, together with the student, identifies the problems to be solved, establishes the objectives, plans the interventions to achieve these objectives and, at the end of the course, examines the results to see if the intervention has been successful. The psychological counseling provided was organized in four phases (46, 52–56): (1) definition of the problem in concrete terms; (2) analysis of the solutions attempted to solve the problem; (3)

concrete definition of the change to be made; (4) formulation and implementation of a change plan.

The counseling path includes the following techniques (53):

- empathic listening in order to let the individual speak openly, constructing and verifying their own hypotheses through their narratives, inserting themselves, mostly with open questions, which avoid influencing the individual's answers and preserve maximum freedom of expression.
- Reformulation of the student's verbal and non-verbal communication to implement a restructuring of the narrative, referring new elements and meanings to the individual, derived from their own hypotheses (55).
- Reframing and feedback to guide the student toward change.

During the entire counseling process, the therapist:

- allows the individual to experiment with the solutions built in the interview, while still having a “protected” space available to process the effects;
- supports and consolidates the new ways of interacting with the student, putting them in relation to the old schemes;
- outline the problematic issues faced by the student, relating them to the new strategies implemented;
- acknowledges and positively emphasizes the commitment of the individual in achieving the agreed objectives.

## Measures

All the instruments were administered in Italian, the participant's first language. All the measures were already available in Italian, so it was not necessary to translate them.

In order to measure positive and negative affect, the Positive and Negative Affect Schedule (PANAS) (57, 58) was used. The PANAS is a well-known scale that measures the most general dimension of affective experience, and it includes two 10-item mood scales. The Positive Affect scale reflects a pleasurable engagement with the environment and measures the extent to which a person feels determined, excited, or enthusiastic; instead, the Negative Affect scale reflects a variety of unpleasant mood states such as feeling upset, scared or nervous. The participants were asked to indicate how often over the past week they had experienced the different feelings and emotions described in each item using a scale ranging from 1 (“very slightly”) to 5 (“extremely”). Several research has supported the excellent psychometric proprieties of the PANAS [e.g., (59, 60)], and in the Italian context, there is evidence to support its reliability and validity (57). In the present study the alpha coefficient was 0.91 (at T1) and 0.90 (at T2) for PA, and 0.92 (at T1) and 0.94 (at T2) for NA.

We used The Satisfaction With Life Scale (SWLS) (61) as a measure of individuals' global satisfaction with life. The scale reflects the judgmental component of subjective well-being and includes five items (sample item: “In most ways my life is close to my ideal”). Students were asked to indicate how much they agree or disagree with each of these five items using a 5-point scale that ranges from 1 (“strongly disagree”) to 5 (“strongly agree”). The scale has shown to be a valid and reliable measure of life satisfaction [e.g., (62, 63)]. The psychometric properties of the



scale have also been supported in the Italian context (64). The alpha coefficients for T1 and T2 were 0.80 and 0.83, respectively.

In the present study, The Young Person's Clinical Outcomes in Routine Evaluation (YP-CORE) (65, 66) was also included. The YP-CORE is a brief scale, especially designed for young people attending counseling or therapy, which measures global mental distress. It comprises 10 self-report items which cover the psychological domains of well-being (sample item: "My problems have felt like too much for me"), risk to self (sample item: "I've thought about hurting myself"), symptoms/problems (sample item: "I've felt unhappy") and functioning (sample item: "I've felt able to cope when things go wrong"). The students rated how often over the last week they had felt in the way described by each item, by using a 5-point scale that ranges from 1 ("not at all") to 5 ("most or all of the time"). The psychometric properties of the YP-CORE have been investigated in clinical as well as in nonclinical samples [e.g., (67, 68)] and there is evidence of its good psychometric properties in different countries [e.g., (69, 70)], as well as in the Italian context (71). The alpha coefficient for the current study was 0.74 at T1 and 0.84 at T2.

Anxiety was assessed by the Y form of the State-Trait Anxiety Inventory (STAI-Y) (72), which is made of two separate self-report scales for measuring state and trait anxiety. The state anxiety was measured by the S-Anxiety scale (STAI Form Y-1) which is made of 20 items that evaluate how the participants feel "right now, at this moment" (sample items: "I am worried", "I feel calm"). The students were therefore asked to rate the extent to which they were feeling tense, nervous or worried at the moment, on a scale ranging from 1 ("not at all") to 4 ("very much so"). The trait anxiety was instead measured by the T-Anxiety scale (STAI Form Y-2) which consists of 20 items that assess how the respondents generally feel anxious and refers to relatively stable aspects (sample items: "I worry too much over things that really don't matter", "I am a steady person"). In this case the students rated the extent to which they commonly feel tense, nervous or worried, on a scale ranging from 1 ("almost never") to 4 ("almost always"). The STAI is one of the most used measures of state and trait non-disorder-specific anxiety (73–76) and it has shown excellent psychometric properties [e.g., (77–79)], including in the Italian context (80). In the current study, internal reliability of S-Anxiety was 0.94 at T1 and 0.95 at T2, while it was 0.89 (at T1) and 0.92 (at T2) for T-Anxiety.

Stress was assessed by means of the single-item Distress Thermometer (DT) (81). Students were asked to indicate the stress they had perceived over the last week on an 11-point scale, ranging from 0 (no distress) to 10 (extreme distress). The DT has proven to be a sensitive tool to assess the construct of psychosocial distress (82), and it has also proved to be effective in the Italian context (83–85).

To measure the future time perspective, we used the 9-item scale which measures the future temporal frame of the Zimbardo Time Perspective Inventory Short Form (ZTPI-short version) (86, 87). This scale reflects a future-oriented temporal frame and describes individuals as having a strong sense of purpose for the future (sample item: "When I want to achieve something, I set goals and consider specific means for reaching those goals"). Replies for each item were chosen from a 5-point scale ranging

from 1 ("strongly disagree") to 5 ("strongly agree"). Several reviews of time perspective instruments have found the ZTPI to be a valid and reliable measure [e.g., (88)]. The Italian version of the future scale has good psychometric properties (87). In the present study the alpha coefficient was 0.71 at T1 and 0.68 at T2.

## Analysis

The analysis was conducted by using the IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, N.Y., USA). Bivariate correlations and descriptive statistics were computed for all the study variables at both time points. A set of independent *t*-tests were performed on the study variables to detect possible differences between those who remained and dropped out with respect to the study variables at T1. A one-way repeated measures multivariate analysis of variance (MANOVA) with time (T1 and T2) as the grouping factor was performed to examine changes in students' subjective well-being, global distress, emotional health (positive and negative affects and anxiety), and future time perspective. Finally, in order to investigate where significant differences occurred before and after the intervention, we performed Bonferroni-corrected dependent *t*-tests on variables showing a significant change over time.

## RESULTS

Descriptive statistics of all the study variables for the two time points are presented in **Table 1** while bivariate correlations are shown in **Table 2**.

No significant differences were detected between the two groups (remainers and dropouts) at T1 either for negative affect [ $t_{(54)} = 1.84$ ;  $p = 0.07$ ], subjective well-being [ $t_{(54)} = -1.12$ ;  $p = 0.27$ ], global mental distress [ $t_{(54)} = 1.77$ ;  $p = 0.08$ ], state anxiety [ $t_{(54)} = 0.80$ ;  $p = 0.43$ ], trait anxiety [ $t_{(54)} = 1.43$ ;  $p = 0.16$ ], or stress [ $t_{(54)} = 0.88$ ;  $p = 0.38$ ]. We found a statistically significant difference between the two groups for positive affect [ $t_{(54)} = -2.11$ ;  $p = 0.04$ ], with the dropouts reporting higher levels of positive emotions than those who participated in the counseling sessions (dropouts:  $M = 2.83$ ;  $SD = 0.94$ ; remainers:  $M = 2.34$ ;  $SD = 0.82$ ). Finally, there was a statistically significant difference between remainers and dropouts with regard to the future time perspective [ $t_{(54)} = -2.72$ ;  $p = 0.01$ ], with the dropouts indicating higher levels of future time perspective compared to the remainers (dropouts:  $M = 3.65$ ;  $SD = 0.59$ ; remainers:  $M = 3.25$ ;  $SD = 0.51$ ).

The results of the repeated measures MANOVA analysis indicated significant changes in the variables considered before and after the intervention [Wilks's  $\Lambda = 0.45$ ,  $F_{(8,24)} = 3.66$ ,  $p = 0.006$ ]. The results of the Bonferroni-corrected dependent *t*-tests showed that positive affect [ $t_{(31)} = -3.52$ ,  $p = 0.001$ , Cohen's  $d = -0.62$ ], subjective well-being [ $t_{(31)} = -3.28$ ,  $p = 0.001$ , Cohen's  $d = -0.58$ ] and future time perspective [ $t_{(31)} = -3.22$ ,  $p = 0.003$ , Cohen's  $d = -0.57$ ] increased significantly across the two time points. By contrast, the participants reported significantly lower levels of negative affect [ $t_{(31)} = 3.73$ ,  $p < 0.001$ , Cohen's  $d = 0.66$ ], global mental distress [ $t_{(31)} = 4.54$ ,  $p < 0.001$ , Cohen's  $d = 0.80$ ], and state [ $t_{(31)} = 3.36$ ,  $p = 0.002$ , Cohen's  $d = 0.59$ ] and trait anxiety [ $t_{(31)} = 3.24$ ,  $p = 0.003$ , Cohen's  $d = 0.57$ ], as well

**TABLE 1 |** Descriptive statistics of the study variables.

	range	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
<b>Pretest variables</b>					
Positive affect (PA)	1–5	2.34	0.82	1.2	4.1
Negative affect (NA)	1–5	3.12	0.93	1.6	5
Subjective well-being (SWLS)	1–5	2.59	0.85	1	4.4
Global mental distress (YP-CORE)	1–5	3.19	0.65	1.7	4.3
State anxiety (S-Anxiety)	1–4	2.72	0.62	1.6	3.9
Trait anxiety (T-Anxiety)	1–4	2.87	0.46	2.3	3.9
Perceived stress (DT)	0–10	7.16	2.02	1	10
Future time perspective (FTP)	1–5	3.25	0.51	2	4.2
<b>Posttest variables</b>					
Positive affect (PA)	1–5	2.86	0.77	1.3	4.1
Negative affect (NA)	1–5	2.52	0.93	1.1	4.4
Subjective well-being (SWLS)	1–5	2.89	0.81	1.6	4.8
Global mental distress (YP-CORE)	1–5	2.57	0.79	1.4	4.3
State anxiety (S-Anxiety)	1–4	2.32	0.67	1.2	3.6
Trait anxiety (T-Anxiety)	1–4	2.65	0.54	1.6	3.5
Perceived stress (DT)	0–10	5.91	2.18	2	10
Future time perspective (FTP)	1–5	3.43	0.47	2.6	4.6

Note: *M*, mean; *SD*, standard deviation; *Min*, minimum; *Max*, maximum.

**TABLE 2 |** Bivariate correlations between study variables.

	1	2	3	4	5	6	7	8
<b>Pretest variables</b>								
Positive affect (PA)	-							
Negative affect (NA)	0.22	-						
Subjective well-being (SWLS)	0.42**	-0.33*	-					
Global mental distress (YP-CORE)	-0.58***	0.62***	-0.52***	-				
State anxiety (S-Anxiety)	-0.32*	0.70***	-0.26	0.62***	-			
Trait anxiety (T-Anxiety)	-0.48***	0.63***	-0.53***	0.76***	0.68***	-		
Perceived stress (DT)	-0.10	0.58***	-0.17	0.47***	0.53***	0.48***	-	
Future time perspective (FTP)	0.68***	-0.27*	0.49***	-0.53***	-0.26	-0.48***	-0.01	-
<b>Posttest variables</b>								
Positive affect (PA)	-							
Negative affect (NA)	-0.49**	-						
Subjective well-being (SWLS)	0.43*	-0.27	-					
Global mental distress (YP-CORE)	-0.70***	0.68***	-0.42*	-				
State anxiety (S-Anxiety)	-0.47**	0.61***	-0.50**	0.78***	-			
Trait anxiety (T-Anxiety)	-0.68***	0.61***	-0.63***	0.82***	0.74***	-		
Perceived stress (DT)	-0.30	0.44*	-0.24	0.58***	0.57***	0.51**	-	
Future time perspective (FTP)	0.62***	-0.25	0.53**	-0.33	-0.28	-0.56***	-0.17	-

\* $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\* $p < 0.001$ .

as perceived stress [ $t_{(31)} = 3.75$ ,  $p < 0.001$ , Cohen's  $d = 0.66$ ] after the intervention. All the variables showed differences that represented a medium effect size, except for the one detected for global mental distress which represented a large effect size.

## DISCUSSION

Young people are exposed to different specific threats to their mental health (89, 90) and the present study evaluated the effectiveness of an online individual counseling intervention

on a sample of 32 Italian undergraduate students during the COVID-19 pandemic. Using an uncontrolled pretest/post-test design, the effects of a short-term individual online counseling intervention on the perception of stress, global distress, subjective well-being, emotional health status (positive and negative affects and anxiety), and future time perspective was investigated by comparing the levels of these psychological dimensions at the beginning (T1) and at the end (T2) of the intervention.

In line with existing evidence on the effectiveness of university face-to-face counseling (35, 36), the results confirmed our

hypothesis showing a significant decrease of global mental distress and perceived stress after the online intervention. The effectiveness of the online counseling intervention in reducing the levels of anxiety, both state and trait, and in increasing the individual's subjective well-being was also confirmed. With regards to the emotional health status, our hypotheses were also confirmed since the results showed a growth of positive affect and a reduction of negative one at the T2 of the intervention. These results are consistent with existing studies on the efficacy of online group counseling in promoting well-being and increasing the emotional health of undergraduate students during the pandemic (42, 43).

The online counseling intervention also produced an increase in student's future time perspective (FTP), that is, a higher tendency for them to think about the future in terms of goals to be achieved and tasks to be done. The present study is the first to have investigated this psychological dimension on young adults during the COVID-19 pandemic, even though research on time perspective and future orientation is crucial to understanding how people are dealing with this pandemic, especially among young people for which future aspirations are so salient (91). Several studies demonstrated that time perspective is an important psychological variable associated with many areas of human functioning (i.e., well-being, health behaviors, risky behaviors) (92–94). More recently, O'Neill et al. (95) also found that FTP is related with psychological resilience, intended as a core component of mental health. Particularly for young adults, planning for the future represents an important developmental task that becomes fundamental in order to orient and guide the students in their career decision-making (96–98). Therefore, this result shed light on the potential of online psychological counseling in increasing university student's planning for the future, restoring the fragmentation in their views toward the future and the sense of timelessness that the COVID-19 pandemic produced.

In conclusion, the results suggested that a short-term online individual psychological counseling intervention represents an effective and incisive way to face the emerging distress and discomfort within university environments. Taking into consideration the negative impact of the COVID-19 pandemic on student's mental health, we strongly encourage universities to improve the planning of online counseling services in order to facilitate the creation of supportive and meaningful spaces that are able to prevent student's mental health problems, promote their subjective well-being, and elaborate the emotional turmoil provoked by the COVID-19 pandemic.

## Limitations

Although our results indicate that counseling interventions can be a promising mental health promoting action, the study design is not free from limitations. Firstly, we excluded students who presented psychiatric disorders or who were receiving pharmacological treatment for psychiatric disorders, however, this exclusion criteria was mainly based on information reported by the students themselves and by the clinical evaluation of the therapist. Secondly, the lack of a control group did not allow us to draw definitive conclusions regarding the effects of

the counseling intervention and caution must be made when interpreting the presented results as other factors besides the intervention may have played a role in the changes observed. The intervention described in the present study was part of the normally routine care of the counseling center, therefore no control group was possible for ethical reasons. Moreover, in order to sustain the students' mental health during the disruptive period of the second wave of the COVID-19 pandemic in Italy, the management of the counseling service decided not to activate a waiting list and to welcome all students who requested the online service. Despite this limitation, our results appeared to be in line with previous studies which have proved the efficacy of university counseling interventions in reducing mental distress and improving psychological well-being (e.g., 35, 36, 42, 43). Therefore, we believe that our findings provide the basis on which to build future research studies, which could involve more participants, multiple sites, and a control group. Thirdly, the number of participants resulted in a small sample for the analysis. Finally, the attrition rate was quite high. This is quite common in clinical intervention (99) and can also depend on whether the intervention is online (100). Future studies can promote greater levels of engagement and intrinsic motivation in students to reduce this high rate. Future research also needs to investigate the effect of online counseling intervention on other variables, such as academic performances and career oriented decision-making as well as deepen the effectiveness of different techniques and their specific impact on mind-body processes (100–105). Moreover, future studies should enhance the implementation of qualitative and multilevel investigations in this field, taking into consideration its value in shedding light on the affective processes and subjective meanings of the experiences in different populations (106–112).

## CONCLUSION

The study enriched the still limited field of studies about the effectiveness of online counseling interventions and their impact on the mental health status of university students during the pandemic. It contributed to the ongoing debate concerning the psychological impact of the COVID-19 pandemic on young adults, demonstrating the promising impact of online counseling intervention and its efficient contribution in promoting the well-being of university students. Taking into consideration the unknown long-lasting effects of the pandemic on mental health, the study called for enabling support environments that allow university students to meaningfully participate in transformative and healthy opportunities.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethical standards of the Italian Association

of Psychology (AIP), as well as the 1964 Helsinki declaration and its subsequent amendments specifying the ethical principles that ensure the protection of individuals participating in medical research. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

GC and MC developed the theoretical framework of the present study, designed the study, and developed the methodological approach. EC and LG performed all the

analyses and designed tables and figures. FT led the literature search and interpretation of data. GC, MC, and PL critically revised the manuscript. MC contributed to the scientific supervision of the whole work. All authors made a substantial contribution to the work, read, and approved the final version of the work.

## FUNDING

This study was funded by the University of Foggia (TASSE TFA\_SOSTEGNO 19/20\_Traetta).

## REFERENCES

- Wang XY Li G, Malik S, Anwar A. Impact of COVID-19 on achieving the goal of sustainable development: e-learning and educational productivity. *Econ Res-Ekon Istraz.* (2021) 10:1–7. doi: 10.1080/1331677X.2021.1927789
- Alkhamies AA, Alaqil NS, Alsoghayer AS, Alharbi BA. Prevalence and determinants of burnout syndrome and depression among medical students at Qassim University, Saudi Arabia. *Saudi Med J.* (2020) 41:1375. doi: 10.15537/smj.2020.12.25427
- Ma Z, Zhao J, Li Y, Chen D, Wang T, Zhang Z, et al. Mental health problems and correlates among 746 217 college students during the coronavirus disease 2019 outbreak in China. *Epidemiol Psychiatr Sci.* (2020) 29:e181. doi: 10.1017/S2045796020000931
- Naser AY, Dahmash EZ, Al-Rousan R, Alwafi H, Alrawashdeh HM, Ghoul I, et al. Mental health status of the general population, healthcare professionals, and university students during 2019 coronavirus disease outbreak in Jordan: a cross-sectional study. *Brain Behav.* (2020) 10:e01730. doi: 10.1002/brb3.1730
- Son C, Hegde S, Smith A, Wang X, Sasangohar F. Effects of COVID-19 on college students' mental health in the United States: Interview survey study. *J Med Internet Res.* (2020) 22:e21279. doi: 10.2196/21279
- Wang C, Zhao H. The impact of COVID-19 on anxiety in Chinese university students. *Front Psychol.* (2020) 11:1168. doi: 10.3389/fpsyg.2020.01168
- Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic. *JAMA Network Open.* (2020) 3:e2025591. doi: 10.1001/jamanetworkopen.2020.25591
- Tang W, Hu T, Hu B, Jin C, Wang G, Xie C, et al. Prevalence and correlates of PTSD and depressive symptoms one month after the outbreak of the COVID-19 epidemic in a sample of home-quarantined Chinese university students. *J Affect Disord.* (2020) 274:1–7. doi: 10.1016/j.jad.2020.05.009
- Liu S, Liu Y, Liu Y. Somatic symptoms and concern regarding COVID-19 among Chinese college and primary school students: a cross-sectional survey. *Psychiatry Res.* (2020) 289:113070. doi: 10.1016/j.psychres.2020.113070
- Gritsenko V, Skugarevsky O, Konstantinov V, Khamenka N, Marinova T, Reznik A, et al. 19 fear, stress, anxiety, and substance use among Russian and Belarusian university students. *Int J Ment Health Addict.* (2021) 19:2362–8. doi: 10.1007/s11469-020-00330-z
- Yao H, Chen JH, Xu YF. Rethinking online mental health services in China during the COVID-19 epidemic. *Asian J Psychiatr.* (2020) 50:102015. doi: 10.1016/j.ajp.2020.102015
- Kaparonaki CK, Patsali ME, Mousa DP, Papadopoulou EV, Papadopoulou KK, Fountoulakis KN. University students' mental health amidst the COVID-19 quarantine in Greece. *Psychiatry research.* (2020) 290:113111. doi: 10.1016/j.psychres.2020.113111
- Patsali ME, Mousa DP, Papadopoulou EV, Papadopoulou KK, Kaparonaki CK, Diakogiannis I, et al. University students' changes in mental health status and determinants of behavior during the COVID-19 lockdown in Greece. *Psychiatry Res.* (2020) 292:113298. doi: 10.1016/j.psychres.2020.113298
- Savage MJ, James R, Magistro D, Donaldson J, Healy LC, Nevill M, et al. Mental health and movement behaviour during the COVID-19 pandemic in UK university students: prospective cohort study. *Ment Health Phys Act.* (2020) 19:100357. doi: 10.1016/j.mhpa.2020.100357
- Ahmed MZ, Ahmed O, Aibao Z, Hanbin S, Siyu L, Ahmad A. Epidemic of COVID-19 in China and associated psychological problems. *Asian J Psychiatr.* (2020) 51:102092. doi: 10.1016/j.ajp.2020.102092
- Alivernini F, Manganelli S, Girelli L, Cozzolino M, Lucidi F, Cavicchiolo E. Physical distancing behavior: the role of emotions, personality, motivations, and moral decision-making. *J Pediatr Psychol.* (2021) 46:15–26. doi: 10.1093/jpepsy/jsaa122
- Cavicchiolo E, Manganelli S, Girelli L, Cozzolino M, Lucidi F, Alivernini F. Adolescents at a distance: the importance of socio-cognitive factors in preventive behavior during the COVID-19 pandemic. *Eur J Health Psychol.* (2021) 28:161–70. doi: 10.1027/2512-8442/a000083
- Copeland WE, McGinnis E, Bai Y, Adams Z, Nardone H, Devadanam V, et al. Impact of COVID-19 pandemic on college student mental health and wellness. *J Am Acad Child Adolesc Psychiatry.* (2021) 60:134–41. doi: 10.1016/j.jaac.2020.08.466
- Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* (2020) 287:112934. doi: 10.1016/j.psychres.2020.112934
- Gioia F, Fioravanti G, Casale S, Boursier V. The effects of the fear of missing out on people's social networking sites use during the COVID-19 pandemic: the mediating role of online relational closeness and individuals' online communication attitude. *Front Psychiatry.* (2021) 12:146. doi: 10.3389/fpsyg.2021.620442
- Gioia F, Rega V, Boursier V. Problematic internet use and emotional dysregulation among young people: A literature review. *Clin Neuropsychiatry.* (2021) 18:41–54. doi: 10.36131/cnfioritiditore20210104
- Bruno G, Panzeri A, Granzio U, Alivernini F, Chirico A, Galli F, et al. The Italian COVID-19 psychological research consortium (IT C19PRC): general overview and replication of the UK study. *J Clin Med.* (2021) 10:52. doi: 10.3390/jcm10010052
- Quintiliani L, Sisto A, Vicinanza F, Curcio G, Tambone V. Resilience and psychological impact on Italian university students during COVID-19 pandemic. Distance learning and health. *Psychol Health Med.* (2022) 27:69–80. doi: 10.1080/13548506.2021.1891266
- Romeo A, Benfante A, Castelli L, Di Tella M. Psychological distress among Italian university students compared to general workers during the COVID-19 pandemic. *Int J Environ Res Public Health.* (2021) 18:2503. doi: 10.3390/ijerph18052503
- Villani L, Pastorino R, Molinari E, Anelli F, Ricciardi W, Graffigna G, et al. Impact of the COVID-19 pandemic on psychological well-being of students in an Italian university: a web-based cross-sectional survey. *Global Health.* (2021) 17:1–4. doi: 10.1186/s12992-021-00680-w
- Parola A, Rossi A, Tessitore F, Troisi G, Mannarini S. Mental health through the COVID-19 quarantine: a growth curve analysis on Italian young adults. *Front Psychol.* (2020) 2466. doi: 10.3389/fpsyg.2020.567484
- Marelli S, Castelnuovo A, Somma A, Castronovo V, Mombelli S, Bottoni D, et al. Impact of COVID-19 lockdown on sleep quality in university students and administration staff. *J Neurol.* (2021) 268:8–15. doi: 10.1007/s00415-020-10056-6



28. Meda N, Pardini S, Slongo I, Bodini L, Zordan MA, Rigobello P, et al. Students' mental health problems before, during, and after COVID-19 lockdown in Italy. *J Psychiatr Res.* (2021) 134:69–77. doi: 10.1016/j.jpsychires.2020.12.045
29. Wind TR, Rijkeboer M, Andersson G, Riper H. The COVID-19 pandemic: The 'black swan' for mental health care and a turning point for e-health. *Internet Interv.* (2020) 20:100317. doi: 10.1016/j.invent.2020.100317
30. Zhai Y, Du X. Addressing collegiate mental health amid COVID-19 pandemic. *Psychiatr Res.* (2020) 288:113003. doi: 10.1016/j.psychres.2020.113003
31. Drago A, Winding TN, Antypa N. Videoconferencing in psychiatry, a meta-analysis of assessment and treatment. *Eur Psychiatry.* (2016) 36:29–37. doi: 10.1016/j.eurpsy.2016.03.007
32. Berryhill MB, Culmer N, Williams N, Halli-Tierney A, Betancourt A, Roberts H, et al. Videoconferencing psychotherapy and depression: a systematic review. *Telemed J E Health.* (2019) 25:435–46. doi: 10.1089/tmj.2018.0058
33. Andrews G, Basu A, Cuijpers P, Craske MG, McEvoy P, English CL, et al. Computer therapy for the anxiety and depression disorders is effective, acceptable and practical health care: an updated meta-analysis. *J Anxiety Disord.* (2018) 55:70–8. doi: 10.1016/j.janxdis.2018.01.001
34. Situmorang DD. Online/cyber counseling services in the COVID-19 outbreak: are they really new? *J Pastoral Care Counsel.* (2020) 74:166–74. doi: 10.1177/1542305020948170
35. Cerutti R, Fontana A, Ghezzi V, Menozzi F, Spensieri V, Tambelli R. Exploring psychopathological distress in Italian university students seeking help: a picture from a university counselling service. *Current Psychology.* (2020) 26:1–3. doi: 10.1007/s12144-020-00665-9
36. Ghilardi A, Buizza C, Carobbio EM, Lusenti R. Detecting and managing mental health issues within young adults. A systematic review on college counselling in Italy. *Clin Pract Epidemiol Ment Health.* (2017) 13:61–70. doi: 10.2174/1745017901713010061
37. Harrer M, Apolinário-Hagen J, Fritsche L, Drüge M, Krings L, Beck K, et al. Internet- and app-based stress intervention for distance-learning students with depressive symptoms: protocol of a randomized controlled trial. *Front Psychiatry.* (2019) 10:361. doi: 10.3389/fpsy.2019.00361
38. Bolinski F, Boumparis N, Kleiboer A, Cuijpers P, Ebert DD, Riper H. The effect of e-mental health interventions on academic performance in university and college students: a meta-analysis of randomized controlled trials. *Internet Interv.* (2020) 20:100321. doi: 10.1016/j.invent.2020.100321
39. Hadler NL, Bu P, Winkler A, Alexander AW. College student perspectives of telemental health: a review of the recent literature. *Curr Psychiatry Rep.* (2021) 23:1–8. doi: 10.1007/s11920-020-01215-7
40. Lipson SK, Lattie EG, Eisenberg D. Increased rates of mental health service utilization by US college students: 10-year population-level trends (2007–2017) Psychiatric services. (2019) 70:60–3. doi: 10.1176/appi.ps.201800332
41. Jennings KS, Goguen KN, Britt TW, Jeffers SM, Wilkes III JR, Brady AR, et al. The role of personality traits and barriers to mental health treatment seeking among college students. *Psychol Serv.* (2017) 14:513. doi: 10.1037/ser0000157
42. Celia G, Cavicchiolo E, Girelli L, Limone P, Cozzolino M. Effect of online counselling on emotional outcomes during the COVID-19 pandemic: An innovative group intervention for university students using the brain wave modulation technique. *Couns Psychother Res.* (2021) 1–13. doi: 10.1002/capr.12512
43. Zeren SG, Erus SM, Amanvermez Y, Genc AB, Yilmaz MB, Duy B. The effectiveness of online counseling for university students in Turkey: a non-randomized controlled trial. *Eur J Educ Res.* (2020) 9:825–34. doi: 10.12973/eu-jer.9.2.825
44. Ceccato I, Palumbo R, Di Crosta A, Marchetti D, La Malva P, Maiella R, et al. "What's next?" Individual differences in expected repercussions of the COVID-19 pandemic. *Pers Individ Differ.* (2021) 174:110674. doi: 10.1016/j.paid.2021.110674
45. Parola A, Marcionetti J. Youth unemployment and health outcomes: the moderation role of the future time perspective. *Int J Educ Vocat Guid.* (2021) 5:1–9. doi: 10.1007/s10775-021-09488-x
46. Watzlawick P, Weakland J, Fisch R. *Change: Principles of Problem Formation and Problem Resolution.* New York, NY: WW Norton and Company (1974).
47. Haley J, editor. *Conversations with Milton H. Erickson: Vol. 1 Changing Individuals.* New York, NY: Triangle Press (1985).
48. Rossi E, Iannotti S, Rossi K, Yount G, Cozzolino M. *The Bioinformatics of Integrative Medical Insights: The International PsychoSocial and Cultural Bioinformatics Project. Integrative Medicine Insights, Libertas Academica Press.* (2006) 7–26. doi: 10.1177/117863370600100002
49. Cozzolino M, Celia G, Girelli L, Limone P. Effects of the brain wave modulation technique administered online on stress, anxiety, global distress, and affect during the first wave of the covid-19 pandemic: a randomized clinical trial. *Front Psychol.* (2021) 12:1577. doi: 10.3389/fpsyg.2021.635877
50. Cozzolino M, Celia G. The psychosocial genomics paradigm of hypnosis and mind–body integrated psychotherapy: experimental evidence. *Am J Clin Hypn.* (2021) 64:123–38. doi: 10.1080/00029157.2021.1947767
51. Celia G. *La psicoterapia strategico-integrata. L'evoluzione dell'intervento clinico breve.* Milano: FrancoAngeli (2016).
52. Celia G. *Il gruppo strategico integrato. Teoria, metodi e strumenti per una conduzione efficace.* Milano: Franco Angeli (2014).
53. Celia G. *Prontuario di strategie terapeutiche. Esercizi e prescrizioni per sciogliere nodi psicologici in breve tempo.* Milano: Franco Angeli (2020).
54. Cozzolino M, Guarino F, Castiglione S, Ciatelli A, Celia G. Pilot study on epigenetic response to a mind-body treatment. *Transl Med UniSa.* (2017) 17:37.
55. Cozzolino M. *Le strategie comunicative.* Firera Publishing (2007).
56. Celia G. Les styles narratifs du groupe comme indicateurs de changement. *Revue de psychothérapie psychanalytique de groupe.* 2020:157–68. doi: 10.3917/rppg.074.0157
57. Terraciano A, McCrae RR, Costa Jr PT. Factorial and construct validity of the Italian Positive and Negative Affect Schedule (PANAS). *Eur J Psychol Assess.* (2003) 19:131. doi: 10.1027//1015-5759.19.2.131
58. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol.* (1988) 54:1063. doi: 10.1037/0022-3514.54.6.1063
59. Crawford JR, Henry JD. The positive and negative affect schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *Br J Clin Psychol.* (2004) 43:245–65. doi: 10.1348/0144665031752934
60. Leue A, Lange S. Reliability generalization: an examination of the positive affect and negative affect schedule. *Assessment.* (2011) 18:487–501. doi: 10.1177/1073191110374917
61. Diener E, Emmons RA, Larsen RJ, Griffin S. The life satisfaction scale. *J Pers Assess.* (1985) 49:71–5. doi: 10.1207/s15327752jpa4901\_13
62. Lucas R, Diener E, Suh E. Discriminant validity of subjective well-being, self-esteem, and optimism. *J Pers Soc Psychol.* (1996) 71:616–28. doi: 10.1037/0022-3514.71.3.616
63. Pavot W, Diener E. Review of the satisfaction with life scale. In: Diener E, editor. *Assessing Well-Being. Social Indicators Research Series.* Springer, Dordrecht (2009). p. 101–17.
64. Di Fabio A, Gori A. Measuring adolescent life satisfaction: psychometric properties of the satisfaction with life scale in a sample of Italian adolescents and young adults. *J Psychoeduc Assess.* (2016) 34:501–6. doi: 10.1177/0734282915621223
65. Twigg E, Barkham M, Bewick BM, Mulhern B, Connell J, Cooper M. The Young Person's CORE: development of a brief outcome measure for young people. *Couns Psychother Res.* (2009) 9:160–8. doi: 10.1080/14733140902979722
66. Twigg E, McInnes B. *YP-CORE User Manual, Version 1.0.* Rugby: CORE System Trust & CORE Information Management Systems Ltd. (2010).
67. O'Reilly A, Peiper N, O'Keeffe L, Illback R, Clayton R. Performance of the CORE-10 and YP-CORE measures in a sample of youth engaging with a community mental health service. *Int J Methods Psychiatr Res.* (2016) 25:324–32. doi: 10.1002/mpr.1500
68. Twigg E, Cooper M, Evans C, Freire E, Mellor-Clark J, McInnes B, et al. Acceptability, reliability, referential distributions and sensitivity to change in the young person's clinical outcomes in routine evaluation (YP-CORE) outcome measure: replication and refinement. *Child Adolesc Ment Health.* (2016) 21:115–23. doi: 10.1111/camh.12128
69. Feixas G, Badia E, Bados A, Medina JC, Grau A, Magallón E, et al. Adaptation and psychometric properties of the spanish version of the yP-CoRe (young person's clinical outcomes in routine evaluation). *Actas Esp Psiquiatr.* (2018) 46:75–82. doi: 10.1037/t69088-000



70. Gergov V, Lahti J, Marttunen M, Lipsanen J, Evans C, Ranta K, et al. Psychometric properties of the Finnish version of the young person's clinical outcomes in routine evaluation (YP-CORE) questionnaire. *Nord J Psychiatry*. (2017) 71:250–5. doi: 10.1080/08039488.2016.1270352
71. Di Biase R, Evans C, Rebecchi D, Baccari F, Saltini A, Bravi E, et al. Exploration of psychometric properties of the Italian version of the core young person's clinical outcomes in routine evaluation (YP-CORE). *Res Psychother*. (2021) 24:554. doi: 10.4081/ripppo.2021.554
72. Spielberger CD, Gorsuch R, Lushene R, Vagg P, Jacobs G. *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA, USA: Consulting Psychologists Press (1983).
73. Littleton HL, Breitkopf CR, Berenson AB. Correlates of anxiety symptoms during pregnancy and association with perinatal outcomes: a meta-analysis. *Am J Obstet Gynecol*. (2007) 196:424–32. doi: 10.1016/j.ajog.2007.03.042
74. Manzoni GM, Pagnini F, Castelnovo G, Molinari E. Relaxation training for anxiety: a ten-years systematic review with meta-analysis. *BMC Psychiatry*. (2008) 8:1–2. doi: 10.1186/1471-244X-8-41
75. Panteleeva Y, Ceschi G, Glowinski D, Courvoisier DS, Grandjean D. Music for anxiety? Meta-analysis of anxiety reduction in non-clinical samples. *Psychol Music*. (2018) 46:473–87. doi: 10.1177/0305735617712424
76. Zsido AN, Teleki SA, Csokasi K, Rozsa S, Bandi SA. Development of the short version of the spielberger state–trait anxiety inventory. *Psychiatry Res*. (2020) 291:113223. doi: 10.1016/j.psychres.2020.113223
77. Barnes LL, Harp D, Jung WS. Reliability generalization of scores on the Spielberger state–trait anxiety inventory. *Educ Psychol Meas*. (2002) 62:603–18. doi: 10.1177/0013164402062004005
78. Kabacoff RI, Segal DL, Hersen M, Van Hasselt VB. Psychometric properties and diagnostic utility of the Beck Anxiety Inventory and the State-Trait Anxiety Inventory with older adult psychiatric outpatients. *J Anxiety Disord*. (1997) 11:33–47. doi: 10.1016/S0887-6185(96)00033-3
79. Spielberger CD, Vagg PR, Barker LR, Donham GW, Westberry LG. The factor structure of the state-trait anxiety inventory. *Stress and anxiety*. (1980) 7:95–109.
80. Pedrabissi L, Santinello M. Verifica della validità dello STAI forma Y di Spielberger. *Giunti Organizzazioni Speciali*. (1989) 191–2:11–4.
81. Jacobsen PB, Donovan KA, Trask PC, Fleishman SB, Zabora J, Baker F, et al. Screening for psychologic distress in ambulatory cancer patients: a multicenter evaluation of the distress thermometer. *Cancer*. (2005) 103:1494–502. doi: 10.1002/cncr.20940
82. Donovan KA, Grassi L, McGinty HL, Jacobsen PB. Validation of the distress thermometer worldwide: state of the science. *Psycho-Oncol*. (2014) 23:241–50. doi: 10.1002/pon.3430
83. Cozzolino M, Girelli L, Vivo DR, Limone P, Celia G. A mind–body intervention for stress reduction as an adjunct to an information session on stress management in university students. *Brain Behav*. (2020) 10:e01651. doi: 10.1002/brb3.1651
84. Cozzolino M, Vivo DR, Girelli L, Limone P, Celia G. The evaluation of a mind–body intervention (MBT-T) for stress reduction in academic settings: a pilot study. *Behav Sci*. (2020) 10:124. doi: 10.3390/bs10080124
85. Grassi L, Sabato S, Rossi E, Marmai L, Biancosino B. Affective syndromes and their screening in cancer patients with early and stable disease: Italian ICD-10 data and performance of the Distress Thermometer from the Southern European Psycho-Oncology Study (SEPOS). *J Affect Disord*. (2009) 114:193–9. doi: 10.1016/j.jad.2008.07.016
86. Zimbardo P, Boyd J. Putting Time into Perspective. A Valid, Reliable Individual-differences Metric Measurement. *J Pers Soc Psychol*. (1999) 77:1271–88. doi: 10.1037/0022-3514.77.6.1271
87. D'Alessio M, Guarino A, De Pascalis V, Zimbardo PG. Testing Zimbardo's Stanford time perspective inventory (STPI)-short form. *Time & Society*. (2003) 12:333–47. doi: 10.1177/0961463X030122010
88. Sircova A, Van De Vijver FJ, Osin E, Milfont TL, Fioulaine N, Kislali-Erginbilgic A, et al. A global look at time: A 24-country study of the equivalence of the Zimbardo Time Perspective Inventory. *Sage Open*. (2014) 4:2158244013515686. doi: 10.1177/2158244013515686
89. Alivernini F, Manganelli S, Cavicchiolo E, Chirico A, Lucidi F. The use of self-regulated cognitive strategies across students with different immigrant backgrounds and gender. *J Psychoeduc Assess*. (2019) 37:652–64. doi: 10.1177/0734282918785072
90. Patel V, Flisher AJ, Hetrick S, McGorry P. Mental health of young people: a global public-health challenge. *Lancet*. (2007) 369:1302–13. doi: 10.1016/S0140-6736(07)60368-7
91. Holman EA, Grisham EL. When time falls apart: The public health implications of distorted time perception in the age of COVID-19. *Psychol Trauma*. (2020) 12:S63. doi: 10.1037/tra0000756
92. Carelli MG, Wiberg B, Wiberg M. Development and construct validation of the Swedish Zimbardo time perspective inventory. *Eur J Psychol Assess*. (2011) 27:220–227. doi: 10.1037/t07377-000
93. Zhang JW, Howell RT. Do time perspectives predict unique variance in life satisfaction beyond personality traits? *Pers Individ Differ*. (2011) 50:1261–6. doi: 10.1016/j.paid.2011.02.021
94. Zimbardo P, Boyd J. *The Time Paradox: The New Psychology of Time That Will Change Your Life*. New York, NY: Simon and Schuster (2008).
95. O'Neill E, Clarke P, Fido D, Vione KC. The role of future time perspective, body awareness, and social connectedness in the relationship between self-efficacy and resilience. *Int J Ment Health Addict*. (2020) 23:1–1. doi: 10.1007/s11469-020-00434-6
96. Fusco L, Parola A, Sica LS. Life design for youth as a creativity-based intervention for transforming a challenging World. *Front Psychol*. (2021) 12:662072. doi: 10.3389/fpsyg.2021.662072
97. Walker TL, Tracey TJ. The role of future time perspective in career decision-making. *J Vocat Behav*. (2012) 81:150–8. doi: 10.1016/j.jvb.2012.06.002
98. Luyckx K, Lens W, Smits I, Goossens L. Time perspective and identity formation: Short-term longitudinal dynamics in college students. *Int J Behav Dev*. (2010) 34:238–47. doi: 10.1177/0165025409350957
99. Farris MS, Devoe DJ, Addington J. Attrition rates in trials for adolescents and young adults at clinical high-risk for psychosis: a systematic review and meta-analysis. *Early Interv Psychiatry*. (2020) 14:515–27. doi: 10.1111/eip.12864
100. Välimäki M, Anttila K, Anttila M, Lahti M. Web-based interventions supporting adolescents and young people with depressive symptoms: systematic review and meta-analysis. *JMIR mHealth and uHealth*. (2017) 5:e8624. doi: 10.2196/mhealth.8624
101. Cozzolino M, Cocco S, Piezzo M, Celia G, Costantini S, Abate V, et al. psychosocial genomics pilot study in oncology for verifying clinical, inflammatory and psychological effects of mind-body transformations-therapy (MBT-T) in breast cancer patients: preliminary results. *J Clin Med*. (2021) 10:136. doi: 10.3390/jcm10010136
102. Cozzolino M, Vivo DR, Celia G. School-based mind–body interventions: a research review. *Human Arenas*. (2021) 1:1–7. doi: 10.1007/s42087-020-00163-1
103. Margherita G, Gargiulo A, Troisi G, Tessitore F, Kapusta ND. Italian validation of the capacity to love inventory: preliminary results. *Front Psychol*. 2018:1434. doi: 10.3389/fpsyg.2018.01434
104. Venuleo C, Salvatore G, Ruggieri RA, Marinaci T, Cozzolino M, Salvatore S. Steps towards a unified theory of psychopathology: the phase space of meaning model. *Clin Neuropsychiatry*. (2020) 17:236–52. doi: 10.36131/cnforitieditore20200405
105. Rossi EL, Cozzolino M, Mortimer J, Atkinson D, Rossi KL. A brief protocol for the creative psychosocial genomic healing experience: the 4-stage creative process in therapeutic hypnosis and brief psychotherapy. *Am J Clin Hypn*. (2011) 54:133–52. doi: 10.1080/00029157.2011.605967
106. Tessitore F. The Asylum Seekers Photographic Interview (ASPI): Evaluation of a new method to increase Nigerian asylum seekers' narrative meaning-making after trauma. *Psychol Trauma*. (2021) 14:66–79. doi: 10.1037/tra0000913
107. Tessitore F, Margherita G. From struggle to hope: A gender-sensitive investigation on Nigerian male and female asylum seekers' experiences. *J Prev Interv Community*. (2021) 12:1–6. doi: 10.1080/10852352.2021.1935195
108. Salvatore S, De Luca Picione R, Cozzolino M, Bochicchio V, Palmieri A. The role of affective sensemaking in the constitution of experience. The affective pertinentization model (APER). *Integr Psychol Behav Sci*. (2021) 4:1–9. doi: 10.1007/s12124-020-09590-9
109. Alivernini F, Cavicchiolo E, Manganelli S, Chirico A, Lucidi F. Students' psychological well-being and its multilevel relationship with immigrant background, gender, socioeconomic status, achievement, and class size. *Sch Eff Sch Improv*. (2020) 31:172–91. doi: 10.1080/09243453.2019.1642214

110. Alivernini F, Manganelli S, Lucidi F. Personal and classroom achievement goals: their structures and relationships. *J Psychoeduc Assess.* (2018) 36:354–65. doi: 10.1177/0734282916679758
111. Cavicchiolo E, Alivernini F, Manganelli S. Immigrants are like... The representation of immigrants in Italy: The metaphors used by students and their family background. *ECPS J.* (2016) 13:161–88. doi: 10.7358/ecps-2016-013-cavi
112. Alivernini F, Cavicchiolo E, Manganelli S, Chirico A, Lucidi F. Support for autonomy at school predicts immigrant adolescents' psychological well-being. *J Immigr Minor Health.* (2019) 21:761–6. doi: 10.1007/s10903-018-0839-x

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Celia, Tessitore, Cavicchiolo, Girelli, Limone and Cozzolino. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# The Protective Effect of Health Literacy on Reducing College Students' Stress and Anxiety During the COVID-19 Pandemic

Yuting Ying<sup>1</sup>, Chunxia Jing<sup>2\*</sup> and Fan Zhang<sup>3\*</sup>

<sup>1</sup> Department of Biostatistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou, China,

<sup>2</sup> Department of Epidemiology, School of Medicine, Jinan University, Guangzhou, China, <sup>3</sup> Department of Public Health and Preventive Medicine, School of Medicine, Jinan University, Guangzhou, China

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Shu Wang,  
Capital Medical University, China  
Jianxiong Hu,  
Guangdong Provincial Center for  
Disease Control and Prevention, China  
Wenning Fu,  
Huazhong University of Science and  
Technology, China

### \*Correspondence:

Fan Zhang  
fanzhang@jnu.edu.cn  
Chunxia Jing  
jcxphd@gmail.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

**Received:** 18 February 2022

**Accepted:** 13 April 2022

**Published:** 19 May 2022

### Citation:

Ying Y, Jing C and Zhang F (2022) The  
Protective Effect of Health Literacy on  
Reducing College Students' Stress  
and Anxiety During the COVID-19  
Pandemic.  
Front. Psychiatry 13:878884.  
doi: 10.3389/fpsy.2022.878884

**Background:** The coronavirus (COVID-19) pandemic threatens people's health and well-being all around the world, resulting in increased stress and anxiety. Existing literature has found health literacy has a protective effect on health, and the study has taken a closer look at the effects of health literacy on perceived stress and anxiety among Chinese college students.

**Methods:** With structural questionnaires, a cross-sectional survey was conducted to collect the responses of 1,251 participants from different universities in Hubei and Guangdong, China. Participants' health literacy and perceived stress and anxiety symptoms were evaluated.

**Results:** Only 11.83% of the participants reported sufficient health literacy. Compared with college students from Hubei and Guangdong with a major in medicine showed a higher percentage of having sufficient literacy. Moreover, having sufficient health literacy showed a protective effect in reducing the risk of stress (OR = 0.14, 95%CI = 0.01–0.04;  $p < 0.001$ ) and anxiety (OR = 0.02, 95%CI = 0–0.61;  $p < 0.001$ ).

**Conclusion:** Health literacy was found to have a protective effect in reducing anxiety and stress among college students. This effect has remained among students from different majors and locations. However, it is noteworthy that the overall level of health literacy is relatively low among college students, particularly among those from Hubei Province or with non-medical majors. Therefore, more effort should be put into developing health education programs promoting health literacy and mental health on campus.

**Keywords:** health literacy, college students, anxiety, stress, COVID-19

## INTRODUCTION

Since late December 2019 in Wuhan, China (1, 2), the coronavirus disease (COVID-19) has spread rapidly in China and worldwide. COVID-19 has cast a detrimental effect on people's physical and emotional wellbeing (3). People reported heightened degrees of loneliness, despair, anxiety, and stress related to the pandemic and its corresponding social distancing policies (4). Furthermore, the psychological consequences of COVID-19 have been discovered in a variety of populations,

including patients with COVID-19, healthcare providers, and the elderly (5). College students may also be vulnerable to mental health problems considering the various challenges they face while moving from adolescence to young adulthood, including the collective stress and financial strain in the context of a pandemic (6). Therefore, it is critical to address the impact of the COVID-19 pandemic on the protective factors that affect college students' overall mental health. Particularly, greater mindfulness and social support, which were found to be a protective factor for psychological health (7).

Among the COVID-19-related psychological manifestations, one of the most common issues under the impact of the pandemic was the high prevalence of anxiety (8, 9). The increase in cases of COVID-19 infection and mortality has sparked widespread concern and anxiety (10). In previous research investigating psychological reactions during the outbreak of COVID-19 in China, Wang et al. found that more than half of the subjects felt moderate to severe psychological distress (e.g., avoidance, intrusion, and hyperarousal) toward the pandemic, while one-third suffered from moderate or severe anxiety (11). In China, women suffered from a greater psychological impact of the pandemic and exhibited higher levels of stress, anxiety, and depression (12, 13). For college students, the uncertainty of enrollment, online participation, and examination during the pandemic may negatively affect their mental health. A previous study revealed that college students reported higher levels of stress, anxiety, and depression (13).

Emerging research has recognized health literacy (HL) as a critical factor in promoting health, quality of life, and well-being. HL was defined as "the degree to which individuals can obtain, process, and understand health information and services they have to make appropriate health decisions" (14). Individuals with limited HL often lack knowledge about healthy lifestyles and the causes of diseases (15). Meanwhile, people with sufficient HL reported better quality of life and mental health (16), and fewer symptoms of depression and anxiety (17, 18). To explain this effect, it is possible that higher HL could encourage people to adopt healthy behaviors (19), form healthy lifestyles (20), and reduce their uncertainties when facing the pandemic (21). However, it has remained unclear how HL may influence college students' stress and anxiety in relation to the COVID-19 pandemic. Evidence on the association between HL and psychological disturbances is limited. In addition, the levels of HL among college students varied across age, gender, and field of study (22, 23). Moreover, limited HL was associated with a higher risk of obesity and smoking (24).

Little research was conducted on the HL of college students, and the existing evidence suggested that the overall level of HL remained limited (25). College students play an important role in the economic growth and development of a society (6). The majority of college students, although physically mature, are still mentally unstable and immature. In undergoing various physical and psychological changes while facing great uncertainties and stress, adolescence is the peak stage of the onset of mental disorders (26, 27). The student's needs for prompt and effective treatment for mental disorders have exceeded the available resources, resulting in a large unmet need for mental

illness treatment among college students (28, 29). Therefore, understanding the situation of college students' mental health and addressing the protective factors is pivotal for developing health-promoting services on campus.

According to a national assessment of Chinese residents' HL, 27.43% of people aged 15 to 24 had appropriate HL in 2020 (30). Despite this, limited HL may contribute to a range of adverse health outcomes for college students (31, 32). According to Drissi et al., strengthening college students' HL is critical in reducing the risk of mental health problems (33). Compared with other majors, medical students usually have a higher level of HL (22). However, medical students also showed a higher risk for mental illnesses than non-medical students (34). Particularly, depressive symptoms, anxiety, and stress symptoms are more common among medical students (35). In addition, the context of the college may also play a role. Hubei province has been the hardest hit by COVID-19, with 188 people affected physically and psychologically. Meanwhile, Guangdong province faced numerous obstacles during the epidemic due to its large population movements. As a result, college students from Hubei and Guangdong may be at higher risk of mental illness during the pandemic. Hence, in the current study, we have recruited and compared the students from these two provinces.

To sum up, the current study investigated how HL affects anxiety and stress among college students in China during the COVID-19 pandemic to have a better understanding of college students' HL and its impact on mental health. We hypothesized that those with limited HL would be more likely to show anxiety symptoms under the impact of the pandemic.

## MATERIALS AND METHODS

### Study Design and Participants

A cross-sectional study was conducted from December 2020 to February 2021. With a convenience sampling from six universities in Hubei and Guangdong, China, we have collected data with an online platform "Wenjuanxing" (Changsha Haoxing Information Technology Co., Ltd., China) (36), which was widely used in previous research (37). Before data collection, a pilot survey was conducted to test the feasibility of the measurements, and minor adjustments to the questionnaire were made accordingly. The link of the survey was shared with 1,380 college students *via* snowball sampling, resulting in 1,275 responses. The minimal required sample size was calculated by taking the reference of sample size calculation in the "Chinese Citizens' Health Literacy Survey" as follows:  $[N = U^2 \pi(1 - \pi) \div \delta^2 \times \text{deff}]$ . In this formula,  $U$  was 1.96, the design effect ( $\text{deff}$ ) was set to 3.0, and the allowable error  $\delta$  was 0.05. A total sample size of 1,130 was obtained with a 10% possible rate of invalid response. In total, 1,275 responses were collected.

Eligible participants were 18 years or older and were studying in universities in Hubei and Guangdong provinces, mainland China. This survey was entirely voluntary for participants. To avoid missing data, each IP address can only access the link once, and anonymous responses can only be submitted if all of the questions have been answered. The questionnaire did not include any personal information or sensitive content. In



addition, attention check questions, such as “1 + 1 =?”, were included in the survey to test whether the participants were paying attention while answering questions. Response times of <180 s will be considered as invalid data, and the responses were deemed invalid if the participants choose the same option for over 80% of consecutive items in the survey. After the screening, 98.20% of the responses ( $N = 1,251$ ) were included in the analysis.

## Measurements

Demographic information was collected, including participants' age, gender, grade, major, ethnic, and family income (per month).

## Health Literacy

The Chinese Citizen health literacy survey questionnaire, designed by the China Health Education Center, was used to measure participants' HL (38). The questionnaire included three dimensions, namely, health belief and knowledge, health behavior, and health skill literacy (39). Twenty items were listed, in which wrong answers and “Do not know” were scored 0 points, and the correct answer was scored 1. The total score of HL was calculated by adding the scores of all items. Participants who had a total HL (HL) score of 16 or above would be coded as having “Sufficient HL (score  $\geq 16$ ),” and those with a score lower than 16 were coded as having “limited HL (score < 16).” Cronbach's alpha in this study was 82.

## Mental Health

The Generalized Anxiety Disorder Questionnaire (GAD-7) (40–42) was used to estimate an individual's anxiety symptoms. It is commonly used in clinical practice and research because of its diagnostic reliability and efficiency (43). The questionnaire includes 7 items, assessing participants' anxiety symptoms such as feeling nervous, anxious, inability to stop worrying, excessive worries, etc. (44). GAD-7 uses a 4-point Likert scale in scoring, with 0 indicating “Not at all,” and 3 indicating “almost every day.” The total score ranges from 0–20, with a score of  $\geq 5$ ,  $\geq 10$ , and  $\geq 15$  representing mild, moderate, and severe anxiety, respectively (45). Cronbach's alpha in this study is 98.

The Chinese version of the perceived stress scale (CPSS) (46) was used to measure perceived stress among college students. The scale includes 14 items, each having five responses, with 0 indicating “never” and 4 indicating “always.” The total score ranged from 0–56. A total score between 15 and 28 was deemed moderate stress, a total score ranging from 29–42 was reckoned as strong stress, and a score of above 42 was considered as intense stress. The CPSS demonstrates strong reliability and validity in a Chinese population (47), with a Cronbach's alpha of .90 in this study.

## Data Analysis

Data analyses were performed using STATA software (Version 15.0 for Mac). To address the group differences, a  $T$ -test and one-way ANOVA were used. We used multivariate logistic regression to explore the effect of HL on anxiety and stress. We also explored the main effect of major on HL. Demographic variables, including age, gender, major, province,

**TABLE 1 |** Participants' characteristics ( $N = 1,251$ ).

Demographics	Mean or Frequencies (%)	$p$ -value
<b>Age, years</b>	21.36 $\pm$ 2.51	<0.001
<b>Gender</b>		
Male	598 (47.8)	<0.001
Female	653 (52.2)	
<b>Province</b>		
Hubei	514 (41.1)	<0.001
Guangdong	737 (58.9)	
<b>Major</b>		
Liberal arts	373 (29.8)	<0.001
Science	472 (37.7)	
Medicine	406 (32.5)	
<b>Grade</b>		
Undergraduate	907 (72.5)	<0.001
Postgraduate	310 (24.8)	
Doctor	34 (2.7)	
<b>Ethnic, Han</b>	1076 (86.0)	<0.001
<b>Region, Urban</b>	637 (50.9)	<0.001
<b>Family Income (per m)</b>		
<4999	325 (26.0)	<0.001
5000–6999	484 (38.7)	
$\geq 7000$	442 (35.3)	
<b>Sufficient Health literacy</b>	148 (11.83)	<0.001
<b>Diagnosed with anxiety</b>		
Weak	109 (8.71)	<0.001
Moderate	135 (10.79)	
Strong	745 (59.55)	
<b>Diagnosed with stress</b>		
Weak	152 (12.15)	<0.001
Moderate	557 (44.52)	
Strong	449 (35.89)	
Intense	93 (7.43)	
Total	1251 (100.0)	

ethnicity, region, and family income, were controlled in the adjusted models.

## RESULTS

A total of 1,251 participants were incorporated into the analysis, with a valid response rate of 98.20%. The descriptive results of the participants were shown in **Table 1**. Overall, the mean age was 21.4 years ( $SD = 2.52$ ), with 47.8% male and 32.5% medical students. Approximately 60% of the participants were from Guangdong, with 72.5% of them being undergraduates. More than 50% of participants are placed in urban areas, and 26% have a family income of <5,000 yuan per month. The average HL score was 7.6, and only 11.83% of participants showed sufficient HL (with a total HL score  $\geq 16$ ). Participants with sufficient HL are more likely to be female (16.39%), older, medical students (27.83%), with higher grades, and with better family income from

**TABLE 2 |** Mean scores of the sample from the Chinese version of the Perceived Stress Scale (CPSS) and Generalized Anxiety Disorder questionnaire (GAD-7).

	M+N-MAX	Mean (SD)
Perceived Stress Scale	0~56	27.3 ± 9.16
Anxiety	0~21	13.1 ± 7.02

Guangdong province. The mean score of CPSS and GAD-7 was 27.3 (SD = 9.16) and 13.1 (SD = 7.02), respectively, (see **Table 2**). As seen in **Table 3**, HL was negatively correlated with anxiety level ( $p < 0.05$ ) and stress level ( $p < 0.05$ ).

Sufficient HL is a protective effect on stress (see **Table 4**). A participant with limited HL is more likely to perceive greater stress ( $p < 0.001$ ). Participants with moderate stress levels had an Risk Ratio (RR) of.42 (95% CI = 0.27–0.65,  $p < 0.001$ ). Meanwhile, those with strong stress levels had an RR of.17 (95% CI = 0.10–0.29,  $p < 0.001$ ), and those with intense stress levels had an RR of.03 (95% CI = 0.00–0.21,  $p < 0.001$ ). We further adjusted the data to reflect age, sex, province, and major, with which the results remained similar (moderate stress level: RR = 0.43, 95%CI = 0.24–0.77; strong stress level: RR = 0.22, 95%CI = 0.12–0.43; high intensity stress level: RR = 0.50, 95%CI = 0–0.45;  $p$  for trend  $< 0.001$ ).

Sufficient HL was associated with reduced anxiety (see **Table 5**). Participants with limited HL were more likely to experience a higher level of anxiety ( $p$  for trend  $< 0.001$ ). The RR of participants with moderate anxiety level was.28 (95% CI = 0.15–0.52,  $p < 0.001$ ), and that with strong anxiety level was 14 (95% CI = 0.01–0.04,  $p < 0.001$ ). We further adjusted for age, sex, province, major, grade, and family income, and the results remained similar (moderate anxiety level: RR = 0.13, 95%CI = 0.02–0.76; strong anxiety level: RR = 0.02, 95%CI = 0.00–0.61;  $p$  for trend  $< 0.001$ ).

## DISCUSSION

Health literacy research is still an emerging research area, and the influence of HL on college student's mental health has not been well understood (48). This study measured HL, perceived stress, and anxiety among Chinese college students. Compared to medical students, HL among non-medical students was lower. However, HL had an overall positive effect on reducing anxiety symptoms and stress among college students.

Health literacy has attracted growing research attention. Developing HL skills early in life can have beneficial effects on education and academic performance, which may have long-term benefits. Sufficient HL could contribute to improved health outcomes, better health care, and decision-making in health-related situations (49, 50). Additionally, it would also help college students to better adapt to their campus life and future workplace, thus positively impacting public health (51, 52).

Based on the results of this study, only 11.83% reported sufficient HL, and the rate was even lower among non-medical students. As mentioned by an action plan to improve HL developed by the United States Center for Disease

Control (US CDC) is commendable for: “(1) developing and disseminating accurate, accessible, and actionable health and safety information; (2) integrating clear communication and HL into public health planning, funding, and, policy development, research and evaluation; and (3) the inclusion of accurate, standards-based and developmentally appropriate health and science information and curricula in educational settings from childcare to college level” (53). Considering our findings, further health education should be developed on campus with actionable health information, to improve students' health literacy levels. Further health education should also be integrated into the curriculum of general education to ensure that students from different majors could all access to and apply health information in their daily life.

With the data of 1,251 participants in this survey, about 60% of college students showed anxiety symptoms, and 43.43% perceived strong or intense stress. Moreover, limited HL was associated with a higher level of perceived stress (54), and this is consistent with a prior survey that indicated limited HL was negatively associated with anxiety (17, 55). Individuals with sufficient HL usually better understand health information, and thus know better about how to cope with the infection risk. Therefore, they have a means to maintain or reduced anxiety or stress. In contrast, people with limited HL may have difficulty in obtaining related health knowledge, and experience increased stress and anxiety level (56). A previous study showed that mental disorders like anxiety and perceived stress could negatively affect college students' HL (57), and our cross-sectional findings provided more evidence supporting this negative association without determining the specific causal relationship.

The current study has focused on college student's mental health and the protective effect of HL. College students are the cornerstone of society's future. Their future life and career would be compromised by lacking sufficient HL. Our findings have underscored that it is necessary to develop health education to cultivate students' HL, which would further benefit their mental well-being. To better meet the public health demands under the impact of the pandemic, HL is more important than ever before. HL would enable individuals to take better care of their physical and mental health, particularly during the COVID-19 pandemic, and enhancing HL among college students would have long-term benefits for public health (53).

## Limitations

Despite the insights from the findings, the limitations have to be acknowledged. The current study was conducted by cross-sectional data. As mentioned above, longitudinal studies are warranted to better understand the causal relationship between HL and mental health. Online questionnaires were used to obtain data from college students in two provinces in mainland China. Thus, the sample may not be enough to be a representative of the overall college students. Hence, cautions should be taken when generalizing the findings into other populations. To ensure the generalizability of our findings, more research with a larger sample size is required. Furthermore, participants' experiences during the pandemic were important to mental health. However,

**TABLE 3 |** Correlation matrix of the relationship between the study variables.

Variables	1	2	3	4	5	6	7	8	9
1. Health Literacy.	1								
2. AnxietyLevel	−0.429*	1							
3. StressLevel	−0.216*	0.175*	1						
4. Gender	0.147*	−0.131*	−0.020*	1					
5. Age	0.394*	−0.269*	−0.092*	0.080*	1				
6. Ethic	−0.126*	0.096*	−0.005	−0.025	−0.071*	1			
7. Region	−0.097*	0.073*	0.034	−0.018	−0.001	0.028	1		
8. Major	0.302*	−0.162*	−0.085*	0.071*	0.200*	−0.040	−0.023	1	
9. Grade	0.410*	−0.247*	−0.096*	0.071*	0.815*	−0.085*	−0.048	0.219*	1

\* $p < 0.05$ .**TABLE 4 |** The association between health literacy and stress level.

Health literacy	p for trend	Stress level							
		Weak		Moderate		Strong		High intensity	
		RR (95%CI)	p	RR (95%CI)	p	RR (95%CI)	p	RR (95%CI)	p
<b>Model 1</b>									
Limited	<0.001	Reference		0.42 (0.27–0.65)	< 0.001	0.17 (0.10–0.29)	< 0.001	0.03 (0.00–0.21)	<0.001
Sufficient									
<b>Model 2</b>									
Limited	<0.001	Reference		0.37 (0.22–0.61)	<0.001	0.17 (0.09–0.30)	<0.001	0.03 (0.00–0.26)	0.001
Sufficient									
<b>Model 3</b>									
Limited	<0.001	Reference		0.43 (0.24–0.77)	.005	0.22 (0.12–0.43)	<0.001	0.05 (0.00–0.45)	0.007
Sufficient									

Model 1, Unadjusted; Model 2, Adjusted for age and gender; Model 3, Adjusted for age, sex, province, major, grade, region, incomes.

**TABLE 5 |** The association between health literacy and anxiety level.

Health literacy	<i>p</i> for trend	Anxiety level							
		Normal		Weak		Moderate		Strong	
		RR (95%CI)	<i>p</i>	RR (95%CI)	<i>p</i>	RR (95%CI)	<i>p</i>	RR (95%CI)	<i>p</i>
<b>Model 1</b>									
Limited	<0.001	Reference		2.94 (1.85–4.68)	<0.001	0.28 (0.15–0.52)	<0.001	0.14 (0.01–0.04)	<0.001
Sufficient									
<b>Model 2</b>									
Limited	<0.001	Reference		2.20 (1.31–3.69)	<0.001	0.31 (0.16–0.61)	<0.001	0.02 (0.01–0.06)	0.001
Sufficient									
<b>Model 3</b>									
Limited	<0.001	Reference		5.63 (1.25–25.42)	0.025	0.13 (0.02–0.76)	<0.001	0.02 (0.00–0.61)	0.025
Sufficient									

Model 1, Unadjusted; Model 2, Adjusted for age and gender; Model 3, Adjusted for age, sex, province, major, grade, region, incomes.

our pilot survey indicated that only <1% of participants have reported “knowing or having close contact with people infected with COVID-19.” In addition, no sick or suspected cases were included in this study, implying that we may have a selection

bias in our sample. Moreover, we have adopted a culture-specific measurement of HL, which may lead to inconsistent findings with a different instrument. Lastly, more cross-cultural comparisons should be done in the future.

Despite the limitations, this study sheds light on the mental health of college students. The results will be insightful for developing health education programs or mental health services for both medical and non-medical college students. Adequate support should be provided to increase college students' HL to reduce the risk of anxiety symptoms and stress. HL is a national and international priority, and improving the asset of HL would indicate more opportunities for health and lifelong learning. It is relevant to a whole-school, whole-community, and whole-child approach, and it also involves healthcare professionals, institutions, and systems at different levels of the society (58). The current study provides evidence about an updated profile of HL among Chinese college students and its effects on anxiety symptoms and stress during the pandemics.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

## REFERENCES

- Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med.* (2020). 382:1199–1207. doi: 10.1056/NEJMoa2001316
- Tan W, Zhao X, Ma X, Wang W, Niu P, Xu W, et al. A novel coronavirus genome identified in a cluster of pneumonia cases—Wuhan, China 2019–2020. *China CDC Weekly.* (2020) 2:61–2. doi: 10.46234/ccdcw2020.017
- Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* (2020) 288:112954. doi: 10.1016/j.psychres.2020.112954
- Rajkumar RP. COVID-19 and mental health: a review of the existing literature. *Asian J Psychiatry.* (2020) 52:102066. doi: 10.1016/j.ajp.2020.102066
- The Lancet P. Isolation and inclusion. *Lancet Psychiatry.* (2020) 7:371. doi: 10.1016/S2215-0366(20)30156-5
- Auerbach RP, Mortier P, Bruffaerts R, Alonso J, Benjet C, Cuijpers P, et al. WHO World mental health surveys international college student project: prevalence and distribution of mental disorders. *J Abnorm Psychol.* (2018) 127:623. doi: 10.1037/abn0000362
- Haliwa I, Spalding R, Smith K, Chappell A, Strough J. Risk and protective factors for college students' psychological health during the COVID-19 pandemic. *J Am Coll Health.* (2021). doi: 10.1080/07448481.2020.1863413. [Epub ahead of print].
- Salari N, Hosseini-Far A, Jalali R, Vaisi-Raygani A, Rasoulpoor S, Mohammadi M, et al. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Global Health.* (2020) 16:57. doi: 10.1186/s12992-020-00589-w
- Luo M, Guo L, Yu M, Jiang W, Wang H. The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public - a systematic review and meta-analysis. *Psychiatry Res.* (2020) 291:113190. doi: 10.1016/j.psychres.2020.113190
- Elbay RY, Kurtulmuş A, Arpacioğlu S, Karadere E. Depression, anxiety, stress levels of physicians and associated factors in Covid-19 pandemics. *Psychiatry Res.* (2020) 290:113130. doi: 10.1016/j.psychres.2020.113130
- Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health.* (2020) 17:1729. doi: 10.3390/ijerph17051729
- Lim GY, Tam WW, Lu Y, Ho CS, Zhang MW, Ho RC. Prevalence of depression in the community from 30 countries between 1994 and 2014. *Sci Rep.* (2018) 8:1–10. doi: 10.1038/s41598-018-21243-x

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Research Ethics Committee of Jinan University. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

YY contributed to collecting data, performed the data analysis, and wrote the paper. FZ and CJ conceived and designed the whole paper. All authors contributed to the article and approved the submitted version.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2022.878884/full#supplementary-material>

- Zhang MW, Ho CS, Ho R. Methodology of development and students' perceptions of a psychiatry educational smartphone application. *Technol Health Care.* (2014) 22:847–55. doi: 10.3233/THC-140861
- Ratzan S, Parker R, Selden C, Zorn M. *National Library of Medicine Current Bibliographies in Medicine: Health Literacy.* Bethesda, MD: National Institutes of Health, US Department of Health and Human Service (2000).
- Paasche-Orlow MK, Parker RM, Gazmararian JA, Nielsen-Bohlman LT, Rudd RR. The prevalence of limited health literacy. *J Gen Intern Med.* (2005) 20:175–84. doi: 10.1111/j.1525-1497.2005.40245.x
- Angner E, Miller MJ, Ray MN, Saag KG, Allison JJ. Health literacy and happiness: a community-based study. *Soc Indic Res.* (2010) 95:325–38. doi: 10.1007/s11205-009-9462-5
- Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med.* (2011) 155:97–107. doi: 10.7326/0003-4819-155-2-201107190-00005
- Dodson S, Osicka T, Huang L, McMahon LP, Roberts MA. Multifaceted assessment of health literacy in people receiving dialysis: associations with psychological stress and quality of life. *J Health Commun.* (2016) 21:91–8. doi: 10.1080/10810730.2016.1179370
- Zhang F, Or PPL, Chung JWY. How different health literacy dimensions influences health and well-being among men and women: the mediating role of health behaviours. *Health Expect.* (2021) 24:617–27. doi: 10.1111/hex.13208
- Geboers B, Reijneveld SA, Jansen CJM, de Winter AF. Health literacy is associated with health behaviors and social factors among older adults: results from the lifelines cohort study. *J Health Commun.* (2016) 21:45–53. doi: 10.1080/10810730.2016.1201174
- von Haehling S, Morley JE, Coats AJS, Anker SD. Ethical guidelines for publishing in the journal of cachexia, sarcopenia and muscle: update 2017. *J Cachexia Sarcopenia Muscle.* (2017) 8:1081–3. doi: 10.1002/jcsm.12261
- Rababah JA, Al-Hammouri MM, Drew BL, Aldalaykeh M. Health literacy: exploring disparities among college students. *BMC Public Health.* (2019) 19:1401. doi: 10.1186/s12889-019-7781-2
- Vamos S, Yeung P, Bruckermann T, Moselen EF, Dixon R, Osborne RH, et al. Exploring health literacy profiles of Texas University students. *Health Behav. Policy Rev.* (2016) 3:209–25. doi: 10.14485/HBPR.3.3.3
- Sansom-Daly UM, Lin M, Robertson EG, Wakefield CE, McGill BC, Girgis A, et al. Health literacy in adolescents and young adults: an updated review. *J Adolesc Young Adult Oncol.* (2016) 5:106–18. doi: 10.1089/jayao.2015.0059
- Zhang Y, Zhang F, Hu P, Huang W, Lu L, Bai R, et al. Exploring health literacy in medical University students of Chongqing, China: a cross-sectional study. *PLoS ONE.* (2016) 11:e0152547. doi: 10.1371/journal.pone.0152547



26. Jorm AF. Mental health literacy: empowering the community to take action for better mental health. *Am Psychol.* (2012) 67:231. doi: 10.1037/a0025957
27. Loureiro LM, Jorm AF, Mendes AC, Santos JC, Ferreira RO, Pedreiro AT. Mental health literacy about depression: a survey of portuguese youth. *BMC Psychiatry.* (2013) 13:1–8. doi: 10.1186/1471-244X-13-129
28. Auerbach RP, Alonso J, Axinn WG, Cuijpers P, Ebert DD, Green JG, et al. Mental disorders among college students in the world health organization world mental health surveys. *Psychol Med.* (2016) 46:2955–70. doi: 10.1017/S0033291716001665
29. Beiter R, Nash R, McCrady M, Rhoades D, Linscomb M, Clarahan M, et al. The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *J Affect Disord.* (2015) 173:90–6. doi: 10.1016/j.jad.2014.10.054
30. Xinhua. *China's Health Literacy Rate Surges in 2020 XINHUANET2021* Available online at: [http://www.xinhuanet.com/english/2021-06/15/c\\_1310008822.htm](http://www.xinhuanet.com/english/2021-06/15/c_1310008822.htm).
31. Loureiro LMJ, Jorm AF, Oliveira RA, Mendes AMOC, dos Santos JCP, Rodrigues MA, et al. Mental health literacy about schizophrenia: a survey of Portuguese youth. *Early Interv Psychiatry.* (2015) 9:234–41. doi: 10.1111/eip.12123
32. Melas P, Tartani E, Forsner T, Edhborg M, Forsell Y. Mental health literacy about depression and schizophrenia among adolescents in Sweden. *Eur Psychiatry.* (2013) 28:404–11. doi: 10.1016/j.eurpsy.2013.02.002
33. Drissi N, Alhmoudi A, Al Nuaimi H, Alkhyeli M, Alsalam S, Ouhbi S. Investigating the impact of COVID-19 lockdown on the psychological health of University students and their attitudes toward mobile mental health solutions: two-part questionnaire study. *JMIR formative research.* (2020) 4:e19876. doi: 10.2196/19876
34. Dyrbye LN, Thomas MR, Huschka MM, Lawson KL, Novotny PJ, Sloan JA, et al. A multicenter study of burnout, depression, and quality of life in minority and nonminority US medical students. *Mayo Clinic Proceedings.* (2006) 81:1435–42. doi: 10.4065/81.11.1435
35. Fawzy M, Hamed SA. Prevalence of psychological stress, depression and anxiety among medical students in Egypt. *Psychiatry Res.* (2017) 255:186–94. doi: 10.1016/j.psychres.2017.05.027
36. Liu B, Qiao K, Lu Y. The relationship between perceived stress, state-trait anxiety, and sleep quality among University graduates in China during the COVID-19 pandemic. *Front Psychol.* (2021):12:664780. doi: 10.3389/fpsyg.2021.664780
37. Li M, Liu L, Yang Y, Wang Y, Yang X, Wu H. Psychological impact of health risk communication and social media on college students during the COVID-19 pandemic: cross-sectional study. *J Med Internet Res.* (2020) 22:e20656. doi: 10.2196/20656
38. Li Z, Sun Z. *Research on the status of health literacy among residents in Hunan Province and its influencing factors.* (PhD thesis). Central South University, China (2010).
39. Liu Y, Wang Y, Liang F, Chen Y, Liu L, Li Y, et al. The health literacy status and influencing factors of older population in Xinjiang. *Iran J Public Health.* (2015) 44:913–9.
40. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med.* (2006) 166:1092–7. doi: 10.1001/archinte.166.10.1092
41. Hinz A, Klein AM, Brähler E, Glaesmer H, Luck T, Riedel-Heller SG, et al. Psychometric evaluation of the generalized anxiety disorder screener GAD-7, based on a large German general population sample. *J Affect Disord.* (2017) 210:338–44. doi: 10.1016/j.jad.2016.12.012
42. Doi S, Ito M, Takebayashi Y, Muramatsu K, Horikoshi M. Factorial validity and invariance of the 7-item Generalized Anxiety Disorder Scale (GAD-7) among populations with and without self-reported psychiatric diagnostic status. *Front Psychol.* (2018) 9:1741. doi: 10.3389/fpsyg.2018.01741
43. Ruiz MA, Zamorano E, García-Campayo J, Pardo A, Freire O, Rejas J. Validity of the GAD-7 scale as an outcome measure of disability in patients with generalized anxiety disorders in primary care. *J Affect Disord.* (2011) 128:277–86. doi: 10.1016/j.jad.2010.07.010
44. Zhong Q-Y, Gelaye B, Zaslavsky AM, Fann JR, Rondon MB, Sánchez SE, et al. Diagnostic validity of the generalized anxiety disorder-7 (GAD-7) among pregnant women. *PLoS ONE.* (2015) 10:e0125096. doi: 10.1371/journal.pone.0125096
45. Löwe B, Decker O, Müller S, Brähler E, Schellberg D, Herzog W, et al. Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Medical care.* (2008):266–74. doi: 10.1097/MLR.0b013e318160d093
46. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* (1983) 24:385–96. doi: 10.2307/2136404
47. Yang T, Huang H. An epidemiological study on stress among urban residents in social transition period. *Zhonghua liu xing bing xue za zhi= Zhonghua liuxingbingxue zazhi.* (2003) 24:760–4.
48. Rababah JA, Al-Hammouri MM, Drew BL. The impact of health literacy on college students' psychological disturbances and quality of life: a structural equation modeling analysis. *Health Qual Life Outcomes.* (2020) 18:292. doi: 10.1186/s12955-020-01541-7
49. Paakkari L, Inchley J, Schulz A, Weber MW, Okan O. Addressing health literacy in schools in the WHO European region. *Public Health Panorama.* (2019):5:2–3. doi: 10.1093/eurpub/ckaa165.152
50. Vamos S, Okan O, Sentell T, Rootman I. Making a case for “Education for Health Literacy”: an international perspective. *Int J Environ Res Public Health.* (2020) 17:1436. doi: 10.3390/ijerph17041436
51. McDaid D, Organization WH. *Investing in Health Literacy: What Do We Know About the Co-benefits to the Education Sector of Actions Targeted at Children and Young People?* Organization WH (2016).
52. Services DoHaH. *National Action Plan to Improve Health Literacy.* CDC (2010). Available online at: <https://www.cdc.gov/healthliteracy/planact/national.html>
53. Vamos SD, McDermott RJ. Rebranding school health: the power of education for health literacy. *J Sch Health.* (2021) 91:670–6. doi: 10.1111/josh.13056
54. Eisapareh K, Nazari M, Kaveh MH, Ghahremani L. The relationship between job stress and health literacy with the quality of work life among Iranian industrial workers: The moderating role of social support. *Current Psychol.* (2020). doi: 10.1007/s12144-020-00782-5
55. Palazzo MC, Dell'Osso B, Altamura AC, Stein DJ, Baldwin DS. Health literacy and the pharmacological treatment of anxiety disorders: a systematic review. *Hum Psychopharmacol.* (2014) 29:211–5. doi: 10.1002/hup.2397
56. Kugbey N, Meyer-Weitz A, Oppong Asante K. Access to health information, health literacy and health-related quality of life among women living with breast cancer: Depression and anxiety as mediators. *Patient Educ Couns.* (2019) 102:1357–63. doi: 10.1016/j.pec.2019.02.014
57. Kim JE, Saw A, Zane N. The influence of psychological symptoms on mental health literacy of college students. *Am J Orthopsychiatry.* (2015) 85:620–30. doi: 10.1037/ort0000074
58. Lewallen TC, Hunt H, Potts-Datema W, Zaza S, Giles W. The whole school, whole community, whole child model: a new approach for improving educational attainment and healthy development for students. *J Sch Health.* (2015) 85:729–39. doi: 10.1111/josh.12310

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Ying, Jing and Zhang. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





# Severe Symptoms of Mental Disorders Among Students Majoring in Foreign Languages in Vietnam: A Cross-Sectional Study

Nguyen Thi Thang<sup>1</sup>, Dao Thi Dieu Linh<sup>1\*</sup>, Ta Nhat Anh<sup>1</sup>, Nguyen Thi Phuong<sup>1</sup>,  
Nguyen Duc Giang<sup>1</sup>, Nguyen Xuan Long<sup>1</sup>, Dao Thi Cam Nhung<sup>1</sup> and Khuong Quynh Long<sup>2†</sup>

<sup>1</sup> Department of Educational Psychology, University of Languages and International Studies, Vietnam National University, Hanoi, Vietnam, <sup>2</sup> Center for Population Health Science, Hanoi University of Public Health, Hanoi, Vietnam

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Eleonora Natalini,  
European Hospital, Italy  
Mohammad Farris Iman Leong Bin  
Abdullah,  
Universiti Sains Malaysia  
(USM), Malaysia

### \*Correspondence:

Dao Thi Dieu Linh  
linhdtd@vnu.edu.vn

### †ORCID:

Dao Thi Dieu Linh  
orcid.org/0000-0001-6662-6995  
Khuong Quynh Long  
orcid.org/0000-0002-1232-6230

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 15 January 2022

**Accepted:** 10 May 2022

**Published:** 30 May 2022

### Citation:

Thang NT, Linh DTD, Anh TN, Phuong NT, Giang ND, Long NX, Nhung DTC and Long KQ (2022) Severe Symptoms of Mental Disorders Among Students Majoring in Foreign Languages in Vietnam: A Cross-Sectional Study.  
Front. Public Health 10:855607.  
doi: 10.3389/fpubh.2022.855607

Mental health disorders among university students have been a serious issue in many countries and can negatively affect academic performance and all aspects of daily living, relationships, and physical health. In this study, we aim to estimate the prevalence of severe symptoms of mental disorders and examine associated factors among students majoring in foreign languages in Vietnam. We used the Depression, Anxiety, and Stress Scales (DASS-21) to detect severe symptoms of mental disorders in 1,788 students, including severe symptoms of depression, anxiety, and stress. The Financial-Study-Family-Friend (FSFF) scale was utilized to assess how much students worried about finance, academic, and social support from family and friends. Multiple logistic regressions were carried out to evaluate the relationship between severe symptoms of mental disorders and FSFF factors. The prevalence of severe levels of depression, anxiety, and stress were 21.1, 35.0, and 16.3%, respectively. While varying somewhat due to students' demographic characteristics, all four aspects of the FSFF scale were related to the severe symptoms of mental disorders of students. Concerns about study had the largest effects (ORs ranging from 2.84 to 3.72) while difficulty in finance had the smallest effects (ORs ranging from 1.23 to 1.37) on students' depression, anxiety, and stress. The prevalence of severe symptoms of mental disorders in students was high in our study. Teachers and universities should focus more attention on students' mental health. Social support from family and friends also plays a crucial role in the mental health of students.

**Keywords:** social factors, foreign languages, student, Vietnam, symptoms of mental disorders

## INTRODUCTION

Mental health is the foundation for general well-being and manifests itself in effective functioning in life. Mental health is not only the absence of mental disorders but also includes the ability to think, learn, and understand one's feelings and the reactions of others (1). Nearly one billion people globally have mental disorders (MD); severe MD tend to reduce life expectancy by 10 to 20 years in members of the general population (2). Suicide is the second leading cause of death for young people aged 15–29 and accounts for ~800,000 deaths each year (2). Unfortunately, access to quality

mental health services remains insufficient in many places around the world, especially in low- and middle-income countries, where more than 75% of people suffer from MD (2).

The transition to college, which for the majority of youth coincides with the transition to emerging adulthood, is stressful and disruptive (3). Previous studies indicated that the prevalence of mental health disorders among university students is higher than that in the general population, of whom 35% suffer from depression and anxiety (4). In a study of 4,184 French students (5) the prevalence of symptoms of depression and anxiety was 12.6, and 7.6%, respectively. Another study of Chinese students showed that the prevalence of depressive symptoms was 11.7% (6).

The factors contributing to MD among students may include living away from their family and friends, entering adulthood and having to adapt to student life, financial burden, and non-self-determined motivation (3, 5, 7, 8). Other factors implicated in psychological morbidity among students include academic pressure, demanding workloads (9), concerns about personal health (10), physical inactivity (11), student abuse and mistreatment (12), reduced academic achievement, substance abuse, violence, and poor reproductive and sexual health (13). MD among students can negatively impact their academic performance (14). MD also can affect many areas of students' lives, students' lives, including motivation and concentration, which may reduce their quality of life, academic achievement, physical health, and satisfaction with the college experience, and negatively impact relationships with friends and family members. These issues can also have long-term consequences for students, affecting their future employment, earning potential, and overall health (14–16).

In Vietnam, several studies have been conducted to evaluate the prevalence of MD and related factors among undergraduate students (17). The prevalence of stress, anxiety, and depression ranges from 10.1 to 18.6% (11). However, most previous studies among language learners focused on anxiety regarding the learning process, while other MD in students, such as depression and stress, were rarely mentioned (18–20). Besides, according to the screening results of the University of Languages and International Studies (ULIS) Psychological Center, which is a center established by ULIS to help students and teachers to screen for mental health problems, foreign language students have the high prevalence of symptoms of mental disorders (SoMD). However, to the best of our knowledge, there has been limited research on symptoms of mental disorders among students of foreign languages. This article aims to examine the severe SoMD of students majoring in a foreign language at a Vietnamese university (specifically, their levels of anxiety, depression, and stress), and to determine how social factors impact their mental health, allowing specific measures to improve the quality of their mental health to be formulated and proposed.

## METHODS

### Study Design and Participants

This was a cross-sectional study conducted in 2 months, from August to October 2021 at a foreign languages university in Hanoi, Vietnam.

The participants of this study were 1,788 students of the University of Foreign Languages in Hanoi, a university specializing in language education, linguistics, and international studies that educates graduates majoring in foreign languages, meeting the urgent need for qualified teachers and officials with foreign language competence. Participants included first- to fourth-year students from eight faculties: the Faculty of Japanese Language and Culture, the Faculty of Chinese Language and Culture, the Faculty of German Language and Culture, the Faculty of French Language and Culture, the Faculty of Russian Language and Culture, the Faculty of Korean Language and Culture, and the Faculty of English Language Education. Participants were recruited based on the following criteria: (1) aged 18 years old and above, (2) enrollment at the University of Foreign Languages in Hanoi, Vietnam; (3) being students majoring in foreign languages; and (4) having the physical and psychological capacity to fill the questionnaires.

### Sampling Procedure

An online survey was conducted. Students were invited to participate through an anonymous link distributed via email to students at the University of Foreign Languages and International Studies. The study was also announced by the UPC and the student communications departments. A set of screening questions was included at the beginning of the survey to ensure that students met the inclusion criteria of the study. The survey was open for 2 months, from August to October 2021. One reminder email was also sent to obtain a higher response rate. Results were reported separately according to faculty and year of study. At the time surveyed, there were approximately 5,000 full-time students at the University of Foreign Languages who were eligible to participate in the study. Most of the students were from the northern provinces of Vietnam. Of which 1,778 students accepted and submitted the completed questionnaire, accounting for 35.6%.

## Measurement

### Dependent Variables

This study measured severe SoMD using the Depression, Anxiety, and Stress Scales (DASS-21). The DASS-21 is a widely used screening tool to assess SoMD in community settings. The DASS-21 has been validated and used in many previous studies in Vietnam, showing good reliability and validity (21, 22).

This instrument is a self-report questionnaire comprised of 21 items, with seven items per subscale, measuring three aspects: depression, anxiety, and stress. Participants rated the DASS-21 using a four-point Likert rating scale ranging from 0 “did not apply to me at all” to 3 “applied to me very much or most of the time.” Sum scores are computed by adding up the scores on the items per subscale and multiplying them by a factor of two. Sum scores for each of the subscales may range between 0 and 42, with the higher score indicating greater severity of symptoms.

The symptomatology of all three aspects (depression, anxiety, and stress) are expressed using five levels: normal, mild, moderate, severe, and extremely severe. The classifications of scores for depression levels are: 0–9 (normal), 10–13 (mild), 14–20 (moderate), 21–27 (severe), and 28+ (extremely severe); for anxiety, levels are: 0–7 (normal), 8–9 (mild), 10–14 (moderate),

15–19 (severe), and 20+ (extremely severe); for stress, levels are: 0–14, 15–18, 19–25, 26–33, and 34+, representing normal to extremely severe (23). In this study, participants who had severe to extremely severe symptoms of MD were classified as having severe SoMD.

## Independent Variables

### *Financial-Study-Family-Friend (FSFF) Scale*

To evaluate factors related to severe SoMD among students, the FSFF scale was designed and piloted.

This questionnaire was comprised of 20 items, with 6–8 items per subscale, measuring three aspects: financial burden (6 items), difficulty in learning (6 items), and social support (family: 5 items; friends: 3 items). Responses were given using a four-point Likert scale ranging from 0 (very strongly disagree) to 3 (very strongly agree). The scores for items 13 to 20 (i.e., family and friend subscales) were reversed. The mean score for each scale was then obtained, with higher values indicating students having more problems in this aspect.

## Covariates

The covariates included the socioeconomic characteristics of the participants: age, gender, majoring in languages; academic performance (GPA); financial factors (financial resources, perceived financial situation, and tuition and living expenses); and history of stress, anxiety, or depression.

## Statistical Methods

### Properties of FSFF

The internal consistency of the FSFF was measured using Cronbach's alpha. A Cronbach alpha coefficient of from 0.6 to 0.7, from 0.7 to 0.8, and above 0.80 indicates poor, adequate, and good internal consistency, respectively. To identify the factorial structure of FSFF, exploratory factor analysis (EFA) was applied. Before conducting EFA, the Kaiser-Meyer-Olkin test was conducted to measure the sampling adequacy for factor analysis, with values >0.7 considered to be appropriate. Parallel analysis was used to decide the number of factors retained. The principal factor extraction method and Promax oblique rotation were then applied to assume existing correlations between factors.

The correlation between FSFF and DASS-21 subscale scores was assessed using Pearson's correlation coefficient, which ranges from 0 to 1; a higher value indicates a better linear correlation.

### Relationship Between FSFF and Severe SoMD

Multivariable logistic regressions were carried out to evaluate the relationship between FSFF subscale scores with severe SoMD. Two sets of models were fitted. In the partially adjusted models, we fitted each component of FSFF (i.e., financial, study, family, and friend) for each model separately, while in the fully adjusted model, all four aspects were included in the same model. All models were further adjusted for age, gender, monthly living expenses, GPA, and family medical history. A  $p$ -value of <0.05 was considered statistically significant. All analyses were conducted using Stata version 17 (Stata Corp, College Station, TX).

## Ethical Consideration

The study was approved by the Institutional Review Board of the Hanoi University of Public Health in Vietnam (IRB decision no. 325/2021/YTCC-HD3). All participants were given information about the study and notified of their rights as study participants. They also provided their informed consent voluntarily.

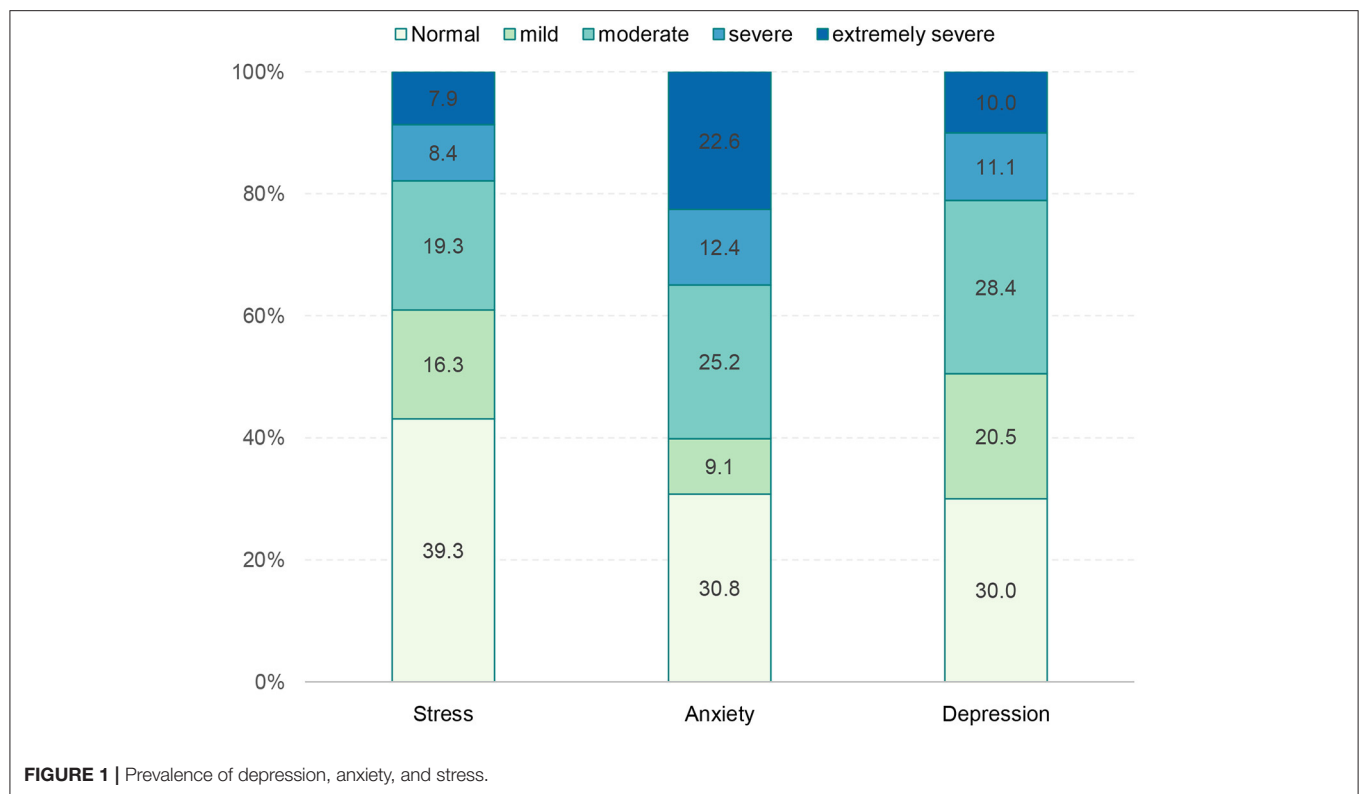
## RESULTS

### Participant Characteristics

A total of 1,788 participants enrolled in the study, including 126 male and 1,662 female students. Students' demographic characteristics are shown in **Table 1**. More than one-third of the participants were 19 years old (40.3%) with no family history of stress, anxiety, or depression (93.1%). The percentage of students with a family history of stress, anxiety, and depression was 6.9%. Nearly half of the participants had financial support from their families (46.4%). About 74% of respondents had tuition and living expenses of about \$150–195 (USD)/month and had

**TABLE 1 |** Participant characteristics.

	Male <i>n</i> (%) <i>N</i> = 126	Female <i>n</i> (%) <i>N</i> = 1,662	Total <i>n</i> (%) <i>N</i> = 1,788
<b>Age</b>			
22	13.5	14.7	14.6
21	34.1	22.0	22.8
20	14.3	22.9	22.3
19	38.1	40.4	40.3
<b>Family history of stress, anxiety or depression</b>			
No	93.7	93.0	93.1
Yes	6.3	7.0	6.9
<b>Financial resources</b>			
Family	46.8	46.3	46.4
Part-time job	13.5	10.5	10.7
Scholarship, other	39.7	43.1	42.9
<b>Perceived financial situation</b>			
Very difficult	4.8	4.3	4.3
Difficult	15.1	16.8	16.7
Normal	57.9	63.5	63.1
Comfortable	29.0	14.1	14.5
Very comfortable	3.2	1.3	1.4
<b>Tuition and living expenses</b>			
150–195 (USD)	78.2	73.4	73.7
200–239 (USD)	8.9	13.8	13.4
240–304 (USD)	4.8	6.9	6.7
310–435 (USD)	8.1	6.0	6.1
<b>GPA</b>			
Under 2.0	0.8	1.1	1.1
2.0–2.49	8.7	6.3	6.4
2.5–3.19	34.9	43.5	42.9
3.2–3.59	44.4	40.0	40.3
3.6–4	11.1	9.2	9.3



a normal perceived financial situation (63.1%). The majority of students have a GPA ranging from 2.5 to 3.59 (83.2%).

## Prevalence of Depression, Anxiety, and Stress

**Figure 1** shows the prevalence of stress, anxiety, and depression status among participants. The prevalence of symptoms of stress, anxiety, and depression among students was 83.7, 65.0, and 78.9%, respectively. A high prevalence of severe and extremely severe mental health problems was found, with 8.4 and 7.9% related to stress, 12.4 and 22.6% to anxiety, and 11.1 and 10.0% to depression, respectively.

## Properties of FSFF Scale

**Table 2** presents the properties of the FSFF scale. Using EFA, 20 items from the original set of 23 items remained in the final set. Four latent factors were found to explain these 20 items: items 1 to 6 were explained by the finance factor, and items 7 to 12, items 13 to 17, and items 18 to 20 were explained by the study, family, and friend factors, respectively. The factor loadings were high in all four aspects, ranging from 0.62 to 0.83 in finance, 0.34 to 0.74 in study, 0.71 to 0.73 in family, and 0.57 to 0.80 in friends.

The floor and ceiling effects were low at <15%, while the internal consistency reliabilities were high in all four factors, with the Cronbach's alpha coefficients for the finance, study, family, and friend factors being 0.84, 0.79, 0.89, and 0.76, respectively.

## Correlation Between Severe SoMD and Four Components of Scale FSFF

**Figure 2** shows the correlation between the DASS-21 score (stress, anxiety, depression) and four components (finance, study, family, friend) of scale FSFF. The stress, anxiety, and depression scores were strongly correlated, with correlation coefficients ranging from 0.68 to 0.75, while the correlation among four components of the FSFF scale was weak to moderate, with coefficients ranging from 0 to 0.43. Regarding the relation between DASS-21 subscales and FSFF subscales, the strongest relationships were found between the study aspect of the FSFF scale and DASS-21 subscales, with correlation coefficients ranging from 0.40 to 0.48,  $p < 0.001$ .

## Relationship Between Severe SoMD and Four Components of the FSFF Scale

**Table 3** shows the logistic regression of the relationship between severe mental health problems and four components of the FSFF scale. The results from fully adjusted models were consistent with those from the partially adjusted models. Conditional on students' demographic characteristics, all four aspects of the FSFF scale were related to the mental health problems of students. In worrying about finance, family, and friend, particularly, were associated with higher odds of having severe stress, with the OR ranging from 1.29 (95%CI: 1.11–1.51) to 1.76 (95%CI: 1.51–2.05), and 1.44 (95%CI: 1.24–1.67), respectively. Students who felt worried about their studies were 3.72 times (95%CI: 3.01–4.59) more likely to experience severe stress.



**TABLE 2 |** Properties of FSFF scale.

	Factor loading			
	Finance	Study	Family	Friend
I'm worried about the cost of tuition	0.71			
I've calculated daily living expenses	0.61			
I worry about finding a part-time job every month	0.61			
My family's financial support is not enough for me to live and study	0.68			
I hope to receive financial support from sources outside my family	0.62			
I worry about tuition and daily living expenses	0.83			
I wonder about my future career		0.34		
I have difficulty completing academic tasks		0.74		
I try to find a way to study that works for me personally		0.60		
I am overloaded with academic deadlines		0.63		
I'm obsessed with personal academic achievement		0.62		
I need help with my studies		0.69		
I can talk about my problems with my family*			0.71	
I received support and encouragement from my family*			0.85	
I feel comfortable talking to my family members*			0.84	
My family supports me in making decisions*			0.76	
My family really tries to help me*			0.73	
I can talk about my problems with my friends*				0.72
I have friends who are willing to comfort and share with me*				0.80
There are people who always take care of my feelings*				0.58
Floor effect	3.36	0.62	2.85	3.97
Ceiling effect	4.03	5.59	10.57	13.48
Cronbach's alpha	0.84	0.79	0.89	0.76
Mean (SD)	1.50 (0.80)	1.94 (0.64)	1.26 (0.81)	1.19 (0.80)

\*Reversed score.

Similar patterns were found in students who experienced severe anxiety and severe depression. Among these, students worrying about finance, study, family, and friends were likely to have severe anxiety, with OR ranging from 1.18 to 2.84; and had a higher likelihood of having severe depression, with OR ranging from 1.37 to 3.11. All results were significant, with  $p < 0.001$ .

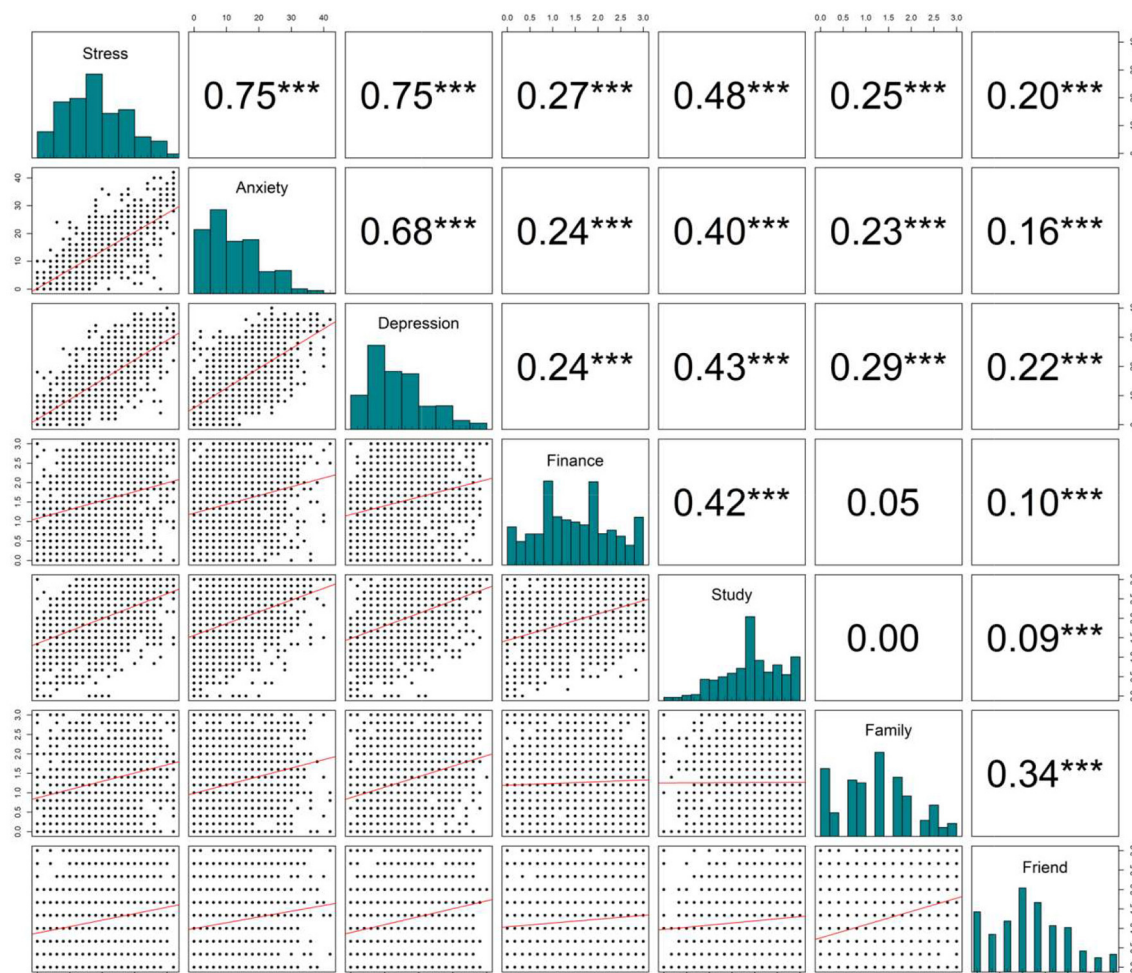
## DISCUSSION

In this study, we found a high prevalence of severe SoMD among foreign language students. Specifically, the stress rates of students in the research sample were severe (8.4%), and extremely severe (7.9%). The anxiety rate of students in the study sample was severe (12.4%); approximately one-fourth of participants were at an extremely severe level (22.6%). The rate of depression of students in the study sample was severe (11.1%), and extremely severe (10%), respectively. This rate was higher compared to previous studies (24, 25).

Regarding gender characteristics and the level of severe SoMD among college students, another study of high school students also showed a high percentage of students suffering from depression, anxiety, and stress, with depression and anxiety having a statistically significant association with gender (26). Females had higher levels of both depression and anxiety and

this difference was statistically significant. Other studies have also found that gender differences and depression and anxiety among students were significantly related, and depression tended to be less prevalent among males than females (27, 28). The differences between male and female students in depression and anxiety prevalence could be explained by the average personality traits of both genders. Females generally have higher levels of neuroticism than males (29). Therefore, this research may be impacted by the inclusion of a higher number of female than male participants. This gender imbalance is a characteristic of language schools in Vietnam.

In this study, the percentage of students with depression, anxiety, and stress was positively correlated with a number of factors, such as financial situation, family, friends, and academic problems. In particular, anxiety about academic problems can cause students to experience higher stress levels than other problems. A correlation between demographic factors (such as economic conditions and family support) and depression and anxiety symptoms was found in the study by Abdel Wahed and Hassan (30). They found that higher depression scores were associated with increasing age, low socioeconomic standards, and geographical location. Socioeconomic status, especially the financial status of the family, is a factor that affects the quality of life and mental health of students (31–33). Besides economic factors, social support from family and friends is correlated with



**FIGURE 2 |** Correlation matrix of DASS21 score (depression, anxiety, and stress scores) and four components of FSFF scale. \*\*\* $p < 0.001$ .

better mental health among students. These findings are similar to the research results of authors such as Chernomas and Shapiro (34), Usher and Curran (35), and Hefner and Eisenberg (36).

Regarding the correlation between learning issues and mental health problems, especially stress levels, our research shows that anxiety about studying can cause almost four times more stress than other influencing factors. A similar result was also found in the study conducted by Mofatteh (37). The author asserts that numerous college-related academic stressors can lead to S.A.D (Stress, Anxiety, Depression) in students. One of the factors that was strongly present in many of the studies evaluated in this review was degree-related issues and the pressure to graduate. The relationship between study pressure and stress and anxiety levels in foreign language students was shown to be similar in studies by Köksal et al. (38); Marcos-Llinás and Garau (39).

Thus, it can be said that the four factors affecting students' severe SoMD (stress, anxiety, and depression) that were investigated in this study (namely, financial problems, familial support, friends, and academic problems) were statistically significant and similar to previous studies. In the scope of this study, studying was the factor that had the most significant

impact on students' mental health problems in all three aspects: stress, depression, and anxiety. Next are family, friends, and finally financial issues.

These are remarkable findings and could greatly assist schools and psychologists in developing ways to reduce levels of stress, depression, and anxiety, and thereby improve the quality of students' mental health. In fact, in response to the findings of this study, several online workshops were held as part of UPC activities for students in several universities to teach students about mental health, how to balance their emotions, and the importance of healthy activities.

## LIMITATIONS

The findings of this study should be interpreted in the context of potential limitations. Firstly, as this is a cross-sectional study, students' psychological problems could only be measured for a short period of time. Further research needs to be conducted over an extended period to determine whether the manifestations of depression, anxiety, and stress are long-term problems for foreign language students. Secondly, given that many previous

**TABLE 3 |** Relationship between FSFF scale and severe symptoms of mental disorders development.

	Partially adjusted model			Fully adjusted model		
	OR	95 CI	P-value	OR	95 CI	P-value
<b>Severe stress</b>						
Finance	1.23	[1.06; 1.42]	0.005	1.29	[1.11; 1.51]	0.001
Study	3.76	[3.08; 4.60]	0.000	3.72	[3.01; 4.59]	0.000
Family	1.85	[1.60; 2.15]	0.000	1.76	[1.51; 2.05]	0.000
Friend	1.40	[1.20; 1.62]	0.000	1.44	[1.24; 1.67]	0.000
<b>Severe anxiety</b>						
Finance	1.18	[1.02; 1.37]	0.026	1.23	[1.05; 1.43]	0.008
Study	2.87	[2.36; 3.48]	0.000	2.84	[2.32; 3.48]	0.000
Family	1.68	[1.44; 1.95]	0.000	1.63	[1.40; 1.90]	0.000
Friend	1.16	[1.00; 1.34]	0.049	1.18	[1.01; 1.37]	0.029
<b>Severe depression</b>						
Finance	1.36	[1.16; 1.59]	0.000	1.37	[1.17; 1.61]	0.000
Study	3.22	[2.62; 3.94]	0.000	3.11	[2.51; 3.84]	0.000
Family	1.79	[1.53; 2.09]	0.000	1.75	[1.49; 2.05]	0.000
Friend	1.46	[1.25; 1.72]	0.000	1.46	[1.24; 1.72]	0.000

All models are adjusted for age, gender, monthly living expenses, GPA, family medical history.

studies have shown that a higher percentage of female students suffer from depression, the greater number of female than male students included in this study may have resulted in more students reporting severe SoMD than would have if the genders were balanced; the results in this regard would be more accurate if the proportion of male participants is higher. Thirdly, using DASS-21 only helped us to capture the severity of symptoms of MHD in students, not a diagnosis for mental disorders. Fourthly, the participants in this study comprised only 35.6% of the total number of students at the University of Languages and International Studies, which might introduce selection bias.

## CONCLUSION

The research showed that students of the University of Foreign Languages in Hanoi, Vietnam have a high prevalence of severe SoMD. Studying and family are two factors that significantly impacted the levels of stress, anxiety, and depression of students, and students who had close connections and received care and support from their families were shown to have better mental health. These findings also suggest that teachers and universities should pay special attention to female students because they tend to be more prone to mental disorders than male students. Schools and educators should promote information about the role of families in students' SoMD and develop appropriate learning strategies to ensure both students' mental health and their learning quality.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The study was approved by the Institutional Review Board of Hanoi University of Public Health in Vietnam (IRB decision no 325/2021/YTCC-HD3). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

DL and NT conceived of the study. NT and KL performed the official statistical analyses and interpreted the results. NT, DL, and NP wrote the manuscript. TA, NG, NL, and DN provided the critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript.

## FUNDING

This research was funded by the University of Languages and International Studies, Vietnam National University, Hanoi under grant number N.21.01.

## ACKNOWLEDGMENTS

The authors would like to thank all students who participated in this study for their support.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.855607/full#supplementary-material>

## REFERENCES

- World Health Organization. *Mental Health: Strengthening Our Response*. (2018). Available online at: <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response> (accessed December 10, 2021).
- World Health Organization. *World Mental Health Day: An Opportunity to Kick-Start a Massive Scale-Up in Investment in Mental Health*. (2020). Available online at: [https://www.who.int/health-topics/mental-health#tab=tab\\_1](https://www.who.int/health-topics/mental-health#tab=tab_1) (accessed December 10, 2021).
- Conley CS, Kirsch AC, Dickson DA, Bryant FB. Negotiating the transition to college: developmental trajectories and gender differences in psychological functioning, cognitive-affective strategies, and social well-being. *Emerg Adulthood*. (2014) 2:195–210. doi: 10.1177/2167696814521808
- Ibrahim AK, Kelly SJ, Adams CE, Glazebrook C. A systematic review of studies of depression prevalence in university students. *J Psychiatr Res*. (2013) 47:391–400. doi: 10.1016/j.jpsychires.2012.11.015
- Tran A, Tran L, Geghre N, Darmon D, Rampal M, Brandone D, et al. Health assessment of French university students and risk factors associated with mental health disorders. *PLoS ONE*. (2017) 12:e0188187. doi: 10.1371/journal.pone.0188187
- Chen L, Wang L, Qiu XH, Yang XX, Qiao ZX, Yang YJ, et al. Depression among Chinese university students: prevalence and socio-demographic correlates. *PLoS ONE*. (2013) 8:e58379. doi: 10.1371/journal.pone.0058379
- McLafferty M, Lapsley CR, Ennis E, Armour C, Murphy S, Bunting BP, et al. Mental health, behavioural problems and treatment seeking among students commencing university in Northern Ireland. *PLoS ONE*. (2017) 12:e0188785. doi: 10.1371/journal.pone.0188785
- Tien Nam P, Thanh Tung P, Hanh Dung N, Hoang An D, Dang The Anh B, Bich Diep Q, et al. Prevalence of smoking among health science students in Vietnam in 2018 and associated factors: a cross-sectional study. *Health Psychol Open*. (2020) 7:2055102920967244. doi: 10.1177/2055102920967244
- Elani HW, Allison PJ, Kumar RA, Mancini L, Lambrou A, Bedos C. A systematic review of stress in dental students. *J Dental Educ*. (2014) 78:226–42. doi: 10.1002/j.0022-0337.2014.78.2.tb05673.x
- Borst JM, Frings-Dresen MHW, Sluiter JK. Prevalence and incidence of mental health problems among Dutch medical students and the study-related and personal risk factors: a longitudinal study. *Int J Adolesc Med Health*. (2016) 28:349–55. doi: 10.1515/ijamh-2015-0021
- Pham Tien N, Pham Thanh T, Nguyen Hanh D, Duong Hoang A, Bui Dang The A, Kim Bao G, et al. Utilization of mental health services among university students in Vietnam. *Int J Mental Health*. (2021) 50:113–35. doi: 10.1080/00207411.2020.1816114
- Cook AF, Arora VM, Rasinski KA, Curlin FA, Yoon JD. The prevalence of medical student mistreatment and its association with burnout. *Acad Med*. (2014) 89:749–54. doi: 10.1097/ACM.0000000000000204
- Patel V, Flisher AJ, Hetrick S, McGorry P. Mental health of young people: a global public-health challenge. *Lancet*. (2007) 369:1302–13. doi: 10.1016/S0140-6736(07)60368-7
- Pillay AL, Thwala JD, Pillay I. Depressive symptoms in first year students at a rural South African University. *J Affect Disord*. (2020) 265:579–82. doi: 10.1016/j.jad.2019.11.094
- Unger KV. *Handbook on Supported Education: Providing Services for Students With Psychiatric Disabilities*. Rockville, MD: Paul H Brookes Publishing Company (1998).
- Eisenberg D, Downs MF, Golberstein E, Zivin K. Stigma and help seeking for mental health among college students. *Med Care Res Rev*. (2009) 66:522–41. doi: 10.1177/1077558709335173
- Kieu TTT. Depression, anxiety and stress among students in Ho Chi Minh city. In: *The 5th International Conference on Child Mental Health in Vietnam 2019 Hanoi*. Hanoi: Vietnam National University (VNU) (2019). p. 98–104.
- Horwitz Ek, Horwitz Mb, Cope J. Foreign language classroom anxiety. *Modern Lang J*. (1986) 70:125–32. doi: 10.1111/j.1540-4781.1986.tb05256.x
- Sheen Y. Recasts, language anxiety, modified output, and L2 learning. *Lang Learn*. (2008) 58:835–74. doi: 10.1111/j.1467-9922.2008.00480.x
- Spielmann G, Radnoffsky ML. Learning language under tension: new directions from a qualitative study. *Modern Lang J*. (2001) 85:259–78. doi: 10.1111/0026-7902.00108
- Ngoc NB, Tuan NV. Stress among nursing students at Hai Phong Medical College in 2020. *J Med Res*. (2021) 143:159–66.
- Tran TD, Tran T, Fisher J. Validation of the depression anxiety stress scales (DASS) 21 as a screening instrument for depression and anxiety in a rural community-based cohort of northern Vietnamese women. *BMC Psychiatry*. (2013) 13:24. doi: 10.1186/1471-244X-13-24
- Lovibond SH, Lovibond PF. *Manual for the Depression Anxiety Stress Scales*. Sydney, NSW: Psychology Foundation of Australia (1996).
- Woon LS-C, Leong Bin Abdullah MFI, Sidi H, Mansor NS, Nik Jaafar NR. Depression, anxiety, and the COVID-19 pandemic: severity of symptoms and associated factors among university students after the end of the movement lockdown. *PLoS ONE*. (2021) 16:e0252481. doi: 10.1371/journal.pone.0252481
- Sundarasan S, Chinna K, Kamaludin K, Nurunnabi M, Baloch GM, Khoshaim HB, et al. Psychological impact of COVID-19 and lockdown among university students in Malaysia: implications and policy recommendations. *Int J Environ Res Public Health*. (2020) 17:6206. doi: 10.3390/ijerph17176206
- Alharbi R, Alsuhailani K, Almarshad A, Alyahya A. Depression and anxiety among high school student at Qassim Region. *J Family Med Prim Care*. (2019) 8:504–10. doi: 10.4103/jfmpc.jfmpc\_383\_18
- Mazza C, Ricci E, Biondi S, Colasanti M, Ferracuti S, Napoli C, et al. A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *Int J Environ Res Public Health*. (2020) 17:3165. doi: 10.3390/ijerph17093165
- Luo W, Zhong B-L, Chiu HF-K. Prevalence of depressive symptoms among Chinese university students amid the COVID-19 pandemic: a systematic review and meta-analysis. *Epidemiol Psychiatr Sci*. (2021) 30:e31. doi: 10.1017/S2045796021000202
- Costa Jr PT, Terracciano A, McCrae RR. Gender differences in personality traits across cultures: robust and surprising findings. *J Pers Soc Psychol*. (2001) 81:322–31. doi: 10.1037/0022-3514.81.2.322
- Abdel Wahed WY, Hassan SK. Prevalence and associated factors of stress, anxiety and depression among medical Fayoum University students. *Alexandria J Med*. (2017) 53:77–84. doi: 10.1016/j.ajme.2016.01.005
- Bradley G. Responding effectively to the mental health needs of international students. *High Educ*. (2000) 39:417–33. doi: 10.1023/A:1003938714191
- Ratanasiripong P, China T, Toyama S. Mental health and well-being of university students in Okinawa. *Educ Res Int*. (2018) 2018:4231836. doi: 10.1155/2018/4231836
- Li M, Li W-Q, Li LMW. Sensitive periods of moving on mental health and academic performance among university students. *Front Psychol*. (2019) 10:1289. doi: 10.3389/fpsyg.2019.01289
- Chernomas WM, Shapiro C. Stress, depression, and anxiety among undergraduate nursing students. *Int J Nurs Educ Scholarship*. (2013) 10:255–66. doi: 10.1515/ijnes-2012-0032
- Usher W, Curran C. Predicting Australia's university students' mental health status. *Health Promot Int*. (2017) 34:312–22. doi: 10.1093/heapro/dax091
- Hefner J, Eisenberg D. Social support and mental health among college students. *Am J Orthopsychiatry*. (2009) 79:491–9. doi: 10.1037/a0016918
- Mofatteh M. Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health*. (2020) 8:36–65. doi: 10.3934/publichealth.2021004
- Köksal O, Arslan C, Bakla A. An investigation into foreign language learning anxiety, stress and personality in higher education. *Int J New*. (2014) 5:199–208.



39. Marcos-Llinás M, Garau MJ. Effects of language anxiety on three proficiency-level courses of Spanish as a foreign language. *Foreign Lang Ann.* (2009) 42:94–111. doi: 10.1111/j.1944-9720.2009.01010.x

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of

the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Thang, Linh, Anh, Phuong, Giang, Long, Nhung and Long. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Mental Health and Related Factors Among Undergraduate Students During SARS-CoV-2 Pandemic: A Cross-Sectional Study

José Miguel Valdés<sup>1</sup>, Francisco Javier Díaz<sup>1</sup>, Pascale Marie Christiansen<sup>1</sup>, Gabriel Arturo Lorca<sup>1</sup>, Francisco Javier Solorza<sup>1</sup>, Matías Alvear<sup>1</sup>, Saray Ramírez<sup>2,3</sup>, Daniel Nuñez<sup>3,4</sup>, Ricardo Araya<sup>3,5</sup> and Jorge Gaete<sup>2,3\*</sup>

<sup>1</sup> School of Medicine, Universidad de los Andes, Santiago, Chile, <sup>2</sup> Faculty of Education, Research Center for Students Mental Health (ISME), Universidad de los Andes, Santiago, Chile, <sup>3</sup> National Research and Development Agency (ANID), Millennium Science Initiative Program, Millennium Nucleus to Improve the Mental Health of Adolescents and Youths, Imhay, Santiago, Chile, <sup>4</sup> Faculty of Psychology, Universidad de Talca, Talca, Chile, <sup>5</sup> Department of Health Service and Population Research, King's College London, London, United Kingdom

## OPEN ACCESS

### Edited by:

Roy Abraham Kallivayalil,  
Pushpagiri Medical College, India

### Reviewed by:

Chung-Ying Lin,  
National Cheng Kung  
University, Taiwan  
Zayra Antúñez,  
Austral University of Chile, Chile  
Molly Rosenberg,  
Indiana University Bloomington,  
United States

### \*Correspondence:

Jorge Gaete  
jgaete@uandes.cl

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

**Received:** 11 December 2021

**Accepted:** 11 May 2022

**Published:** 31 May 2022

### Citation:

Valdés JM, Díaz FJ, Christiansen PM, Lorca GA, Solorza FJ, Alvear M, Ramírez S, Nuñez D, Araya R and Gaete J (2022) Mental Health and Related Factors Among Undergraduate Students During SARS-CoV-2 Pandemic: A Cross-Sectional Study. *Front. Psychiatry* 13:833263. doi: 10.3389/fpsy.2022.833263

**Background:** Mental health problems among undergraduates are a significant public health concern. Most studies exploring mental health in this population during the pandemic have been conducted in high-income countries. Fewer studies come from Latin American countries. The aim of this study was to determine the prevalence of depression, anxiety, stress, insomnia, and suicide risk, and explore the association with several relevant variables in personal, family, university, and SARS-CoV-2 pandemic domains.

**Methods:** A cross-sectional study was conducted in Chile in a medium-size private University. Outcome variables were explored with valid instruments: Depression, Anxiety, and Stress Scale (DASS-21), Insomnia Severity Index (ISI), and the Columbia-Suicide Severity Rating Scale (C-SSRS). Independent variables from personal (e.g., sex, age, sexual orientation, history of mental health problems, substance use), family (e.g., parental educational background, family history of mental health problems, family functioning), university (e.g., course year, financial support, psychological sense of university belonging, history of failing subjects) and SARS-CoV-2 domains (e.g., history of personal and family contagion, fear of contracting SARS-CoV-2, frequency of physical activity, keeping routines and social contact). Multivariable logistic regression models were conducted for each outcome, after univariable and domain-specific multivariable models. The significant variable at each step was selected if the  $p$ -value was  $\leq 0.05$ .

**Results:** A total of 5,037 students answered the survey—the global response rate of 63.5%. Most of the students were females (70.4%) and freshmen students (25.2%). The prevalence of mental health problems was high: depression (37.1%), anxiety (37.9%), and stress (54.6%). Insomnia was reported in 32.5% of students, and suicide risk in 20.4% of students. The associated variables at personal domain were history of mental health problems, substance use, and sexual orientation; at family domain, family functioning and family history of mental health problems; at university domain, violence victimization

and sense of belonging; and in SARS-CoV-2 domain, having a daily routine and fear to contracting SARS-CoV-2 by students themselves or others.

**Conclusions:** The prevalence of mental health problems is high among undergraduate students and some of the associated factors, such as victimization and a sense of belonging can be used in preventive interventions.

**Keywords:** mental health, undergraduate, college, depression, anxiety, suicide risk, university, insomnia

## INTRODUCTION

Mental health problems are considered a significant public health concern, especially among young people. Pre-pandemic studies have estimated the prevalence of mental disorders among youth from 8.3 to 12.4% (1) and concerning figures can also be seen among undergraduate students. For instance, in USA, The Healthy Minds Study (2020) found a 39% prevalence of depression and a 34% prevalence of anxiety disorder among college students (2). In Chile, the prevalence of mental health problems among undergraduate students seems to have increased in the last few years (3). For instance, in 2013, Antúnez et al., using the Depression, Anxiety, and Stress Scale (DASS-21), found that 30% of undergraduates had depressive symptoms and 21% had anxiety symptoms (4), while, in 2019, Barrera-Herrera et al., using the same instrument, found that both depression and anxiety reached a 46% prevalence (5).

Young people face a crucial developmental period with many normative transitions. Vocational issues, financial problems, academic workload, missing home, and loneliness are some of the common stressors found among undergraduate students (1, 6, 7). The changes found in this period may be aggravated by SARS-CoV-2-related stressors and social disruptions associated with the restrictions in daily activities imposed by the pandemic (8).

Several studies have explored the effect of SARS-CoV-2 pandemic and sanitary measures on mental health among undergraduates. In the USA, 48.1% of undergraduates reported depression, 38.5% anxiety, and 18.0% suicidal ideation. In the same study, 71.3% of the students indicated that their stress and anxiety symptoms increased during the pandemic (9). Additionally, a recent meta-analysis estimated a mean prevalence of 31% for anxiety and 34% for depression (8). Anxiety was slightly higher among males (36%) and females (30%), but depression was higher among females (56%) than among males (34%).

Mental health problems may disrupt performance in the University. For example, a study conducted in USA found that during the pandemic high levels of depression were associated with difficulties in focusing on academic work (10). Other findings demonstrated that mental health distress was correlated

to a perceived poor academic performance caused by SARS-CoV-2 (11).

Several factors have been identified related to the presence of mental health problems, some of them related to the expansion of the disease and other related to personal or contextual factors. In the first case, a large survey conducted in China found an increased risk of mental health problems when undergraduates reported having relatives or friends being infected with SARS-CoV-2 (12). A study in Taiwan showed that self-reported susceptibility of contracting SARS-CoV-2 was associated with suicidal ideation (13). In the second case, a study conducted in Canada reported that females had higher rates of mental health problems (14). On the other hand, one study conducted in Indonesia, Taiwan, and Thailand showed found that a higher support received from family, classmates, and faculties decreased suicidal ideation (15). A study in USA found that a higher alcohol use was associated with increased depression and anxiety symptoms (16). A study in Spain reported that using tobacco, insomnia and low self-esteem were associated with depression, anxiety and stress (17). Another large survey conducted in France showed that low-quality housing and insolation were highly associated with mental health problems (18).

In Latin America, fewer studies have explored the effect of the pandemic on mental health among undergraduates. It is known that in this region of the world higher mental problem symptoms have been reported in the general population during the pandemic (19), and also before the pandemic for various reasons such as treatment gap (20). We have found three studies conducted in Brazil (21–23), two studies conducted in Mexico (24, 25), and one in Chile (26). The studies in Brazil found that undergraduate students exhibited higher scores for perceived stress and depressive signs and lower resilience scores when compared to administrative and faculty staff (21). Additionally, variables associated with symptoms of depression, anxiety and stress in Brazil were: being female, having a chronic disease, fewer positive relations with others, lower self-acceptance, self-blaming, and substance use (22, 23). The studies in Mexico found that anxiety and depressive symptoms were related to younger age, previously diagnosed psychiatric disorder, and using drugs (25); and the main reason undergraduate students requested professional help was the presence of anxiety symptoms (24). Finally, only one research explored mental health problems among first-year university students from a State University in Chile, and found that 77% of the students perceived that their mood was worse during the pandemic, and the main associated factors with both depressive and anxiety symptoms were being

**Abbreviations:** YLDs, years lived with disability; DASS-21, Depression, Anxiety, and Stress Scale; SARS-CoV-2, Severe Acute Respiratory Syndrome Coronavirus 2; ADHD, Attention Deficit Disorder with Hyperactivity; ASSIST, Alcohol, Smoking and Substance Involvement Screen Test; SD, Standard deviation; SSAF, Sense of Social and Academic Fit tool; ISI, Insomnia Severity Index; C-SSRS, Columbia-Suicide Severity Rating Scale.

female, problems with family or friends, problems with online classes and attention deficit symptoms (26).

The general aim of this study was to determine the prevalence of mental health problems among undergraduate students and is associated factors among undergraduate students in Santiago, Chile. The specific aims were: First, to determine the prevalence of depression, anxiety, stress, insomnia, and suicide risk. Second, to explore the association of personal, family, and university variables with mental health outcomes. And third, to estimate the association between SARS-CoV-2 pandemic and sanitary measures on the mental health of students.

## METHODS

### Participants

A cross-sectional study based on individual-level data was conducted using an online survey. The protocol of the study was approved by the Ethical Committee of Universidad de los Andes (CEC201984) and registered (ClinicalTrials.gov NCT04447690).

This study followed a convenience sampling strategy. The inclusion criteria were: (1) Registered undergraduate students from Universidad de los Andes, Santiago, Chile, and (2) 18 years old and older at the time of the study. All eligible students ( $n = 7,935$ ), were invited to answer an online survey sent to their institutional email address using Qualtrics, ensuring anonymity.

### Procedure

We contacted all authorities of different Faculties and Academic Units, and a written and signed letter of authorization was required for participation. A massive campaign using social media networks and institutional emails was conducted between June 11th and September 4th 2020. Special efforts were directed to contact and ask for support from social media influencers who actively invited students to answer the survey. Academic councils and authorities were also asked to share information about the study and the survey link.

All relevant information about the study, such as objectives of the study, potential benefits and risks, as well as confidentially issues, the written consent and the link to answer the survey was sent to the students using the institutional emails and the formal channels of communication between Faculties and Academic Units and students. As a result, participants were asked to confirm or refuse to answer the survey. Data entry was possible between August 5th and September 4th 2020. Regarding the pandemic context, it is important to mention that Chile was in the 5th month after the first case reported of SARS-CoV-2 and the Government of Chile implemented lockdown measures in all the country which were in place at the moment of the data collection. Therefore, universities were only implementing online classes. No vaccines were available at that time in Chile.

### Privacy and Anticipation of Potential Risks

Anonymity was ensured and answers were not traceable. In order to promote help-seeking actions among students who considered themselves to have mental health symptoms, at the end of the survey, self-help reflexive questions and phone numbers of several public institutions were displayed. There, they

could ask for help and access assistance if needed. Additionally, high suicide risk was detected using the Columbia-Suicide Severity Rating Scale (Answering “yes” to questions #4 or #5). If high risk was detected, a warning sign appeared on the screen suggesting seeking help, alongside the university wellbeing support contact email address and the phone number of several public institutions where help can be obtained. Every week we informed the university wellbeing personnel on the number of students who potentially may contact them during the following week so they can be prepared to take care of them. Due to the fact that no names or identity information were obtained in the survey, this information was never informed to third parties. Finally, the study opened an Instagram account ([http://www.instagram.com/salud\\_mental\\_med\\_uandes](http://www.instagram.com/salud_mental_med_uandes)) where we shared self-help information and provided contact email addresses and contact phone numbers of wellbeing personnel for those students who may require assistance.

To prevent multiple answers, only institutional mailing systems were used, and a record of IP addresses blocked further attempts to answer multiple times. These IP addresses were encrypted in the server.

### Measures

The survey included widely used scales and, when not instruments were available, several questions were developed by the researchers.

### Independent Variables

Variables from four domains were included in the questionnaire.

#### Personal Domain

- **Sociodemographic variables.** Sex, age, nationality (0 = Chilean; 1 = Other nationality), ethnicity (0 = Non-indigenous; 1 = Indigenous), and occupational status (0 = Studying only; 1 = Studying and part-time job; 2 = Studying and full-time job).
- **General health history.** History of chronic illness (0 = No; 1 = Yes), history of mental health disorders (Depression, Bipolar, Panic, Anxiety, Eating, Attention Deficit Disorder w/Hyperactivity-ADHD), history of mental health treatment (Psychotherapy, Pharmacotherapy), physical activity (0,  $\leq 149$  min/week; 1,  $\geq 150$  min/week. This is equivalent of performing psychical exercise 30 min/day five times a week).
- **Sexuality and sexual health.** Sexual orientation (Heterosexual, Homosexual, Bisexual, Unsure, Other), offspring (0 = No children; 1 = With children), number of sex partners in the last year (0 = None; 1 = 1 or 2; 2 = 3 or more).
- **Substance use:** We used two screening questionnaires: the CAGE questionnaire (27) for alcohol use, and an adapted version of the Alcohol, Smoking and Substance Involvement Screen Test (ASSIST) (28), which included all substances of abuse, but alcohol. We decided to use CAGE for alcohol use because it is a self-report 4-item scale used to assess harmful alcohol consumption (abuse or dependence) widely used in Chile and allowed us to reduce the number of items to the survey. Each item is answered 0 (*No*) or 1



(Yes). The total range score goes from 0 to 4. The cut-off point is  $\geq 2$  (27). It is able to detect alcohol abuse and dependence with a sensitivity of 43%–94% and a specificity of 70%–97% (29). It has been validated in Spanish populations (30). The ASSIST is an interview with eight items exploring the amount and frequency of substance use in the last 3 months and the problems associated with its use. Originally, it explores ten drugs (Tobacco, alcohol, marijuana, cocaine, amphetamines, inhalants, sedatives, hallucinogens, opioids, and others). We included “Vaping” and the use of “nootropics” (cognitive enhancers) in the list of drugs because of the recent concern of increased use among undergraduate students. We adapted the ASSIST to be used as a self-report questionnaire. Additionally, alcohol questions were excluded from this instrument because this substance was assessed with the CAGE for the reasons mentioned above. For all substances, we reported the prevalence of use in the last week, last month, lifetime, and risk of substance use disorder. For the association analyses, we only used the monthly use (0 = No use in the last month; 1 = Monthly use) of the most frequent substances.

### Family Domain

- **Family history.** Parental educational level (0 = Incomplete elementary school; 1 = Complete elementary school and incomplete high school; 2 = Complete high school and incomplete university; 3 = Complete university and incomplete postgraduate studies; 4 = Complete postgraduate studies), family history of mental health problems (Psychiatric disorders, Suicide, Alcohol abuse or dependence, and Drug abuse or dependence).
- **Family functioning.** We used the “Family functionality APGAR score”. This tool is a self-report questionnaire of 5 items, with responses on a Likert Scale from 0 (*Almost never*) to 2 (*Almost every time*) that measures family support in the domains of adaptation, partnership, growth, affection, and conflict resolution. It is interpreted as follows: Highly functional family: 7–10; Moderate dysfunction: 4–6; Severe dysfunction: 0–3 (31). Cronbach’s alpha in the Spanish population is 0.84 (32). Cronbach’s alpha in our sample was 0.87. The reference category for association analyses was Highly functional family.

### University Domain

- **University history.** Academic year (1 = First year; 2 = Second year; 3 = Third year; 4 = Fourth year; 5 = Fifth or more), source of financing (Funding from parents, Credit/loan, Scholarship, Self-funded, Other means), mean commuting time (1 = Higher than average ( $\geq 1SD$ ); 2 = Average (of the total sample) (reference group); and 3 = Lower than average ( $\leq 1SD$ ), history of failing subjects (0 = No failed subjects; 1 = Failed subjects).
- **Violence victimization.** The research team developed several questions aiming to gather information about violence victimization: physical, psychological, exclusion, teasing, and ridiculization.
- **Psychological sense of university belonging** was measured using the Sense of Social and Academic Fit tool (SSAF),

previously validated in English (33). The tool is a self-report questionnaire of 17 items, with responses on a Likert Scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*) that measure academic and social sense of belonging. Cronbach’s alpha in this sample was 0.90; the higher the score, the higher sense of belonging. We categorized this variable according to three groups: 1 = Higher than average ( $\geq 1SD$ ); 2 = Average (of the total sample) (reference group); and 3 = Lower than average ( $\leq 1SD$ ).

### SARS-CoV-2 Experiences Domain

- **SARS-CoV-2 experiences.** History of personal (0 = No; 1 = Yes) and family (0 = No; 1 = Yes) contagion of SARS-CoV-2; fear to contracting SARS-CoV-2 by the students (1 = Not at all; 2 = Slightly; 3 = Somewhat; 4 = Moderately; 5 = Extremely) and fear of others contracting SARS-CoV-2 (1 = Not at all to 5 = Extremely); living condition during pandemic lockdowns (0 = Living with family, friends or roommates; 1 = Living independently); frequency of social contact during lockdowns (1 = Never; 2 = 1 or 2 days/week; 3 = 3 or 4 days/week; 4 = 5 or 6 days/week; 5 = Everyday); frequency of physical exercising during lockdowns (1 = Never to 5 = Everyday); frequency of recreational activities during lockdowns (1 = Never to 5 = Everyday); keeping a routine during lockdowns (1 = Never to 5 = Everyday); and frequency of meditation or praying during lockdowns (1 = Never to 5 = Everyday).

### Dependent Variables

- **Depression, anxiety and stress.** We used the Depression, Anxiety, and Stress Scale (DASS-21) (34, 35). This instrument has 21 items divided into three subscales, and it has been validated in the Chilean college population (36). The cut-off score for the depression subscale is  $\geq 6$  (sensitivity 88.46% and specificity 86.77%), for the anxiety subscale is  $\geq 5$  (sensitivity 87.50% and specificity 83.38%), and for the stress subscale is  $\geq 6$  (sensitivity 81.48% and specificity 71.36%). We used these cut-off scores to create binary outcome variables. The reported Cronbach’s alpha for each subscale is 0.88, 0.71, and 0.80, respectively (37). Cronbach’s alpha in our sample for depression subscale was 0.89, for anxiety subscale was 0.83, and for stress subscale was 0.88.
- **Insomnia.** We used the Insomnia Severity Index (ISI) (38). It is a 7-item scale with answers ranging from 0 to 4. A higher score means more severe symptoms of insomnia. The cut-off score for clinical insomnia is  $\geq 15$  (38). This cut-off score was used to create a binary outcome variable. The English validation reported a Cronbach’s alpha of 0.90 (39), and the Spanish validation reported a Cronbach alpha of 0.82 (40). Cronbach’s alpha in our sample was 0.84.
- **Suicide risk.** We used the Columbia-Suicide Severity Rating Scale (C-SSRS) (41). This scale has seven items exploring the presence of suicidal ideation and plans and suicide attempts in different periods of time. Each item is responded Yes or No. It has been validated in English-speaking (Cronbach’s alpha between 0.73 and 0.93) (41), and Spanish speaking populations ( $\alpha = 0.53$ ) (42). For the analysis of this study, we only considered the first five items that measured suicide risk

in the last month. Cronbach's alpha in our sample was 0.74. We created a binary variable (0 = No risk; 1 = Suicide risk) as outcome.

## Statistical Analyses

A descriptive analysis was performed with measures of variance by calculating 95% confidence intervals and standard deviation accordingly. Measures of central tendency were calculated with the mean, and relative frequencies and percentages were presented (see **Table 1**).

Univariate and multivariate logistic regression models were performed in three sequential steps: (1) Unadjusted models: all variables were assessed to determine if they were associated with each of the five outcomes: depression, anxiety, stress, insomnia, and suicidality. Those variables that had a univariable association ( $p$ -value  $\leq 0.05$ ), were selected to be included in the next step. (2) All variables were organized according to the following domains: personal, family, university, and SARS-CoV-2 related variables. For each domain, we conducted a multivariate logistic model, and those variables that had an association ( $p$ -value  $\leq 0.05$ ), were selected to be included in the final multivariate model. (3) The final model included all the variables associated with the outcomes in step 2. For steps 2 and 3, we included the variables sex and age and respective covariates in each model. In the case of independent variables reflecting a degree of intensity or growth, we conducted the Walt test to decide if they were included in each successive model. All statistical analyses were performed using Stata 15.

## RESULTS

### Sample Description

The main characteristics of the sample are presented in **Table 1**. A total of 5,037 students answered the survey—the global response rate of 63.5%. Most of the students were females (70.4%) and freshmen students (25.2%). The mean age increased by academic year, starting from 19.6 (SD = 2.9) years old in the 1st academic year to 24.0 (SD = 1.9) years old in the 5th or higher academic year. Survey respondents were distributed over 22 different courses. Most students were Chilean (96.5%), Non-Indigenous (98.1%), and only studied (87.5%). Regarding health history, 19.4% had a chronic illness, 35.4% had a diagnosis of an anxiety disorder, and 32.7% had ADHD and depression (27.9%). A 45.4% of students had attended psychotherapy, and 35.7 had used medication for a psychiatric condition. A 43.7% practiced regular physical activity. Most of the sample referred to being heterosexual (88.8%), single (98.6%) with no children (98.6%). A 4.5% of students reported having had three or more sexual partners in the last year. Finally, substance use was highly prevalent, with 54.6% of students reporting alcohol use in the last month. Risk for alcohol use disorder was found in 18.1% of students, and the risk for cannabis use disorder was found in 0.5% of students (see **Table 2**).

In the case of the parents' educational level, most completed university studies (mothers, 55.8% and fathers 45.7%). A 39.1% had a family history of psychiatric disorders, and 11.4% had a family member who committed suicide. A third of students

**TABLE 1 |** Personal variables.

Personal variables	<i>n</i>	% or mean	(95% CI) or (SD)
<b>Sex</b>			
Male	1,491	29.6	(28.4–30.9)
Female	3,546	70.4	(69.1–71.6)
<b>Age distribution by academic year</b>			
1st	1,268	19.6	(2.9)
2nd	961	20.6	(2.7)
3rd	992	21.5	(1.8)
4th	936	22.4	(1.6)
5th or higher	880	24.0	(1.9)
<b>Nationality</b>			
Chilean	4,860	96.5	(95.9–97.0)
Other	177	3.5	(3.0–4.1)
<b>Indigenous ethnicity</b>			
Aimara	6	0.12	(0.1–0.3)
Atacameño	2	0.04	(0.0–0.2)
Collas	1	0.02	(0.0–0.1)
Diaguita	5	0.10	(0.0–0.2)
Mapuche	73	1.51	(1.2–1.9)
Quechua	1	0.02	(0.0–0.1)
Easter islander	1	0.02	(0.0–0.1)
Yamana	2	0.04	(0.0–0.2)
Total	91	1.9	(1.5–2.3)
<b>Occupational status</b>			
Studying only	4,224	87.5	(86.5–88.4)
Studying and part-time job	541	11.2	(10.3–12.1)
Studying and full-time job	62	1.3	(1.0–1.6)
<b>History of chronic illness</b>			
Yes	858	19.4	(18.3–20.6)
No	3,567	80.6	(79.4–81.7)
<b>History of mental health disorders</b>			
Depression	1,237	27.9	(26.6–29.3)
Bipolar disorder	135	3.1	(2.6–3.6)
Panic disorders	993	22.4	(21.2–23.7)
Anxiety disorders	1,568	35.4	(34.0–36.8)
Eating disorders	448	10.1	(9.3–11.0)
ADHD	1,447	32.7	(31.3–34.0)
<b>History of mental health treatment</b>			
Psychotherapy	2,013	45.4	(44.0–46.9)
Pharmacologic	1,580	35.7	(34.3–37.1)
<b>Physical activity during the week</b>			
$\geq 150$ min	1,932	43.7	(42.3–45.2)
$\leq 149$ min	2,486	56.3	(54.8–57.7)
<b>Sexual orientation</b>			
Heterosexual	3,694	88.8	(87.8–89.7)
Homosexual	71	1.7	(1.5–2.1)
Bisexual	214	5.1	(4.5–5.9)
Unsure	157	3.8	(3.2–4.4)
Other	23	0.6	(0.4–0.8)
<b>Offspring</b>			
With children	68	1.4	(1.1–1.7)
No children	4,969	98.6	(98.3–98.9)

(Continued)

TABLE 1 | Continued

Personal variables	<i>n</i>	% or mean	(95% CI) or (SD)
<b>Number of sex partners in the last year</b>			
None	1,697	40.8	(39.3–42.3)
1 or 2	2,274	54.7	(53.2–56.2)
3 or more	188	4.5	(3.9–5.2)
<b>Civil status</b>			
Single	4,964	98.6	(98.2–98.8)
Married	61	1.2	(0.9–1.6)
Civil union agreement	7	0.1	(0.1–0.3)
Divorced	4	0.1	(0.0–0.2)
Widowed	1	0.0	(0.0–0.1)

*n*, Number of participants; *CI*, Confidence Interval; *SD*, Standard Deviation.

reported that they had dysfunctional families according to the APGAR (28.9%) (see **Table 3**).

For most students, their parents paid for their education (89.2%). The mean commuting time was 52.1 min (*SD* = 35.9), and 17.8% of students took more than 88 min from home to the university. A 35.5% of students reported having had failed a subject. A third of students had felt to be excluded from social gatherings in the university, and 9.5% had experienced psychological victimization. The lowest score on the psychological sense of university belonging was in Year 1 (85.6, *SD* = 0.4) and went up the following years but with no special difference between Year 2 and Year 5 or more. A 15.4% of students had a score higher than 1SD over average on the psychological sense of belonging (see **Table 4**).

Regarding SARS-CoV-2 related variables, only 3.0% of students contracted SARS-CoV-2, and 29.5% of students reported that a family relative contracted SARS-CoV-2. Students had a higher sense of fear of having a friend or family member contracting SARS-CoV-2 than themselves. During lockdowns, most students lived with family, friends or roommates, 83.6% kept in touch with people, 78.5% had practiced physical exercise, 76.6% had been involved in recreational activities, 83.6% kept a daily routine, and 47.7% meditated or prayed (see **Table 5**).

## Mental Health Problems

Depression symptoms were reported in 37.1% of students, and among females reached 38.7%, higher than in males (33.2%). Anxiety symptoms were reported in 37.9% of students (females, 42.5%; males, 26.9%). Stress symptoms were reported in 54.6% of students (females, 58.5%; males, 45.1%). Insomnia was reported in 32.5% of students (females, 33.9%; males, 29.2%). Suicide risk was reported in 20.4% of students, higher among females (20.9%) than in males (19.2%) (see **Table 6**).

## Associations

The univariable and multivariable models by domain are presented in the **Supplementary Material**. The final multivariate model is presented in **Table 7**.

In the personal domain, females were more likely of suffering anxiety (OR 1.54; 1.28–1.85 95% CI) and stress symptoms (OR

1.39; 1.17–1.65 95% CI). Higher age reduced the odds for all outcomes. Having a history of chronic illness increased the odds for anxiety (OR 1.41; 1.17–1.69 95% CI) and insomnia (OR 1.20; 1.00–1.43 95% CI). Regarding previous diagnoses of mental health disorders, there was a positive association with several outcomes (see **Table 7** for details). Regarding sexual orientation, homosexuals, bisexuals, and those students who reported to be unsure about their sexuality had higher odds of suicide risk. The consumption of different substances increased the odds of several outcomes, especially anxiety and stress (see **Table 7** for details). On the other hand, last month alcohol use decreased the odds of depressive (OR 0.84; 0.72–0.98 95% CI) and suicide risk (OR 0.73; 0.61–0.89 95% CI).

In the family domain, family history of suicide increased the odds of suicide risk (OR 1.37; 1.06–1.78 95% CI), and family history of any psychiatric disorder increased the odds of anxiety symptoms (OR 1.22; 1.03–1.43 95% CI). Additionally, students who reported having a dysfunctional family were less likely to report symptoms consistent with each of the mental health outcomes. In the university domain, students who were in the 5th or higher academic year were less likely of suffering depressive symptoms (OR 0.70; 0.51–0.97 95% CI). In addition, students who had to pay for college by themselves were more likely of suffering anxiety symptoms (OR 2.06; 1.40–3.05 95% CI), stress (OR 2.07; 1.39–3.08 95% CI), and insomnia (OR 2.18; 1.58–3.02 95% CI). Students who take longer time to get the university were more likely to have depressive (OR 1.24; 1.02–1.51 95% CI) and anxiety symptoms (OR 1.27; 1.04–1.55 95% CI) and suicide risk (OR 1.41; 1.13–1.76 95% CI). Students who had psychological experiences of abuse at college had higher odds of stress (OR 1.70; 1.28–2.27 95% CI), students who had exclusion experiences at university had higher odds for depressive (OR 1.44; 1.21–1.71 95% CI) and anxiety symptoms (OR 1.48; 1.24–1.77 95% CI), stress (OR 1.50; 1.26–1.78 95% CI), and suicide risk (OR 1.47; 1.21–1.79 95% CI), and students who had teasing experiences had higher odds for anxiety symptoms (OR 1.36; 1.06–1.76 95% CI). Finally, students with a higher sense of university belonging were less likely to report symptoms consistent with each of the mental health outcomes.

In the case of pandemic domain variables, the higher the fear of contracting SARS-CoV-2 by students themselves or others, the greater the odds for depressive and anxiety symptoms, stress, and insomnia. Students who were involved in recreational activities during lockdowns decreased the odds of depressive symptoms and stress. Finally, students who kept a routine during lockdowns decreased the odds of depressive and anxiety symptoms, stress, and insomnia (see **Table 7**).

## DISCUSSION

This is one of the first studies exploring mental health problems and their associated factors during the SARS-CoV-2 pandemic in Latin America. Mental health problems such as depression, anxiety, insomnia, and substance use are high among undergraduate students for all years of their careers. We also found a high prevalence of suicide risk (20.4%). A large

**TABLE 2 |** Substance use prevalence.

Substance use time period	Class year	Total		Females		Males	
		<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)
Lifetime tobacco use	1st	623	62.2 (59.2–65.2)	463	62.8 (59.3–66.2)	160	60.6 (54.6–66.3)
	2nd	525	67.4 (64.0–70.6)	376	67.6 (63.6–71.4)	149	66.8 (60.4–72.7)
	3rd	588	68.1 (64.9–71.2)	421	67.4 (63.6–70.9)	167	70.2 (64.1–75.7)
	4th	560	69.1 (65.9–72.2)	404	70.0 (66.0–73.5)	156	67.2 (60.9–73.0)
	5th +	528	71.3 (67.9–74.4)	331	70.0 (65.7–73.9)	197	73.5 (67.9–78.4)
	Total	2,824	67.3 (65.9–68.7)	1,995	67.2 (65.5–68.9)	829	67.7 (65.0–70.2)
Last month tobacco use	1st	180	18.0 (15.7–20.5)	127	17.2 (14.7–20.1)	53	20.1 (15.7–25.4)
	2nd	160	20.5 (17.8–23.5)	112	20.1 (17.0–23.7)	48	21.5 (16.6–27.4)
	3rd	198	22.9 (20.3–25.9)	142	22.7 (19.6–26.2)	56	23.5 (18.6–29.4)
	4th	173	21.4 (18.7–24.3)	124	21.5 (18.3–25.0)	49	21.1 (16.3–26.9)
	5th +	138	18.6 (16.0–21.6)	82	17.3 (14.2–21.0)	56	20.9 (16.4–26.2)
	Total	849	20.2 (19.1–21.5)	587	19.8 (18.4–21.2)	262	21.4 (19.2–23.8)
Last week tobacco use	1st	145	14.5 (12.4–16.8)	102	13.8 (11.5–16.5)	43	16.3 (12.3–21.3)
	2nd	125	16.0 (13.6–18.8)	94	16.9 (14.0–20.3)	31	13.9 (9.9–19.1)
	3rd	170	19.7 (17.2–22.4)	123	19.7 (16.7–23.0)	47	19.7 (15.2–25.3)
	4th	151	18.6 (16.1–21.5)	108	18.7 (15.7–22.1)	43	18.5 (14.0–24.1)
	5th +	114	15.4 (13.0–18.2)	65	13.7 (10.9–17.2)	49	18.3 (14.1–23.4)
	Total	705	16.8 (15.7–18.0)	492	16.6 (15.3–18.0)	213	17.4 (15.4–19.6)
Risk of tobacco use disorder	1st	6	0.5 (0.2–1.0)	5	0.5 (0.2–1.3)	1	0.3 (0.0–2.0)
	2nd	6	0.6 (0.2–1.4)	4	0.6 (0.2–1.6)	2	0.7 (0.2–2.8)
	3rd	15	1.5 (0.9–2.5)	9	1.3 (0.7–2.4)	6	2.2 (1.0–4.7)
	4th	10	1.1 (0.6–2.0)	7	1.0 (0.5–2.2)	3	1.1 (0.4–3.5)
	5th +	10	1.1 (0.6–2.1)	7	1.3 (0.6–2.6)	3	0.9 (0.3–2.9)
	Total	47	0.9 (0.7–1.2)	32	0.9 (0.6–1.3)	15	1.0 (0.6–1.7)
Lifetime vaping use	1st	384	38.4 (35.4–41.4)	256	34.7 (31.4–38.2)	128	48.5 (42.5–54.5)
	2nd	271	34.8 (31.5–38.2)	183	32.9 (29.1–36.9)	88	39.5 (33.3–46.0)
	3rd	299	34.6 (31.5–37.9)	189	30.2 (26.8–34.0)	110	46.2 (40.0–52.6)
	4th	277	34.2 (31.0–37.5)	182	31.5 (27.8–35.4)	95	40.9 (34.8–47.4)
	5th +	267	36.0 (32.7–39.6)	137	29.0 (25.1–33.2)	130	48.5 (42.6–54.5)
	Total	1498	35.7 (34.3–37.2)	947	31.9 (30.2–33.6)	551	45.0 (42.2–47.8)
Last month vaping use	1st	28	2.8 (1.9–4.0)	18	2.4 (1.5–3.8)	10	3.8 (2.0–6.9)
	2nd	19	2.4 (1.6–3.8)	10	1.8 (1.0–3.3)	9	4.0 (2.1–7.6)
	3rd	16	1.9 (1.1–3.0)	8	1.3 (0.6–2.5)	8	3.4 (1.7–6.6)
	4th	16	2.0 (1.2–3.2)	9	1.6 (0.8–3.0)	7	3.0 (1.4–6.2)
	5th +	17	2.3 (1.4–3.7)	7	1.5 (0.7–3.1)	10	3.7 (2.0–6.8)
	Total	96	2.3 (1.9–2.8)	52	1.8 (1.3–2.3)	44	3.6 (2.7–4.8)
Last week vaping use	1st	17	1.7 (1.1–2.7)	12	1.6 (0.9–2.8)	5	1.9 (0.8–4.5)
	2nd	15	1.9 (1.2–3.2)	8	1.4 (0.7–2.9)	7	3.1 (1.5–6.4)
	3rd	14	1.6 (1.0–2.7)	7	1.1 (0.5–2.3)	7	2.9 (1.4–6.1)
	4th	10	1.2 (0.7–2.3)	4	0.7 (0.3–1.8)	6	2.6 (1.2–5.6)
	5th +	9	1.2 (0.6–2.3)	2	0.4 (0.1–1.7)	7	2.6 (1.2–5.4)
	Total	65	1.5 (1.2–2.0)	33	1.1 (0.8–1.6)	32	2.6 (1.9–3.7)
Lifetime alcohol use	1st	753	75.1 (72.4–77.7)	540	73.2 (69.9–76.2)	213	80.7 (75.5–85.0)
	2nd	612	78.3 (75.2–81.0)	440	78.7 (75.1–81.9)	172	77.1 (71.2–82.2)
	3rd	722	83.6 (80.9–85.9)	509	81.3 (78.1–84.2)	213	89.5 (84.9–92.8)
	4th	706	87.2 (84.7–89.3)	497	86.0 (82.9–88.6)	209	90.1 (85.5–93.3)
	5th +	641	86.4 (83.7–88.7)	400	84.6 (81.0–87.6)	241	89.6 (85.3–92.7)
	Total	3434	81.8 (80.6–82.9)	2386	80.2 (78.8–81.6)	1048	85.5 (83.4–87.3)
Last month alcohol use	1st	478	47.7 (44.6–50.8)	323	43.8 (40.2–47.4)	155	58.7 (52.7–64.5)
	2nd	392	50.1 (46.6–53.7)	273	48.8 (44.7–53.0)	119	53.4 (46.8–59.8)

(Continued)



TABLE 2 | Continued

Substance use time period	Class year	Total		Females		Males	
		<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)
Last week alcohol use	3rd	478	55.3 (52.0–58.6)	328	52.4 (48.5–56.3)	150	63.0 (56.7–68.9)
	4th	489	60.4 (57.0–63.7)	335	58.0 (53.9–61.9)	154	66.4 (60.1–72.2)
	5th +	458	61.7 (58.2–65.2)	260	55.0 (50.5–59.4)	198	73.6 (68.0–78.5)
	Total	2295	54.6 (53.1–56.1)	1519	51.1 (49.3–52.9)	776	63.3 (60.6–66.0)
	1st	134	13.4 (11.4–15.6)	73	9.9 (7.9–12.3)	61	23.1 (18.4–28.6)
	2nd	114	14.6 (12.3–17.2)	71	12.7 (10.2–15.7)	43	19.3 (14.6–25.0)
	3rd	147	17.0 (14.7–19.7)	82	13.1 (10.7–16.0)	65	27.3 (22.0–33.3)
Risk of alcohol use disorder	4th	152	18.8 (16.2–21.6)	89	15.4 (12.7–18.6)	63	27.2 (21.8–33.2)
	5th +	149	20.1 (17.4–23.1)	55	11.6 (9.0–14.8)	94	34.9 (29.5–40.8)
	Total	696	16.6 (15.5–17.7)	370	12.4 (11.3–13.7)	326	26.6 (24.2–29.1)
	1st	171	13.5 (11.7–15.5)	109	11.8 (10.0–14.1)	62	17.9 (14.2–22.3)
	2nd	166	17.3 (15.0–19.8)	119	17.5 (14.8–20.6)	47	16.7 (12.7–21.5)
	3rd	216	21.8 (19.3–24.5)	131	18.3 (15.7–21.3)	85	30.7 (25.5–36.4)
	4th	214	22.9 (20.3–25.7)	137	20.4 (17.5–23.6)	77	29.1 (23.9–34.8)
Lifetime cannabis use	5th +	196	22.3 (19.6–25.1)	106	19.0 (15.9–22.4)	90	28.0 (23.4–33.2)
	Total	963	18.1 (17.0–19.1)	602	17.0 (15.8–18.2)	361	24.2 (22.1–26.5)
	1st	417	41.7 (38.6–44.7)	291	39.5 (36.0–43.1)	126	47.7 (41.8–53.8)
	2nd	379	48.5 (45.0–52.0)	265	47.7 (43.5–51.8)	113	50.7 (44.1–57.2)
	3rd	510	59.1 (55.8–62.3)	346	55.4 (51.4–59.2)	164	68.9 (62.7–74.5)
	4th	512	63.2 (59.8–66.5)	350	60.6 (56.5–64.5)	162	69.8 (63.6–75.4)
	5th +	514	69.4 (65.9–72.6)	300	63.4 (59.0–67.6)	214	79.9 (74.6–84.2)
Last month cannabis use	Total	2331	55.6 (54.1–57.1)	1552	52.3 (50.5–54.1)	779	63.6 (60.9–66.2)
	1st	44	4.4 (3.3–5.9)	22	3.0 (1.9–4.5)	22	8.3 (5.5–12.3)
	2nd	53	6.8 (5.2–8.8)	30	5.4 (3.8–7.6)	23	10.3 (6.9–15.1)
	3rd	72	8.3 (6.7–10.4)	37	5.9 (4.3–8.1)	35	14.7 (10.7–19.8)
	4th	74	9.1 (7.3–11.3)	47	8.1 (6.2–10.7)	27	11.6 (8.1–16.5)
	5th +	104	14.0 (11.7–16.7)	45	9.5 (7.2–12.5)	59	22.0 (17.4–27.4)
	Total	347	8.3 (7.5–9.1)	181	6.1 (5.3–7.0)	166	13.6 (11.7–15.6)
Last week cannabis use	1st	23	2.3 (1.5–3.4)	7	0.9 (0.5–2.0)	16	6.1 (3.7–9.7)
	2nd	28	3.6 (2.5–5.2)	14	2.5 (1.5–4.2)	14	6.3 (3.7–10.3)
	3rd	52	6.0 (4.6–7.8)	26	4.2 (2.8–6.0)	26	10.9 (7.5–15.6)
	4th	41	5.1 (3.7–6.8)	20	3.5 (2.2–5.3)	21	9.1 (6.0–13.5)
	5th +	63	8.5 (6.7–10.7)	24	5.1 (3.4–7.5)	39	14.6 (10.8–19.3)
	Total	207	4.9 (4.3–5.6)	91	3.1 (2.5–3.8)	116	9.5 (8.0–11.2)
	1st	5	0.4 (0.2–0.9)	1	0.1 (0.0–0.8)	4	1.2 (0.4–3.0)
Risk of cannabis use disorder	2nd	3	0.3 (0.1–1.0)	0	–	3	1.1 (0.3–3.3)
	3rd	7	0.7 (0.3–1.5)	2	0.3 (0.1–1.1)	5	1.8 (0.8–4.3)
	4th	5	0.5 (0.2–1.3)	1	0.1 (0.0–1.1)	4	1.5 (0.6–4.0)
	5th +	7	0.8 (0.4–1.7)	2	0.4 (0.1–1.4)	5	1.6 (0.6–3.7)
	Total	27	0.5 (0.3–0.7)	6	0.2 (0.1–0.4)	21	1.4 (0.9–2.2)
	1st	205	20.5 (18.1–23.1)	159	21.6 (18.8–24.7)	46	17.4 (13.3–22.5)
	2nd	195	25.0 (22.1–28.2)	152	27.3 (23.8–31.2)	43	19.3 (14.6–25.0)
Lifetime tranquilizers use	3rd	232	26.9 (24.0–29.9)	182	29.1 (25.7–32.8)	50	21.0 (16.3–26.7)
	4th	186	23.0 (20.2–26.0)	148	25.6 (22.2–29.3)	38	16.4 (12.2–21.7)
	5th +	227	30.6 (27.4–34.1)	161	34.1 (29.9–38.4)	66	24.6 (19.8–30.1)
	Total	1045	24.9 (23.6–26.3)	802	27.0 (25.4–28.6)	243	19.8 (17.7–22.2)
	1st	76	7.6 (6.1–9.4)	56	7.6 (5.9–9.7)	20	7.6 (4.9–11.5)
	2nd	84	10.8 (8.8–13.2)	64	11.5 (9.1–14.4)	20	9.0 (5.9–13.5)
	3rd	81	9.4 (7.6–11.5)	62	9.9 (7.8–12.5)	19	8.0 (5.1–12.2)
Last month tranquilizers use	4th	59	7.3 (5.7–9.3)	52	9.0 (6.9–11.6)	7	3.0 (1.4–6.2)

(Continued)

TABLE 2 | Continued

Substance use time period	Class year	Total		Females		Males	
		<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)
Last week tranquilizers use	5th +	63	8.5 (6.7–10.7)	48	10.1 (7.7–13.2)	15	5.6 (3.4–9.1)
	Total	363	8.7 (7.8–9.5)	282	9.5 (8.5–10.6)	81	6.6 (5.3–8.1)
	1st	53	5.3 (4.1–6.9)	42	5.7 (4.2–7.6)	11	4.2 (2.3–7.4)
	2nd	56	7.2 (5.6–9.2)	45	8.1 (6.1–10.7)	11	4.9 (2.7–8.7)
	3rd	61	7.1 (5.5–9.0)	48	7.7 (5.8–10.0)	13	5.5 (3.2–9.2)
	4th	42	5.2 (3.9–6.9)	38	6.6 (4.8–8.9)	4	1.7 (0.6–4.5)
Risk of tranquilizers use disorder	5th +	47	6.3 (4.8–8.3)	37	7.8 (5.7–10.6)	10	3.7 (2.0–6.8)
	Total	259	6.2 (5.5–6.9)	210	7.1 (6.2–8.1)	49	4.0 (3.0–5.3)
	1st	1	0.1 (0.0–0.6)	1	0.1 (0.0–0.8)	0	–
	2nd	9	0.9 (0.5–1.8)	6	0.9 (0.4–2.0)	3	1.1 (0.3–3.3)
	3rd	10	1.0 (0.5–1.9)	6	0.8 (0.4–1.9)	4	1.4 (0.5–3.8)
	4th	4	0.4 (0.2–1.1)	2	0.3 (0.1–1.2)	2	0.8 (0.2–3.0)
Lifetime nootropics use	5th +	4	0.5 (0.2–1.2)	4	0.7 (0.3–1.9)	0	–
	Total	28	0.5 (0.4–0.8)	19	0.5 (0.3–0.8)	9	0.6 (0.3–1.2)
	1st	257	25.7 (23.1–28.5)	182	24.7 (21.7–27.9)	75	28.4 (23.3–34.2)
	2nd	234	30.0 (26.9–33.4)	168	30.2 (26.5–34.2)	66	29.6 (24.0–35.9)
	3rd	279	32.3 (29.3–35.5)	190	30.4 (26.9–34.1)	89	37.4 (31.5–43.7)
	4th	262	32.4 (29.2–35.7)	185	32.0 (28.3–35.9)	77	33.2 (27.4–39.5)
Last month nootropics use	5th +	254	34.3 (29.2–37.8)	150	31.7 (27.7–36.1)	104	31.7 (27.7–36.1)
	Total	1286	30.7 (29.3–32.1)	875	29.5 (27.9–31.1)	411	33.6 (31.0–36.3)
	1st	79	7.9 (6.4–9.7)	58	7.9 (6.1–10.0)	21	8.0 (5.2–11.9)
	2nd	88	11.3 (9.3–13.7)	67	12.1 (9.6–15.0)	21	9.4 (6.2–14.0)
	3rd	78	9.0 (7.3–11.1)	53	8.5 (6.5–10.9)	25	10.5 (7.2–15.1)
	4th	66	8.1 (6.5–10.2)	50	8.7 (6.6–11.2)	16	6.9 (4.3–11.0)
Last week nootropics use	5th +	60	8.1 (6.3–10.3)	38	8.0 (5.9–10.9)	22	8.2 (5.5–12.2)
	Total	371	8.8 (8.0–9.7)	266	9.0 (8.0–10.0)	105	8.6 (7.1–10.3)
	1st	68	6.8 (5.4–8.5)	50	6.8 (5.2–8.8)	18	6.8 (4.3–10.6)
	2nd	72	9.2 (7.4–11.5)	55	9.9 (7.7–12.7)	17	7.6 (4.8–11.9)
	3rd	61	7.1 (5.5–9.0)	40	6.4 (4.7–8.6)	21	8.8 (5.8–13.2)
	4th	54	6.7 (5.1–8.6)	41	7.1 (5.3–9.5)	13	5.6 (3.3–9.4)
Risk of nootropics use disorder	5th +	51	6.9 (5.3–8.9)	32	6.8 (4.8–9.4)	19	7.1 (4.6–10.9)
	Total	306	7.3 (6.5–8.1)	218	7.3 (6.5–8.3)	88	7.2 (5.9–8.8)
	1st	7	0.6 (0.3–1.2)	6	0.7 (0.3–1.4)	1	0.3 (0.0–2.0)
	2nd	9	0.9 (0.5–1.8)	8	1.2 (0.6–2.3)	1	0.4 (0.0–2.5)
	3rd	5	0.5 (0.2–1.2)	1	0.1 (0.0–1.0)	4	1.4 (0.5–3.8)
	4th	5	0.5 (0.2–1.3)	4	0.6 (0.2–1.6)	1	0.4 (0.1–2.6)
Risk of vaping use disorder	5th +	5	0.6 (0.2–1.4)	2	0.4 (0.1–1.4)	3	0.9 (0.3–2.9)
	Total	31	0.6 (0.4–0.8)	21	0.6 (0.4–0.9)	10	0.7 (0.4–1.2)

Risk of vaping use disorder was not included because it had no observations; –, no observations in the category; *n*, number of participants; CI, Confidence Interval.

proportion of students had a history of mental health problems. At the moment of the survey, 41.6% of this population was receiving psychological or psychiatric support. Finally, family history of psychiatric disorders (39.1%) and suicide (11.4%) were frequent among students. During the pandemic, very few students or their families had SARS-CoV-2. However, many students felt fear that themselves or any other family member or friend may contract SARS-CoV-2.

Few studies have explored the prevalence of mental health issues among undergraduate students in a SARS-CoV-2 context.

A recent systematic review and meta-analysis included 16 articles exploring the prevalence of anxiety and depressive symptoms using valid and reliable instruments among university students during the pandemic. The pooled prevalence of anxiety symptoms was 31% (95% CI: 23–39%), and the pooled prevalence of depressive symptoms was 34%; both findings were similar to the ones found in our study (8). A large study conducted in France, surveying 69,054 students, found that suicidal thoughts prevalence was 11.4% (7,891 students), high level of perceived stress affected 24.7% (17,093 students), severe depression at

**TABLE 3 |** Family variables.

Family variables	<i>n</i>	%	(95% CI)
<b>Mother's educational level</b>			
Incomplete elementary school	14	0.3	(0.2–0.5)
Complete elementary school and incomplete high school	54	1.1	(0.9–1.5)
Complete high school and incomplete university	1,182	24.5	(23.3–25.7)
Complete university and incomplete postgraduate	2,691	55.8	(54.3–57.1)
Complete postgraduate	858	17.8	(16.7–18.9)
<b>Father's educational level</b>			
Incomplete elementary school	9	0.2	(0.1–0.4)
Complete elementary school and incomplete high school	56	1.2	(0.9–1.5)
Complete high school and incomplete university	934	19.4	(18.3–20.5)
Complete university and incomplete postgraduate	2,207	45.7	(44.3–47.1)
Complete postgraduate	1,522	31.5	(30.2–32.9)
<b>Family history of mental health problems</b>			
Psychiatric disorders	1,731	39.1	(37.7–40.6)
Suicide	504	11.4	(10.5–12.4)
Alcohol abuse or dependence	1,300	29.4	(28.1–30.7)
Drug abuse or dependence	510	11.5	(10.6–12.5)
<b>Family functioning (APGAR)</b>			
Highly functional	3,116	71.2	(69.8–72.4)
Moderate dysfunctional	798	18.2	(17.1–19.4)
Severe dysfunctional	467	10.7	(9.8–11.6)

*n*, Number of participants; CI, Confidence Interval.

16.1% (11,133 students), and high level of anxiety at 27.5% (18,970 students) (18). In the United States, Wang et al. surveyed 2,031 students using the PHQ-9 and the GAD-7 and found a prevalence of 48.14% for depression, 38.48% for anxiety, and 18.04% for suicidal thoughts (9). Another study among 517 undergraduates in Spain found a high risk of suicide in 22.8% of students (43). These results are similar compared to our study. However, in Japan (44), the results seem to be different. For instance, depression was 11.7% (similar both in men and women), and suicidal ideation was 6.7%, also similar in men and women.

Even though our results are similar to other studies during the pandemic, the prevalence of mental health symptoms among

**TABLE 4 |** University variables.

University variables	<i>n</i>	%	(95% CI)
<b>Academic year</b>			
1st	1,268	25.2	(24.0–26.4)
2nd	961	19.1	(18.0–20.2)
3rd	992	19.7	(18.6–20.8)
4th	936	18.6	(17.5–19.7)
5th or higher	880	17.5	(16.4–18.5)
<b>Source of financing</b>			
Funding from parents	4,307	89.2	(88.3–90.1)
Credit/loan	1,623	33.6	(32.3–35.0)
Scholarship	1,539	31.9	(30.6–33.2)
Self-funded	250	5.2	(4.6–5.8)
Other means	224	4.6	(4.1–5.3)
<b>Commuting time university</b>			
>1SD	861	17.8	(16.8–18.9)
±1SD	3,317	68.7	(67.4–70.0)
<-1SD	649	13.5	(12.5–14.4)
<b>History of failing subjects</b>			
Yes	1,787	35.5	(34.2–36.8)
No	3,250	64.5	(63.2–65.8)
<b>Violence victimization</b>			
Physical	33	0.7	(0.5–1.0)
Psychological	422	9.5	(8.6–10.4)
Exclusion	1,318	29.6	(28.2–30.9)
Teasing	502	11.3	(10.4–12.2)
Ridiculization	514	11.5	(10.6–12.5)
<b>Psychological sense of university belonging</b>			
>1SD	693	15.4	(14.4–16.5)
±1SD	3,054	67.8	(66.5–69.2)
<-1SD	755	16.8	(15.7–17.9)

*Students may have more than one source of financing; n*, Number of participants; *CI*, Confidence Interval.

Chilean undergraduates seems to have increased in recent years. No single cause can be attributed to this increase, but we can mention some potential contributing factors. In recent years, Chile has significantly reduced its economic growth (45); has experienced an unprecedented social outbreak (46), just before the pandemic; and has experienced the pandemic with the health restrictions that have accompanied it, such as the lockdowns (47). These events have been associated with reduced economic expectations, low job creation, and unemployment, especially for young people (48), all which have a clear detrimental impact on the population's mental health (47, 49–51). The context of mental health care where these events have been unfolded needs to be also considered. For instance, the treatment gap for mental disorders is high in Chile, reaching 38.5% among adults, and one-fifth of children or adolescents with a diagnosis receive any mental health service (52). Additionally, there is still an important stigma related to seeking health for mental problems (53–55). Nevertheless, a definitive explanation and the relative

**TABLE 5 |** SARS-CoV-2 experiences variables.

<b>SARS-CoV-2 experiences</b>	<b><i>n</i></b>	<b>%</b>	<b>(95% CI)</b>
History of personal contagion of SARS-CoV-2	133	3.0	(2.6–3.6)
History of family contagion of SARS-CoV-2	1,289	29.5	(28.1–30.8)
<b>Fear of contracting SARS-CoV-2 by the students</b>			
Not at all	358	8.2	(7.4–9.0)
Slightly	840	19.2	(18.1–20.4)
Somewhat	1,510	34.5	(33.1–35.9)
Moderately	1,105	25.3	(24.0–26.6)
Extremely	563	12.9	(11.9–13.9)
<b>Fear of others contracting SARS-CoV-2</b>			
Not at all	46	1.1	(0.8–1.4)
Slightly	132	3.0	(2.5–3.6)
Somewhat	623	14.2	(13.2–15.3)
Moderately	1,493	34.1	(32.7–35.5)
Extremely	2,082	47.6	(46.1–49.1)
<b>Living condition during pandemic lockdowns</b>			
Living independently	80	1.8	(1.5–2.3)
Living with family, friends or roommates	4,296	98.2	(97.7–98.5)
<b>Frequency of social contact during lockdowns</b>			
Never	711	16.4	(15.3–17.5)
1–2 days a week	526	12.1	(11.2–13.1)
3–4 days a week	998	23.0	(21.8–24.3)
5–6 days a week	1,045	24.1	(22.8–25.4)
Everyday	1,061	24.4	(23.2–25.7)
<b>Frequency of physical exercising during lockdowns</b>			
Never	934	21.5	(20.3–22.8)
1–2 days a week	1,217	28.0	(26.7–29.4)
3–4 days a week	1,253	28.9	(27.5–30.2)
5–6 days a week	791	18.2	(17.1–19.4)
Everyday	146	3.4	(2.9–3.9)
<b>Frequency of recreational activities during lockdowns</b>			
Never	1,015	23.4	(22.1–24.7)
1–2 days a week	1,740	40.1	(38.6–41.5)
3–4 days a week	896	20.6	(19.5–21.9)
5–6 days a week	341	7.9	(7.1–8.7)
Everyday	349	8.0	(7.3–8.9)
<b>Keeping a routine during lockdowns</b>			
Never	711	16.4	(15.3–17.5)
1–2 days a week	526	12.1	(11.2–13.1)
3–4 days a week	998	23.0	(21.8–24.3)
5–6 days a week	1,045	24.1	(22.8–25.4)
Everyday	1,061	24.4	(23.2–25.7)
<b>Frequency of meditation or praying during lockdowns</b>			
Never	2,269	52.3	(50.8–53.8)
1–2 days a week	1,146	26.4	(25.1–27.7)
3–4 days a week	387	8.9	(8.1–9.8)
5–6 days a week	181	4.2	(3.6–4.8)
Everyday	358	8.3	(7.5–9.1)

*n*, Number of participants; *CI*, Confidence Interval.

importance of the events presented above cannot be determined with the information available, and further research is needed.

Among the most urgent aspects found in our study was the high prevalence of suicide risk, which seem to be in the higher end range of the prevalence worldwide. Regarding suicide ideation, the global prevalence of suicide ideation has been stated in 10.6% among college students during pre-pandemic (4); however, and as we previously mentioned, some studies during the pandemic have found higher figures (9, 43). Even though the figures of suicide seem to be stable and even lower in the pandemic compared with the pre-pandemic times (56), our results show that undergraduate students have increased the psychological suffering during pandemic which stress the need for preventive measures incorporating the modifiable associated factors found in our study.

On the one hand, several factors were associated with an increased risk of having mental health issues. For example, being female, personal and family history of mental health disorders, tranquilizers use, having dysfunctional families, self-funding university, taking longer than average to get to the university campus, having exclusion experiences at university, and fear of themselves contracting SARS-CoV-2. These results are shared by other studies. For example, being female was also considered a risk factor for stress and anxiety (14, 18). Regarding family functioning, Shao et al., using the same instrument used in our study (57) found that the higher the score on family functionality, the better mental health, and that perceived good family support was a protective factor against poor mental health (58). Family functioning was negatively affected during the pandemic, especially due to changes in workload by parents, economic problems, changes in the daily routine due to lockdowns, and reduced social contact and mobility. Therefore, it was expected to be associated with mental health issues. Additionally, fear of contracting SARS-CoV-2 was also found in other studies. For instance, in Ecuador, fear of Covid-19 was a predictor of depression among university students, and another study found that increased levels of anxiety were associated with having a family member diagnosed with COVID-19 (59). Some studies in the general population have also reported severe stress responses such as post-traumatic stress disorder as a consequence of being exposed to a family affected with Covid-19 (60).

Regarding university experiences, victimization, such as social exclusion, was an important associated factor. In a study cross-cultural study, it was found that bullying victimization was associated with higher scores on DASS (61). On the other hand, to the best of our knowledge, our study is the only one that has explored the effect of the sense of belonging and its relationship with mental health during the pandemic. We found that a higher psychological sense of university was associated with reduced odds for all mental health outcomes. Pre-pandemic studies have shown that students' engagement in university life and relationships with peers and faculty members is fundamental for their wellbeing (62). Another study (63) showed that a sense of university belonging influenced mental health and academic outcomes and reduced depression, anxiety and stress symptoms among undergraduates (64). Potential interventions promoting university involvement and a sense of belonging may help to



**TABLE 6 |** Psychological symptoms (DASS-21), insomnia, and suicide risk by sex and grade.

Variable		Total		Females		Males	
	Grade	<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)	<i>n</i>	% (95% CI)
Depression	1st	395	39.1 (36.1–42.1)	303	40.7 (37.2–44.2)	92	34.6 (29.1–40.1)
	2nd	323	41.1 (37.7–44.6)	254	45.3 (41.2–49.4)	69	30.7 (25.0–37.0)
	3rd	337	38.6 (35.5–41.2)	252	39.8 (36.1–43.7)	85	35.6 (29.8–41.8)
	4th	274	33.6 (30.4–36.9)	195	33.6 (29.9–37.6)	79	33.5 (27.7–39.7)
	5th +	240	32.0 (28.8–35.5)	154	32.3 (28.2–36.6)	86	31.6 (26.4–37.4)
	Total	1,569	37.1 (35.6–38.5)	1,158	38.7 (36.9–40.4)	411	33.2 (30.6–35.9)
	Anxiety	1st	399	39.5 (36.5–42.5)	333	44.7 (41.2–48.3)	66
2nd		324	41.2 (37.8–44.7)	258	46.0 (41.9–50.1)	66	29.3 (23.8–35.6)
3rd		341	39.1 (35.9–42.4)	262	41.4 (37.6–45.3)	79	33.1 (27.4–39.3)
4th		301	36.9 (33.6–40.3)	245	42.2 (38.3–46.3)	56	23.7 (18.7–29.6)
5th +		241	32.2 (28.9–35.6)	175	36.7 (32.5–41.1)	66	24.3 (19.5–29.7)
Total		1,606	37.9 (36.5–39.4)	1,273	42.5 (40.7–44.3)	333	26.9 (24.5–29.4)
Stress		1st	561	55.5 (52.4–58.5)	441	59.2 (55.6–62.7)	120
	2nd	445	56.6 (53.1–60.0)	345	61.5 (57.4–65.4)	100	44.4 (38.1–51.0)
	3rd	480	55.5 (51.7–58.3)	366	57.8 (53.9–61.6)	114	47.7 (41.4–54.0)
	4th	434	53.2 (49.8–56.6)	329	56.7 (52.7–60.7)	105	44.5 (38.3–50.9)
	5th +	390	52.1 (48.5–55.6)	271	56.8 (52.3–61.2)	119	43.8 (38.0–49.7)
	Total	2,310	54.6 (53.1–56.1)	1,752	58.5 (56.7–60.2)	558	45.1 (42.3–47.9)
	Insomnia	1st	330	32.9 (30.0–35.8)	257	34.8 (31.4–38.3)	73
2nd		262	33.4 (30.2–36.8)	194	34.6 (30.8–38.7)	68	30.4 (24.7–36.7)
3rd		300	34.6 (31.5–37.8)	225	35.7 (32.1–39.5)	75	31.5 (25.9–37.7)
4th		261	32.1 (29.0–35.4)	190	32.9 (29.2–36.8)	71	30.3 (24.8–36.5)
5th +		216	29.1 (25.9–32.4)	144	30.4 (26.5–32.3)	72	26.7 (21.7–32.3)
Total		1,369	32.5 (31.1–33.9)	1,010	33.9 (32.2–35.6)	359	29.2 (26.7–31.8)
Suicide Risk		1st	201	20.1 (17.7–22.7)	160	21.7 (18.9–24.8)	41
	2nd	161	20.5 (17.8–23.5)	123	22.0 (18.7–25.6)	38	17.0 (12.6–22.5)
	3rd	196	22.6 (19.9–25.5)	146	23.2 (20.0–26.6)	50	21.0 (16.3–26.7)
	4th	150	18.5 (16.0–21.3)	101	17.5 (14.6–20.8)	49	21.1 (16.3–26.9)
	5th +	149	20.1 (17.3–23.1)	91	19.2 (15.9–23.0)	58	21.6 (17.0–26.9)
	Total	857	20.4 (19.2–21.6)	621	20.9 (19.4–22.3)	236	19.2 (17.1–21.5)

*n*, Number of participants; *CI*, Confidence Interval.

prevent mental health problems among this population and promote greater career satisfaction and success and community involvement in the future (65).

In the present study, we found that having a daily routine during lockdowns (sticking to a daily schedule) was another variable related to positive mental health. Few studies have assessed this association. For instance, one study conducted in a Spanish university (66) found that students who had a routine during the pandemic had a lower risk of mental health problems. Having a routine was one of the most recommended measures to prevent mental health problems at the beginning of the pandemic and quarantine measures proposed by several experts and institutions (67). Our results supported these recommendations.

We found mixed results on the association between substance use and mental health. On the one hand, the consumption of tobacco, cannabis, nootropics, and tranquilizers were associated with some mental health outcomes. These results were also supported by the findings among university students in Brazil (22). Tranquilizer use was associated with most of the mental health outcomes, and to our knowledge, no other study has explored this specific association among undergraduates during the pandemic. We only found one study in Mexico among the general population where they found that tranquilizer use increased the levels of stress and depressive symptomatology (68). On the other hand, we found that alcohol use was associated with a reduced risk for depressive symptoms and

**TABLE 7 |** Final multivariable associations between risk and protective factors and the outcomes depression, anxiety, stress, insomnia, and suicide risk.

Risk and protective factors	Depression	Anxiety	Stress	Insomnia	Suicide risk
	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value
<b>Personal domain</b>					
Sex (ref = Male)					
Female	1.03 (0.86–1.24) 0.741	1.54 (1.28–1.85) <0.001	1.39 (1.17–1.65) <0.001	1.07 (0.90–1.28) 0.414	0.97 (0.78–1.20) 0.784
Age	0.95 (0.91–1.00) 0.034	0.91 (0.86–0.95) <0.001	0.93 (0.90–0.97) <0.001	0.94 (0.91–0.97) <0.001	0.94 (0.90–0.98) 0.004
Occupational status (ref = Studying only)		*0.6812			*0.8191
Studying and break-time job	–	0.93 (0.72–1.20) 0.553	–	–	1.09 (0.82–1.44) 0.564
Studying and full-time job	–	0.73 (0.31–1.74) 0.474	–	–	1.15 (0.51–2.63) 0.733
History of chronic illness (ref = No)					
Yes	–	1.41 (1.17–1.69) <0.001	–	1.20 (1.00–1.43) 0.045	1.17 (0.94–1.45) 0.154
History of mental health disorders					
Depression	1.79 (1.49–2.15) <0.001	1.18 (0.97–1.44) 0.093	1.11 (0.92–1.35) 0.279	–	1.85 (1.50–2.28) <0.001
Bipolar disorder	1.58 (0.99–2.52) 0.053	–	–	–	1.75 (1.13–2.71) 0.013
Panic disorders	1.28 (1.06–1.56) 0.012	2.23 (1.83–2.70) <0.001	1.34 (1.09–1.64) 0.005	1.37 (1.14–1.65) 0.001	–
Anxiety disorders	1.40 (1.18–1.67) <0.001	1.92 (1.60–2.29) <0.001	1.98 (1.66–2.36) <0.001	1.24 (1.05–1.46) 0.011	1.37 (1.12–1.67) 0.002
Eating disorders	1.40 (1.09–1.79) 0.008	1.21 (0.94–1.56) 0.130	1.20 (0.93–1.56) 0.162	1.28 (1.02–1.61) 0.035	–
ADHD	–	–	–	1.33 (1.14–1.55) <0.001	–
History of mental health treatment					
Psychotherapy	–	–	1.16 (0.99–1.36) 0.068	–	1.21 (0.99–1.48) 0.064
Pharmacologic	–	0.84 (0.70–1.02) 0.075	–	–	–
Physical activity during the week (ref = ≤ 149 mins)					
≥ 150 min	0.93 (0.75–1.15) 0.480	0.83 (0.66–1.03) 0.083	0.97 (0.84–1.12) 0.652	1.12 (0.91–1.37) 0.302	0.80 (0.61–1.03) 0.083
Sexual orientation (ref = Heterosexual)					
Homosexual	1.63 (0.90–2.95) 0.106	1.60 (0.89–2.90) 0.119	1.40 (0.77–2.55) 0.274	0.76 (0.43–1.34) 0.344	3.14 (1.77–5.57) <0.001
Bisexual	1.38 (0.99–1.92) 0.061	1.52 (1.09–2.13) 0.014	1.08 (0.76–1.53) 0.677	1.15 (0.84–1.57) 0.376	2.14 (1.53–2.98) <0.001
Unsure	1.58 (1.08–2.31) 0.017	1.44 (0.98–2.12) 0.061	1.38 (0.93–2.07) 0.111	1.04 (0.72–1.50) 0.851	2.45 (1.67–3.59) <0.001
Other	0.65 (0.24–1.75) 0.391	0.84 (0.31–2.31) 0.735	0.42 (0.16–1.10) 0.077	0.55 (0.21–1.44) 0.223	1.74 (0.64–4.71) 0.274
Number of sex breaktners in the last year (ref = none)		*0.1046	*0.1584		
1 or 2	–	1.15 (0.97–1.36) 0.088	1.15 (0.99–1.34) 0.070	–	–

(Continued)

TABLE 7 | Continued

Risk and protective factors	Depression	Anxiety	Stress	Insomnia	Suicide risk
	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value
3 or more	–	0.87 (0.58–1.29) 0.476	0.98 (0.67–1.42) 0.908	–	–
Substance use					
Risk of tobacco use disorder	–	2.46 (1.17–5.17) 0.017	2.29 (1.02–5.11) 0.044	–	–
Last month alcohol use	0.84 (0.72–0.98) 0.022	0.91 (0.77–1.06) 0.214	0.89 (0.77–1.04) 0.141	–	0.73 (0.61–0.89) 0.001
Risk of alcohol use disorder	–	–	–	1.29 (1.09–1.53) 0.003	1.60 (1.29–1.97) <0.001
Last month cannabis use	1.16 (0.88–1.54) 0.287	1.21 (0.91–1.63) 0.194	1.37 (1.03–1.82) 0.030	–	1.13 (0.82–1.54) 0.455
Last month tranquilizers use	1.57 (1.20–2.05) 0.001	1.43 (1.25–2.17) <0.001	1.73 (1.29–2.32) 0.001	3.28 (2.55–4.22) <0.001	1.23 (0.92–1.63) 0.158
Last month nootropics use	–	1.82 (1.39–2.37) <0.001	–	–	–
Risk of nootropics use disorder	–	–	4.56 (1.16–17.91) 0.030	–	–
<b>Family domain</b>					
Father's educational level (ref = Incomplete elementary school)		*0.0656	*0.1733		
Complete elementary school and incomplete high school	–	1.23 (0.17–8.66) 0.836	2.08 (0.30–14.55) 0.461	–	–
Complete high school and incomplete university	–	0.54 (0.09–3.38) 0.508	1.13 (0.18–6.92) 0.894	–	–
Complete university and incomplete postgraduate	–	0.49 (0.08–3.08) 0.448	1.02 (0.17–6.22) 0.984	–	–
Complete postgraduate	–	0.46 (0.07–2.91) 0.411	0.94 (0.15–5.78) 0.950	–	–
Family history of mental health problems					
Psychiatric disorders	1.08 (0.92–1.26) 0.378	1.22 (1.03–1.43) 0.017	1.15 (0.99–1.34) 0.062	1.07 (0.92–1.25) 0.365	1.18 (0.97–1.43) 0.094
Suicide	–	–	–	–	1.37 (1.06–1.78) 0.017
Alcohol abuse or dependence	1.05 (0.89–1.24) 0.588	1.10 (0.93–1.31) 0.265	–	1.01 (0.86–1.19) 0.881	1.11 (0.90–1.37) 0.318
Drug abuse or dependence	–	–	–	–	1.15 (0.88–1.51) 0.308
Family functioning (APGAR) (ref = Highly functional)	*0.0001	*0.0001	*0.0001	*0.0022	*0.0001
Moderate dysfunctional	2.04 (1.69–2.46) <0.001	1.58 (1.30–1.92) <0.001	1.69 (1.40–2.05) <0.001	1.23 (1.02–1.48) 0.030	2.17 (1.76–2.69) <0.001
Severe dysfunctional	3.44 (1.69–2.46) <0.001	1.98 (1.53–2.55) <0.001	2.65 (2.01–3.50) <0.001	1.47 (1.16–1.85) 0.001	3.64 (2.83–4.68) <0.001
<b>University domain</b>					
Academic year (ref = 1st)	*0.0210	*0.1704			
2nd	1.14 (0.90–1.44) 0.271	1.18 (0.93–1.49) 0.174	–	–	–
3rd	0.88 (0.69–1.13) 0.330	0.92 (0.72–1.18) 0.497	–	–	–
4th	0.79 (0.60–1.05) 0.101	1.05 (0.79–1.39) 0.735	–	–	–
5th or higher	0.70 (0.51–0.97) 0.033	0.86 (0.62–1.19) 0.366	–	–	–

(Continued)

TABLE 7 | Continued

Risk and protective factors	Depression	Anxiety	Stress	Insomnia	Suicide risk
	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value
Source of financing					
Self-funded	1.33 (0.94–1.90) 0.111	2.06 (1.40–3.05) <0.001	2.07 (1.39–3.08) <0.001	2.18 (1.58–3.02) <0.001	1.42 (0.96–2.09) 0.081
Commuting time university (ref = ±1SD)	*0.0833	*0.0278	*0.6062		*0.0092
>1SD	1.24 (1.02–1.51) 0.027	1.27 (1.04–1.55) 0.019	1.11 (0.91–1.35) 0.318	–	1.41 (1.13–1.76) 0.002
<-1SD	1.08 (0.87–1.35) 0.483	1.21 (0.97–1.51) 0.096	1.01 (0.82–1.24) 0.915	–	1.07 (0.81–1.41) 0.618
History of failing subjects (ref = No failed subjects)					
Failed subjects	1.05 (0.88–1.24) 0.598	–	1.03 (0.88–1.21) 0.679	1.25 (1.07–1.47) 0.005	1.12 (0.93–1.36) 0.234
Violence victimization					
Physical	–	2.26 (0.77–6.60) 0.136	–	1.81 (0.76–4.31) 0.181	1.71 (0.67–4.34) 0.258
Psychological	1.12 (0.85–1.47) 0.420	1.28 (0.97–1.69) 0.081	1.70 (1.28–2.27) <0.001	–	1.19 (0.90–1.57) 0.219
Exclusion	1.44 (1.21–1.71) <0.001	1.48 (1.24–1.77) <0.001	1.50 (1.26–1.78) <0.001	1.16 (0.97–1.37) 0.096	1.47 (1.21–1.79) <0.001
Teasing	1.25 (0.97–1.60) 0.081	1.36 (1.06–1.76) 0.017	–	1.18 (0.94–1.48) 0.162	–
Psychological sense of university belonging (ref = ±1SD)	*0.0001	*0.0004	*0.0001	*0.0030	*0.0001
>1SD	0.55 (0.43–0.70) <0.001	0.72 (0.57–0.91) 0.005	0.64 (0.52–0.78) <0.001	0.68 (0.55–0.85) 0.001	0.67 (0.49–0.92) 0.013
<-1SD	1.72 (1.39–2.12) <0.001	1.31 (1.06–1.63) 0.013	1.56 (1.24–1.95) <0.001	0.94 (0.77–1.15) 0.556	1.46 (1.17–1.82) 0.001
<b>SARS-CoV-2 experiences domain</b>					
History of family contagion of SARS-CoV-2 (ref = No)					
Yes	–	1.03 (0.88–1.22) 0.699	1.14 (0.98–1.34) 0.091	1.06 (0.91–1.24) 0.463	1.04 (0.86–1.26) 0.700
Fear to contracting SARS-CoV-2 by the students (ref = Not at all)	*0.0046	*0.0001	*0.0001	*0.0001	*0.0566
Slightly	1.06 (0.77–1.47) 0.712	1.13 (0.80–1.60) 0.485	1.26 (0.92–1.72) 0.143	1.14 (0.83–1.57) 0.425	0.68 (0.47–0.98) 0.041
Somewhat	0.84 (0.61–1.15) 0.275	1.31 (0.94–1.82) 0.114	1.51 (1.12–2.04) 0.007	1.09 (0.80–1.48) 0.598	0.62 (0.43–0.88) 0.007
Moderately	1.04 (0.75–1.46) 0.798	1.54 (1.09–2.19) 0.015	1.94 (1.41–2.68) <0.001	1.21 (0.88–1.68) 0.244	0.70 (0.50–1.01) 0.059
Extremely	1.35 (0.93–1.95) 0.115	2.29 (1.56–3.36) <0.001	2.84 (1.97–4.10) <0.001	1.97 (1.38–2.80) <0.001	0.81 (0.54–1.22) 0.322
Fear of others contracting SARS-CoV-2 (ref = Not at all)	*0.0001	*0.0001	*0.0455	*0.0001	*0.0129
Slightly	0.34 (0.14–0.79) 0.013	0.59 (0.24–1.48) 0.263	0.87 (0.38–1.99) 0.738	0.74 (0.33–1.70) 0.484	0.68 (0.28–1.67) 0.400
Somewhat	0.30 (0.14–0.65) 0.002	0.83 (0.37–1.86) 0.658	1.15 (0.54–2.42) 0.719	0.57 (0.27–1.20) 0.137	0.46 (0.21–1.03) 0.059
Moderately	0.42 (0.20–0.90) 0.025	0.94 (0.42–2.07) 0.870	1.23 (0.59–2.60) 0.578	0.78 (0.38–1.63) 0.513	0.60 (0.27–1.32) 0.203
Extremely	0.58 (0.27–1.24) 0.163	1.42 (0.64–3.14) 0.390	1.50 (0.71–3.16) 0.288	1.03 (0.50–2.15) 0.927	0.77 (0.35–1.69) 0.512

(Continued)

TABLE 7 | Continued

Risk and protective factors	Depression	Anxiety	Stress	Insomnia	Suicide risk
	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value
Frequency of social contact during lockdowns (ref = Never)	*0.3578	*0.1204	*0.7611		*0.1250
1–2 days a week	0.92 (0.65–1.29) 0.619	0.72 (0.51–1.02) 0.067	0.89 (0.63–1.26) 0.523	–	0.94 (0.65–1.37) 0.760
3–4 days a week	0.77 (0.53–1.11) 0.154	0.81 (0.56–1.17) 0.264	0.81 (0.56–1.18) 0.276	–	0.74 (0.49–1.11) 0.145
5–6 days a week	0.80 (0.53–1.22) 0.307	0.60 (0.39–0.92) 0.019	0.91 (0.60–1.39) 0.669	–	0.71 (0.44–1.16) 0.171
Everyday	0.84 (0.57–1.22) 0.359	0.81 (0.55–1.19) 0.228	0.84 (0.57–1.23) 0.373	–	1.02 (0.67–1.55) 0.941
Frequency of physical exercising during lockdowns (ref = Never)	*0.5872	*0.8000		*0.1476	*0.9061
1–2 days a week	0.86 (0.70–1.06) 0.147	0.89 (0.72–1.10) 0.290	–	1.02 (0.84–1.25) 0.823	1.00 (0.79–1.27) 1.000
3–4 days a week	0.85 (0.66–1.09) 0.195	0.96 (0.75–1.25) 0.782	–	0.79 (0.62–1.00) 0.053	0.92 (0.68–1.24) 0.584
5–6 days a week	0.82 (0.60–1.12) 0.215	0.92 (0.67–1.26) 0.599	–	0.81 (0.60–1.10) 0.175	0.89 (0.61–1.30) 0.552
Everyday	0.76 (0.45–1.27) 0.298	0.83 (0.50–1.37) 0.462	–	0.68 (0.41–1.11) 0.119	0.75 (0.40–1.41) 0.378
Frequency of recreational activities during lockdowns (ref = Never)	*0.0002		*0.0024		
1–2 days a week	0.76 (0.63–0.92) 0.005	–	0.86 (0.71–1.04) 0.127	–	–
3–4 days a week	0.71 (0.56–0.89) 0.003	–	0.71 (0.57–0.89) 0.003	–	–
5–6 days a week	0.57 (0.41–0.80) 0.001	–	0.78 (0.57–1.05) 0.097	–	–
Everyday	0.52 (0.38–0.73) <0.001	–	0.58 (0.43–0.78) <0.001	–	–
Keeping a routine during lockdowns (ref = Never)	*0.0001	*0.0103	*0.0030	*0.0001	*0.1229
1–2 days a week	0.93 (0.71–1.21) 0.583	0.79 (0.60–1.04) 0.099	0.73 (0.56–0.97) 0.027	0.70 (0.54–0.90) 0.006	0.96 (0.71–1.30) 0.775
3–4 days a week	0.64 (0.50–0.80) <0.001	0.76 (0.60–0.97) 0.028	0.79 (0.62–1.00) 0.054	0.59 (0.48–0.74) <0.001	0.79 (0.60–1.04) 0.092
5–6 days a week	0.53 (0.42–0.68) <0.001	0.66 (0.52–0.85) 0.001	0.63 (0.50–0.80) <0.001	0.44 (0.35–0.56) <0.001	0.71 (0.53–0.94) 0.017
Everyday	0.58 (0.46–0.74) <0.001	0.67 (0.52–0.86) 0.001	0.68 (0.54–0.87) 0.002	0.46 (0.36–0.57) <0.001	0.80 (0.60–1.06) 0.118
Frequency of meditation or praying during lockdowns (ref = Never)	*0.4292	*0.5960	*0.0444		*0.2271
1–2 days a week	0.91 (0.76–1.09) 0.319	0.99 (0.82–1.18) 0.877	1.00 (0.85–1.19) 0.956	–	1.10 (0.89–1.36) 0.391
3–4 days a week	1.02 (0.78–1.33) 0.905	1.22 (0.93–1.60) 0.143	1.33 (1.02–1.74) 0.033	–	1.31 (0.97–1.77) 0.080
5–6 days a week	0.88 (0.59–1.31) 0.516	0.95 (0.64–1.41) 0.806	0.76 (0.53–1.10) 0.141	–	0.80 (0.49–1.31) 0.370
Everyday	0.77 (0.57–1.04) 0.084	0.95 (0.71–1.28) 0.743	1.23 (0.93–1.61) 0.144	–	0.88 (0.61–1.27) 0.481

\*Walt test; n, number of participants; CI, Confidence Interval.

The following variables did not enter into the final multivariable models, so they were removed from the table to simplify the presentation of results: Nationality, Ethnicity, Offspring, Last month tobacco use, Risk of cannabis use disorder, Risk of tranquilizers use disorder, Mother's educational level, Source of financing (Funding from parents, Credit/Loan, Scholarship, Other means), Violence victimization (Ridiculization), History of personal contagion of SARS-CoV-2, Living condition during pandemic lockdowns.

The cells with the "–" symbol represent that the independent variable was not associated with the outcome in the previous analyses (univariable or multivariable by domains).

The model was adjusted by sex and age.



suicide risk. One recent study during the pandemic found that alcohol consumption (amount and frequency) increased as time progressed among university students (16). In addition, this study found that students with more symptoms of depression and anxiety reported had a greater increase in alcohol consumption. Therefore, our results may be seen as contradictory. However, we also found that the presence of alcohol social consequences such as having people criticizing your drinking (measured by CAGE and labeled as Risk of Alcohol Use Disorder), increased the odds for suicide risk. A recent study among female college students found that the quantity of alcohol consumed did not predict the onset of depression; however, experiencing alcohol consequences, regardless of consumption, did increase the risk of incident depression (69). We did not explore if alcohol use started recently or if this consumption was initiated long before the survey. We also do not know the longitudinal progression of alcohol use and depressive symptoms. The self-medication hypothesis says that individuals may use alcohol to reduce psychological distress, and we may have surveyed the students just in the time when their symptoms have been reduced after using alcohol for some of the students. To fully explore the causal relationship in this population, we need to assess the longitudinal association, which is one of the aims of our future studies.

Finally, it is worth mentioning that our sample had a high rate of females (70.4%), which may be related to two contributing factors: (1) the higher proportion of females in the population of undergraduates in this university (60%); and (2) the higher participation of females in this kind of studies (70). For instance, in a recent meta-analysis, the mean proportion of females (adjusted by the size of the study) was 66% (8). It is known that there are sex differences in the neurobiological mechanisms involved in stress, anxiety and affective disorders, where females have an increased risk of presenting these symptoms (71, 72). Furthermore, a study in the general population in Chile found that females were more likely to have a new mental health disorder during the pandemic than males (73).

This study has several strengths. First, it includes a large sample that invited to participate the whole body of students from the different academic units and enrollment years. Second, we had included several variables from different domains to explore the main risk and protective factors and reduce confounding bias. Finally, there are still few studies exploring the effect of pandemic and sanitary measures on mental health among undergraduate students in Latin American countries and in the world, making it an important contribution to research in the field (74). Among the limitations, we could mention that our data come from a cross-sectional survey, and no causality can be implied. Additionally, we used a self-reported questionnaire, which may introduce some reported bias. Moreover, not all the instruments used in this study were validated among Chilean undergraduates, and no diagnostic statements can be formulated because the instruments and methodology used are usually used to screen mental health issues. Our findings are based on data from one university and may therefore not be generalized to other universities or college students in Chile due to some

cluster bias. In addition, our findings cannot be generalized to other phases of the pandemic, but only when lockdown measures were in place. Most students attending this university come from high-income families, which may also reduce the representativity of the results. Finally, the sample had a high rate of females, which may have increased the prevalence of mental health symptoms reported in the study. As anonymity was granted, it was impossible to directly contact high suicide risk students; however, a suggestion for seeking help and information was given at the end of the survey as we explained in Section Method.

Future research among university students can be concentrated on studies exploring the progression of mental health problems and the associated factors over time through longitudinal studies. Additionally, studies exploring the effectiveness of preventive interventions programs using some of the potential mediators found in this research, such as a sense of university belonging, should be conducted in the short term. The college environment offers an excellent opportunity to introduce interventions to prevent mental health problems, substance misuse, and bullying victimization. Additionally, all universities will need to be prepared to implement this kind of intervention when students return to the campus during and after the pandemic emergency.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Scientific Ethical Committee Universidad de los Andes. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

JV: writing—conceptualization, methodology, validation, formal analysis, investigation, data curation, review editing, and project administration and funding acquisition. FD, PC, GL, FS, MA, DN, and RA: writing—review and editing. SR: software, formal analysis, and writing—original draft. JG: conceptualization, methodology, validation, formal analysis, investigation, data curation, writing—review and editing, visualization, supervision, project administration, and funding acquisition. All authors contributed to the article and approved the submitted version.

## FUNDING

This research was funded by Fondo de Desarrollo Institucional, línea Emprendimiento Estudiantil 2019, UAN 1901. Ministry of Education, Chile; Social Responsibility Department, Universidad

de los Andes, Chile, and by ANID—Millennium Science Initiative Program—NCS2021\_081.

## ACKNOWLEDGMENTS

Thanks to Universidad de los Andes collaborators: Jorge Bravo for his excitement and help to invite and motivate students to answer the survey, Claudio Veliz for his help in obtaining University directives collaboration, and María José Pizarro

for her suggestions about using the family APGAR score. Finally, special thanks to all the students who participated in this study.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2022.833263/full#supplementary-material>

## REFERENCES

- Gustavson K, Knudsen AK, Nesvåg R, Knudsen GP, Vollset SE, Reichborn-Kjennerud T. Prevalence and stability of mental disorders among young adults: findings from a longitudinal study. *BMC Psychiatry*. (2018) 18:65. doi: 10.1186/s12888-018-1647-5
- Eisenberg D, Lipson SK. *The Healthy Minds Study - Fall 2020 Data Report* (2020).
- Álamo C, Antúnez Z, Baader T, Kendall J, Barrientos M, Barra Ddl. The sustained increase of mental health symptoms in Chilean university students over three years. *Revista Latinoamericana de Psicología*. (2020) 52:71–80. doi: 10.14349/rjp.2020.v52.8
- Antúnez Z, Vinet EV. Problemas de salud mental en estudiantes de una universidad regional chilena. *Revista Médica de Chile*. (2013) 141:209–16. doi: 10.4067/S0034-98872013000200010
- Barrera-Herrera A, San Martín Y. Prevalencia de sintomatología de salud mental y hábitos de salud en una muestra de universitarios chilenos. *Psykhē*. (2021) 30:1–6. doi: 10.7764/psykhē.2019.21813
- Arnett JJ. Emerging adulthood. A theory of development from the late teens through the twenties. *Am Psychol*. (2000) 55:469–80. doi: 10.1037/0003-066X.55.5.469
- Arnett JJ, Žukauskiene R, Sugimura K. The new life stage of emerging adulthood at ages 18–29 years: implications for mental health. *Lancet Psychiatry*. (2014) 1:569–76. doi: 10.1016/S2215-0366(14)00080-7
- Chang JJ, Ji Y, Li YH, Pan HF, Su PY. Prevalence of anxiety symptom and depressive symptom among college students during COVID-19 pandemic: a meta-analysis. *J Affect Disord*. (2021) 292:242–54. doi: 10.1016/j.jad.2021.05.109
- Wang X, Hegde S, Son C, Keller B, Smith A, Sasangohar F. Investigating mental health of US college students during the COVID-19 pandemic: cross-sectional survey study. *J Med Internet Res*. (2020) 22:e22817. doi: 10.2196/22817
- Kecojevic A, Basch CH, Sullivan M, Davi NK. The impact of the COVID-19 epidemic on mental health of undergraduate students in New Jersey, cross-sectional study. *PLoS ONE*. (2020) 15:e0239696. doi: 10.1371/journal.pone.0239696
- Kokkinos CM, Tsouloupas CN, Voulgaridou I. The effects of perceived psychological, educational, and financial impact of COVID-19 pandemic on Greek university students' satisfaction with life through Mental Health. *J Affect Disord*. (2022) 300:289–95. doi: 10.1016/j.jad.2021.12.114
- Ma Z, Zhao J, Li Y, Chen D, Wang T, Zhang Z, et al. Mental health problems and correlates among 746 217 college students during the coronavirus disease 2019 outbreak in China. *Epidemiol Psychiatr Sci*. (2020) 29:e181. doi: 10.1017/S2045796020000931
- Ahorsu DK, Pramukti I, Strong C, Wang HW, Griffiths MD, Lin CY, et al. COVID-19-related variables and its association with anxiety and suicidal ideation: differences between international and local university students in Taiwan. *Psychol Res Behav Manag*. (2021) 14:1857–66. doi: 10.2147/PRBM.S333226
- Prowse R, Sherratt F, Abizaid A, Gabrys RL, Hellemans KGC, Patterson ZR, et al. Coping with the COVID-19 pandemic: examining gender differences in stress and mental health among university students. *Front Psychiatry*. (2021) 12:650759. doi: 10.3389/fpsy.2021.650759
- Pramukti I, Strong C, Sitthimongkol Y, Setiawan A, Pandin MGR, Yen CF, et al. Anxiety and suicidal thoughts during the COVID-19 pandemic: cross-country comparative study among Indonesian, Taiwanese, and Thai University Students. *J Med Internet Res*. (2020) 22:e24487. doi: 10.2196/24487
- Lechner WV, Laurene KR, Patel S, Anderson M, Grega C, Kenne DR. Changes in alcohol use as a function of psychological distress and social support following COVID-19 related University closings. *Addict Behav*. (2020) 110:106527. doi: 10.1016/j.addbeh.2020.106527
- Ramón-Arhués E, Gea-Caballero V, Granada-López JM, Juárez-Vela R, Pellicer-García B, Antón-Solanas I. The prevalence of depression, anxiety and stress and their associated factors in college students. *Int J Environ Res Public Health*. (2020) 17:7001. doi: 10.3390/ijerph17197001
- Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic. *JAMA Netw Open*. (2020) 3:e2025591. doi: 10.1001/jamanetworkopen.2020.25591
- Zhang SX, Chen J. Scientific evidence on mental health in key regions under the COVID-19 pandemic - meta-analytical evidence from Africa, Asia, China, Eastern Europe, Latin America, South Asia, Southeast Asia, and Spain. *Eur J Psychotraumatol*. (2021) 12:2001192. doi: 10.1080/20008198.2021.2001192
- Kohn R, Ali AA, Puac-Polanco V, Figueroa C, López-Soto V, Morgan K, et al. Mental health in the Americas: an overview of the treatment gap. *Rev Panam Salud Publica*. (2018) 42:e165. doi: 10.26633/RPSP.2018.165
- Amaral-Prado HM, Borghi F, Mello T, Grassi-Kassisse DM. The impact of confinement in the psychosocial behaviour due COVID-19 among members of a Brazilian university. *Int J Soc Psychiatry*. (2021) 67:720–727. doi: 10.1177/0020764020971318
- Lopes AR, Nihei OK. Depression, anxiety and stress symptoms in Brazilian university students during the COVID-19 pandemic: predictors and association with life satisfaction, psychological well-being and coping strategies. *PLoS ONE*. (2021) 16:e0258493. doi: 10.1371/journal.pone.0258493
- Silva AND, Guedes CR, Santos-Pinto CDB, Miranda ES, Ferreira LM, Vettore MV. Demographics, socioeconomic status, social distancing, psychosocial factors and psychological well-being among undergraduate students during the COVID-19 pandemic. *Int J Environ Res Public Health*. (2021) 18:7215. doi: 10.3390/ijerph18147215
- Camacho-Zuñiga C, Pego L, Escamilla J, Hosseini S. The impact of the COVID-19 pandemic on students' feelings at high school, undergraduate, and postgraduate levels. *Heliyon*. (2021) 7:e06465. doi: 10.1016/j.heliyon.2021.e06465
- García-Espinosa P, Ortiz-Jiménez X, Botello-Hernández E, Aguayo-Samaniego R, Leija-Herrera J, Góngora-Rivera F. Psychosocial impact on health-related and non-health related university students during the COVID-19 pandemic. Results of an electronic survey. *Rev Colomb Psiquiatr*. (2021) 50:214–224. doi: 10.1016/j.rcp.2021.04.008
- Mac-Ginty S, Jiménez-Molina Á, Martínez V. Impacto de la pandemia por COVID-19 en la salud mental de estudiantes uni-versitarios en Chile. *Revista Chilena de Psiquiatría y Neurología de la Infancia y Adolescencia*. (2021) 32:23–37. Available online at: <https://psicologia.udp.cl/cms/wp-content/uploads/2021/04/Rev-SOPNIA-2021-23-37.pdf>
- Ewing JA. Detecting alcoholism. The CAGE questionnaire. *JAMA*. (1984) 252:1905–7. doi: 10.1001/jama.252.14.1905
- Ali R, Meena S, Eastwood B, Richards I, Marsden J. Ultra-rapid screening for substance-use disorders: the alcohol, smoking and substance involvement

- screening test (ASSIST-Lite). *Drug Alcohol Depend.* (2013) 132:352–61. doi: 10.1016/j.drugalcdep.2013.03.001
29. Fiellin DA, Reid MC, O'Connor PG. Screening for alcohol problems in primary care: a systematic review. *Arch Intern Med.* (2000) 160:1977–89. doi: 10.1001/archinte.160.13.1977
  30. Saitz R, Lepore MF, Sullivan LM, Amaro H, Samet JH. Alcohol abuse and dependence in Latinos living in the United States: validation of the CAGE (4M) questions. *Arch Intern Med.* (1999) 159:718–24. doi: 10.1001/archinte.159.7.718
  31. Smilkstein G. Family APGAR analyzed. *Fam Med.* (1993) 25:293–4.
  32. Mayorga-Munoz C, Gallardo-Peralta L, Galvez-Nieto JL. Psychometric properties of APGAR-family scale in a multiethnic sample of Chilean older people. *Rev Med Chil.* (2019) 147:1283–90. doi: 10.4067/s0034-98872019001001283
  33. Walton GM, Cohen GL. A question of belonging: race, social fit, and achievement. *J Pers Soc Psychol.* (2007) 92:82–96. doi: 10.1037/0022-3514.92.1.82
  34. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the Beck depression and anxiety inventories. *Behav Res Ther.* (1995) 33:335–43. doi: 10.1016/0005-7967(94)00075-U
  35. Lovibond SH, Lovibond PF. *Manual for the Depression Anxiety Stress Scales.* Sydney: Psychology Foundation of Australia (1996).
  36. Antúnez Z, Vinet EV. Escalas de Depresión, Ansiedad y Estrés (DASS - 21): Validación de la Versión abreviada en Estudiantes Universitarios Chilenos. *Terapia psicológica.* (2012) 30:49–55. doi: 10.4067/S0718-48082012000300005
  37. Román F, Santibáñez P, Vinet EV. Uso de las Escalas de Depresión Ansiedad Estrés (DASS-21) como Instrumento de Tamizaje en Jóvenes con Problemas Clínicos. *Acta de Investigación Psicológica.* (2016) 6:2325–36. doi: 10.1016/S2007-4719(16)30053-9
  38. Bastien CH, Vallières A, Morin CM. Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Med.* (2001) 2:297–307. doi: 10.1016/S1389-9457(00)00065-4
  39. Morin CM, Belleville G, Belanger L, Ivers H. The insomnia severity index: psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep.* (2011) 34:601–8. doi: 10.1093/sleep/34.5.601
  40. Fernandez-Mendoza J, Rodriguez-Munoz A, Vela-Bueno A, Olavarrieta-Bernardino S, Calhoun SL, Bixler EO, et al. The Spanish version of the insomnia severity index: a confirmatory factor analysis. *Sleep Med.* (2012) 13:207–10. doi: 10.1016/j.sleep.2011.06.019
  41. Posner K, Brown GK, Stanley B, Brent DA, Yershova KV, Oquendo MA, et al. The Columbia-suicide severity rating scale: initial validity and internal consistency findings from three multisite studies with adolescents and adults. *Am J Psychiatry.* (2011) 168:1266–77. doi: 10.1176/appi.ajp.2011.10111704
  42. Al-Halabi S, Saiz PA, Buron P, Garrido M, Benabarre A, Jimenez E, et al. Validation of a Spanish version of the Columbia-suicide severity rating scale (C-SSRS). *Rev Psiquiatr Salud Ment.* (2016) 9:134–42. doi: 10.1016/j.rpsmen.2016.06.004
  43. Muyor-Rodríguez J, Caravaca-Sánchez F, Fernández-Prados JS. COVID-19 fear, resilience, social support, anxiety, and suicide among college students in Spain. *Int J Environ Res Public Health.* (2021) 18:8156. doi: 10.3390/ijerph18158156
  44. Nomura K, Minamizono S, Maeda E, Kim R, Iwata T, Hirayama J, et al. Cross-sectional survey of depressive symptoms and suicide-related ideation at a Japanese national university during the COVID-19 stay-home order. *Environ Health Prev Med.* (2021) 26:30. doi: 10.1186/s12199-021-00953-1
  45. Cerda R, Silva A, Valente JT. Impact of economic uncertainty in a small open economy: the case of Chile. *Applied Economics.* (2018) 50:2894–908. doi: 10.1080/00036846.2017.1412076
  46. Curilef S, González D, Calderón C. Analyzing the 2019 Chilean social outbreak: modelling Latin American economies. *PLoS ONE.* (2021) 16:e0256037. doi: 10.1371/journal.pone.0256037
  47. Duarte F, Jiménez-Molina Á. A longitudinal nationwide study of psychological distress during the COVID-19 pandemic in Chile. *Front Psychiatry.* (2022) 13:744204. doi: 10.3389/fpsy.2022.744204
  48. Gil D, Domínguez P, Undurraga EA, Valenzuela E. Employment loss in informal settlements during the Covid-19 pandemic: evidence from Chile. *J Urban Health.* (2021) 98:622–34. doi: 10.1007/s11524-021-00575-6
  49. Duarte F, Jiménez-Molina Á. Psychological distress during the COVID-19 epidemic in Chile: the role of economic uncertainty. *PLoS ONE.* (2021) 16:e0251683. doi: 10.1371/journal.pone.0251683
  50. Barrera-Herrera A, Baeza-Rivera MJ, Escandón-Nagel N, Constanzo J, Escobar B. Crisis social chilena y salud mental: una mirada desde el ciclo vital. *Revista de Psicología.* (2022) 40:241–63. doi: 10.18800/psico.202201.008
  51. Jiménez-Molina Á, Reyes P, Rojas G. Socioeconomic determinants and gender gaps in depressive symptoms in Chile. *Rev Med Chil.* (2021) 149:533–42. doi: 10.4067/s0034-98872021000400533
  52. Vicente B, Saldivia S, Kohn R. Epidemiology of mental disorders, use of service, and treatment gap in Chile. *Int J Mental Health.* (2012) 41:7–20. doi: 10.2753/IMH0020-7411410101
  53. Martínez V, Crockett MA, Jiménez-Molina Á, Espinosa-Duque HD, Barrientos E, Ordóñez-Carrasco JL. Stigmatizing beliefs and attitudes to depression in adolescent school students in Chile and Colombia. *Front Psychol.* (2020) 11:577177. doi: 10.3389/fpsyg.2020.577177
  54. Mascayano F, Tapia T, Schilling S, Alvarado R, Tapia E, Lips W, et al. Stigma toward mental illness in Latin America and the Caribbean: a systematic review. *Braz J Psychiatry.* (2016) 38:73–85. doi: 10.1590/1516-4446-2015-1652
  55. Sapag JC, Sena BF, Bustamante IV, Bobbili SJ, Velasco PR, Mascayano F, et al. Stigma towards mental illness and substance use issues in primary health care: challenges and opportunities for Latin America. *Glob Public Health.* (2018) 13:1468–80. doi: 10.1080/17441692.2017.1356347
  56. Pirkis J, John A, Shin S, DelPozo-Banos M, Arya V, Analuisa-Aguilar P, et al. Suicide trends in the early months of the COVID-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries. *Lancet Psychiatry.* (2021) 8:579–88. doi: 10.1016/S2215-0366(21)00091-2
  57. Shao R, He P, Ling B, Tan L, Xu L, Hou Y, et al. Prevalence of depression and anxiety and correlations between depression, anxiety, family functioning, social support and coping styles among Chinese medical students. *BMC Psychol.* (2020) 8:38. doi: 10.1186/s40359-020-00402-8
  58. Huang Y, Su X, Si M, Xiao W, Wang H, Wang W, et al. The impacts of coping style and perceived social support on the mental health of undergraduate students during the early phases of the COVID-19 pandemic in China: a multicenter survey. *BMC Psychiatry.* (2021) 21:530. doi: 10.1186/s12888-021-03546-y
  59. Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* (2020) 287:112934. doi: 10.1016/j.psychres.2020.112934
  60. Kisely S, Warren N, McMahon L, Dalais C, Henry I, Siskind D. Occurrence, prevention, and management of the psychological effects of emerging virus outbreaks on healthcare workers: rapid review and meta-analysis. *BMJ.* (2020) 369:m1642. doi: 10.1136/bmj.m1642
  61. Lin M, Wolke D, Schneider S, Margraf J. Bullying history and mental health in university students: the mediator roles of social support, personal resilience, and self-efficacy. *Front Psychiatry.* (2019) 10:960. doi: 10.3389/fpsy.2019.00960
  62. Lederer AM, Hoban MT, Lipson SK, Zhou S, Eisenberg D. More than inconvenienced: the unique needs of U.S. college students during the COVID-19 pandemic. *Health Educ Behav.* (2021) 48:14–9. doi: 10.1177/1090198120969372
  63. Gopalan M, Brady ST. College students' sense of belonging: a national perspective. *Educ Res.* (2020) 49:134–7. doi: 10.3102/0013189X19897622
  64. Thompson K, Wood D, Davis MacNevin P. Sex differences in the impact of secondhand harm from alcohol on student mental health and university sense of belonging. *Addict Behav.* (2019) 89:57–64. doi: 10.1016/j.addbeh.2018.09.012
  65. Brady ST, Cohen GL, Jarvis SN, Walton GM. A brief social-belonging intervention in college improves adult outcomes for black Americans. *Sci Adv.* (2020) 6:eay3689. doi: 10.1126/sciadv.ay3689
  66. Padrón I, Fraga I, Vieitez L, Montes C, Romero E. A study on the psychological wound of COVID-19 in university students. *Front Psychol.* (2021) 12:589927. doi: 10.3389/fpsyg.2021.589927
  67. World Health Organization. *Mental Health and Psychosocial Considerations During the SARS-COV-2 Outbreak.* Geneva: World Health Organization (2020).
  68. Martínez-Vélez NA, Tiburcio M, Natera Rey G, Villatoro Velázquez JA, Arroyo-Belmonte M, Sánchez-Hernández GY, et al. Psychoactive Substance

- use and its relationship to stress, emotional state, depressive symptomatology, and perceived threat during the COVID-19 pandemic in Mexico. *Front Public Health*. (2021) 9:709410. doi: 10.3389/fpubh.2021.709410
69. Rosenthal SR, Clark MA, Marshall BDL, Buka SL, Carey KB, Shepardson RL, et al. Alcohol consequences, not quantity, predict major depression onset among first-year female college students. *Addict Behav*. (2018) 85:70–6. doi: 10.1016/j.addbeh.2018.05.021
  70. Galea S, Tracy M. Participation rates in epidemiologic studies. *Ann Epidemiol*. (2007) 17:643–53. doi: 10.1016/j.annepidem.2007.03.013
  71. Rubinow DR, Schmidt PJ. Sex differences and the neurobiology of affective disorders. *Neuropsychopharmacology*. (2019) 44:111–28. doi: 10.1038/s41386-018-0148-z
  72. Becker JB, Monteggia LM, Perrot-Sinal TS, Romeo RD, Taylor JR, Yehuda R, et al. Stress and disease: is being female a predisposing factor? *J Neurosci*. (2007) 27:11851–5. doi: 10.1523/JNEUROSCI.3565-07.2007
  73. Borrescio-Higa F, Valenzuela P. Gender inequality and mental health during the COVID-19 pandemic. *Int J Public Health*. (2021) 66:1604220. doi: 10.3389/ijph.2021.1604220
  74. Shanahan L, Steinhoff A, Bechtiger L, Murray AL, Nivette A, Hepp U, et al. Emotional distress in young adults during the COVID-19 pandemic: evidence

of risk and resilience from a longitudinal cohort study. *Psychol Med*. (2022) 52:824–33. doi: 10.1017/S003329172000241X

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Valdés, Díaz, Christiansen, Lorca, Solorza, Alvear, Ramírez, Nuñez, Araya and Gaete. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





# Understanding Reciprocity Among University Students in Low-Resource Settings: Validation and Measurement Using a Mixed-Methods Approach

Mahmoud M. AbuAlSamen\* and Tamam El-Elimat\*

Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Nasr Chalhaf,  
University of Sfax, Tunisia  
Johannes Siegrist,  
Heinrich Heine University of  
Düsseldorf, Germany

### \*Correspondence:

Mahmoud M. AbuAlSamen  
mmabualsamen12@ph.just.edu.jo  
Tamam El-Elimat  
telimat@just.edu.jo

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 18 April 2022

**Accepted:** 05 May 2022

**Published:** 03 June 2022

### Citation:

AbuAlSamen MM and El-Elimat T  
(2022) Understanding Reciprocity  
Among University Students in  
Low-Resource Settings: Validation  
and Measurement Using a  
Mixed-Methods Approach.  
Front. Public Health 10:922892.  
doi: 10.3389/fpubh.2022.922892

**Objectives:** This study aimed to investigate reciprocity among university students in low-resource settings using a convergent mixed-methods approach in Jordan. The study operationalized the effort-reward imbalance (ERI) model which is a sociological framework used to predict occupational-related health outcomes. The basic theory of ERI model assumes that an imbalance of effort and reward predicts adverse health outcomes.

**Methods:** The research involved two studies, Study I ( $n = 833$ ) to quantitatively measure ERI and Study II to collect qualitative data ( $n = 44$ ) on the drivers of ERI among university students. In Study I, a modified Arabic version of the ERI questionnaire was used. The study measured ERI and investigated the reliability and validity of the Arabic version of the ERI model questionnaire. In Study II, data were collected from focus groups and personal interviews and thematic analysis was used.

**Results:** The results suggested that ERI was associated with poor academic performance (OR=2.31, 95% CI 1.60–3.32), absenteeism (OR=1.66, 95% CI 1.21–2.27), low exercise level (OR=2.02, 95% CI 1.49–2.74) and poor self-reported health (OR=1.12, 95% CI 1.08–1.30). Three major themes emerged, namely high academic load, financial pressures and negative influence on the students' performance, wellbeing and health to explain effort-reward imbalance.

**Conclusions:** Results suggest that ERI among university students is multi-faceted and is not bound only to academic-related demands and that the extrinsic factors such as the economic context of Jordan is among drivers of ERI.

**Keywords:** effort-reward imbalance, reciprocity, mixed-methods research, factor analysis, academic-related stress

## INTRODUCTION

Reciprocity is a notion that determines the balance between efforts and rewards. The effort-reward imbalance model (ERI) was proposed by Siegrist et al. to predict occupational-related health outcomes (1). Whilst reciprocity assumes that 'high' effort should adequately be compensated with 'high' reward, negative emotions and stress may be elicited when this equilibrium is violated



(i.e. *high* effort with *low* reward) (2). The ERI model emphasizes the significance of the social role of the subject (3). When people exert their efforts as per their social roles, the social role is expected to satisfy their self-regulatory needs such as successful performance, recognition, integration, and the well-being (1–4).

Following Siegrist's seminal work, the ERI model has been replicated in many different populations worldwide (5). The model was mainly used to investigate the effect of work conditions on the subject and was demonstrated to be ubiquitous to researchers as it was successfully validated in more than ten languages (6, 7). Much of the research conducted on the ERI model was mainly produced from the USA, Europe, and Eastern Asia (2). However, little work has been done on exploring the validity of the ERI model in the Middle East (8). While much of ERI research was investigated in workplace conditions, there has been a growing interest in understanding the validity of ERI model when applied to other social settings such as schools and universities. There has been no work done on understanding the interaction between effort and reward in university settings among students in Jordan. Moreover, a closer look at the literature on ERI shows that most of the evidence takes the form of quantitative research with very little qualitative research to understand the drivers of ERI.

In this study, we aimed to investigate the validity of the ERI model among university students in Jordan using a mixed-methods design to generate both quantitative and qualitative data. We also explored the potential influences of ERI on students' academic performance, wellbeing and health.

## MATERIALS AND METHODS

### Design and Study Population

This study was designed to take a convergent mixed-methods approach. The research involved two studies, Study I used cross-sectional questionnaires to collect quantitative data on ERI among university students, and Study II to collect qualitative data on the drivers of ERI. The major aim of using a mixed-methods design is to triangulate the data from the quantitative questionnaire with qualitative findings that can offer depth in interpretation.

All participants of this study were enrolled at Jordan University of Science and Technology (JUST), Irbid, Jordan. In an attempt to make the study participatory, students were involved at different stages of this research including co-designing, co-analysis and interpretation of study results. For instance, students were involved in the analysis of qualitative data from an early stage in the project. After concluding the qualitative study, the results were discussed with other students in a brainstorming session.

The recruitment location was based on student density and diversity to enhance the quality of the sample obtained. JUST is considered to be the most culture-diverse public institution of higher education in Jordan and attracts students from all Jordanian governorates in addition to having students from 60 different international nationalities.

To be eligible for participation in this study, participants should meet the criteria of being (1) enrolled in a full-time

undergraduate study program at JUST; (2) at least 18 years or older; (3) be willing to participate in the study.

## STUDY I: QUANTITATIVE STUDY

Data collection was conducted by dividing the university into several clusters based on schools of study with a total of 11 clusters. We aimed to reduce bias in data collection by sampling students directly from lecture halls of courses which had a policy of compulsory attendance. These courses involved students from different student levels and ensured the highest representation of the student population at JUST. A total of five research assistants approached the student halls, by giving a general exposition of the study aims to each lecture hall. Students who showed interest to participate were approached using paper-based questionnaires. Participating students gave their written consent. No university official or course instructor were involved in the recruitment of students, and all students had the free will to participate or to withdraw their consent.

We estimated the sample size using a precision level of 0.05 and 95% confidence level, to be 379. To account for the clustered design of the study, the estimated sample size was multiplied by design effect (DE) which can be computed using the formula  $DE = 1 + (m - 1) \times ICC$ , where  $m$  is the number of participants sampled per each school and ICC denoting the intra-cluster correlation coefficient. The intra-cluster correlation coefficient determines the variance within clusters in relation to the variance between clusters and in the current study it was estimated to be 0.02 based on previous research conducted by authors on student samples at JUST. We aimed to sample 50 students from each school. Hence, sample size was determined to be at least 750. We invited 1000 students to participate, and between May and July 2018, a total of 833 participants completed the questionnaire. Non-response was often due to lack of time by students to participate.

### Instrumentation

The development of the Arabic ERI questionnaire in university students was based on the existing body of literature and published guidelines on the ERI model (2, 9).

The survey was developed in Arabic using available translation of the 2013 Arabic version and previous study done on students in school settings (8, 10). In the first stage, the questionnaire was piloted on 89 students for clarity of wording and expression. The pilot sample was not involved in any further analysis. There were four items in the effort scale (E1–E4), 10 items in the reward scale (R1–R10), and five items in the overcommitment scale (OC1–OC5). Newer guidelines recommended the use of condensed response scales (four-point Likert scale instead of 5-point) for obtaining higher response rate (9). The three dimensions were surveyed using a four-point anchored scale (strongly agree = 4, agree, disagree, and strongly disagree = 1).

### Measures

The following measures were obtained in this study: effort-reward imbalance (ERI) ratio, academic performance, absenteeism, exercise level and self-reported health.

## Effort-Reward Imbalance

The effort reward imbalance is computed by dividing the total effort scale over the reward scale. This ratio is then corrected with correction factor  $k$ , that is found by dividing the number of reward items by the number of effort items. Correction factor  $k$  in this study was 2.5 (9).

## Academic Performance

Classification of academic performance was based on JUST internal grading system. Participants were asked to provide data on their GPA and a cut-off point of 2.75 GPA out of 4.00 was taken, where  $<2.75$  was considered a poor academic performance and above was considered good academic performance.

## Absenteeism

Students at JUST attend classes on campus from Sunday to Thursday. Participants were asked to indicate how many days they had to attend university in their current semester of study, in addition to how many days they usually missed on a weekly basis. Absenteeism was computed as the percentage of how many days students were absent on weekly basis out of the total days of compulsory attendance. Participants were then classified into either showing absenteeism (at least absent a day every week) or not showing absenteeism.

## Exercise Level

Participants were asked to indicate how many times per week they were engaged in exercise activity. Low exercise level was defined as having  $<150$  min per week of exercise, while those doing more than 150 min were defined with good level of exercise.

## Self-Reported Health

Participants were asked to rate their health on a scale from 1 to 7. The scale was classified into three classes: poor health (1–3), fair health (4), good health (5–7).

## Statistical Analysis

Reliability of the effort, reward, and overcommitment scales were evaluated using Cronbach's alpha and McDonalds Omega measures. Factorial structure of the questionnaire was conducted using exploratory factor analysis. To determine the number of factors to be extracted, we employed the Horn's parallel analysis method by running a Monte-Carlo simulation with a randomly generated set of data. Additionally, the number of factors was determined by Kaiser's rule and by inspection of the scree plot at the breaking point. The Kaiser-Meyer-Olkin (KMO) sample adequacy index was set at  $>0.6$ . The items were rotated by direct oblimin. The model fit was assessed by chi-squared test, the root means square error of approximation (RMSEA) and Tucker-Lewis index (TLI).

Binary logistic regression models were constructed to investigate the associations between ERI and academic performance, physical activity and absenteeism. Ordinal logistic regression was used to investigate the association of ERI with self-reported health. Questionnaires with data missing on either effort or reward were not considered in the analysis.

Statistical significance was set at  $p < 0.05$ . All data analyses were conducted in R Studio version 1.1.463.

## STUDY II: QUALITATIVE STUDY

Data was collected through conducting both personal interviews and focus groups and they were purposefully targeted at students in different years of study (years 1–6). As most students are not obligated to follow university courses plan and may interchange courses between each 2 years, focus groups were conducted with students of each 2 years together (years 1–2), (years 3–4) and (years 5–6). A total of three focus groups and 11 interviews were conducted during April-May 2018.

At the beginning of a focus group or an interview, a research assistant introduced the aims of the study and initiated discussions regarding each student experience and reflections. The open-ended questions that were used to elicit insights from students are described in **Table 1**.

Interviews were recorded and verbatim transcribed for coding. Thematic analysis was completed by the lead author in this study with the help of two other research assistant students who conducted the interviews. Coding was done manually without using qualitative data analytic software due to the limited availability of funds. Before coding, researchers familiarized themselves with the interviews and then started identifying themes that were included in the codebook. This codebook has an index of all identified themes that were constantly compared together for refinement. Each transcript was coded, and codes were collectively grouped into major themes and sub-themes.

## Quality Assurance

Quality assurance of the qualitative study on the aspects of credibility, dependability, confirmability, transferability and reflexivity is described in full in **Table 2**.

## Reflexivity Statement

This research was conducted when the lead author was a student at JUST while the second author was his research mentor. Several efforts were made to acknowledge, understand and

**TABLE 1 |** Research questions guide in the qualitative study.

Describe the efforts that you make during your university studies in terms of preparation for assessment exams and assignments
Do you feel that the amount of effort you put has changed over the course of your study?
What motivates you to make an effort in your studies?
What does a university degree mean to you and the people close to you?
How do you describe the impact of your family on the effort you make in your studies?
What could change in the effort you make in your studies, if your tuition was covered by your family or by a scholarship?
What do you think is the best reward you deserve for the effort that you put in your studies?
Do you feel that this described reward was realized?
Do you feel rewarded in terms of grades and recognition?
Do you feel recognized by your family and faculty?

**TABLE 2 |** Qualitative study quality assurance measures.

Criterion	Strategy	Application
Credibility	Prolonged engagement and persistent observation	Sufficient time was spent by lead researchers and field researchers in collecting data, gaining deeper insights and develop understanding and context of the data.
	Triangulation	More than one method of data collection was followed in both qualitative and quantitative methods. Data came from more than one source (students in years 1–6) and conducted via different instruments (interviews and focus groups).
	Peer debriefing	All steps in this research were supervised by the lead researchers.
Dependability and confirmability	Negative case analysis	Cases which did not conform with our understanding were sought to refine interpretation of data.
	Full description of study design	All research methods are described in sufficient detail in the method section.
	Peer review	All steps of this research including design, piloting, data collection and analysis were reviewed and audited by external experts.
Transferability	Thick description	Investigators described in sufficient detail the context and the full methods followed in this research.
Reflexivity	Diary	The lead researchers recorded their conceptual lens, positionality and any implicit assumptions that might affect data analysis and/or interpretation.

reduce the possible impact of this studentship on the research and interpretation of data. Much of the qualitative data was analyzed with the help of other students under the guidance of research method experts. The reason of including other students was to make this research a participatory project. However, this may have influenced how data was being analyzed and interpreted. Therefore, after the themes were extracted, two external experts assessed the quality of data analysis and its interpretation. Accordingly, the analysis was refined several times until a common consensus was reached.

### Ethical Consideration

The study protocol was approved by King Abdallah University Hospital Institutional Review Board at Jordan University of Science and Technology (Approval number: 15/114/2018).

Participants had to sign a written informed consent upon participation.

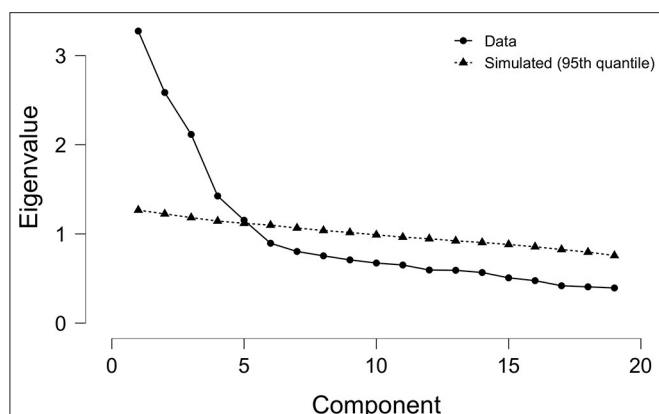
## RESULTS

### Participant Characteristics

Demographic details of participants are shown in Table 3. Regarding the quantitative arm of the study, the majority of students were females (61.8%) compared to males making up 38.2% of the sample. Around 61.0% of the students were enrolled in undergraduate programs at medical schools from all different study years. There were very few students who were employed at the time of the study. Interestingly, 58.0% of students were enrolled on competitive basis compared to 38.3% of students who pay considerably higher fees for admission within the parallel program. Almost half of the students were self-funded, while around 49.1% were covered by a scholarship. Higher education scholarships in Jordan are usually paid by the Royal Court for the family members of public sector employees, including teachers, in addition to scholarships offered by the military for family members of the Jordanian Armed Forces staff. Nevertheless, family income is variable among students, reflecting their different socioeconomic backgrounds.

**TABLE 3 |** Demographic characteristics of participants.

Variable	Study I: Quantitative ( <i>n</i> = 833)	Study II: Qualitative ( <i>n</i> = 44)
<b>Gender, (<i>N</i>%)</b>		
Male	318 (38.2)	19 (43.2)
Female	515 (61.8)	25 (56.8)
<b>Age, mean (SD) years/ range</b>	19.8 (1.5)	18–24
<b>Field of study, <i>N</i> (%)</b>		
Sciences, health and medical studies	508 (61.0)	24 (54.5)
Humanities, arts and engineering	325 (39.0)	20 (45.5)
<b>Academic Year, <i>N</i> (%)</b>		
First year	285 (34.2)	11 (25.0)
Second year	167 (20.0)	14 (31.8)
Third year	181 (21.7)	9 (20.5)
Fourth year and above	200 (24.0)	10 (22.7)
<b>Job status, <i>N</i> (%)</b>		
Full-time job	6 (0.7)	0 (0.0)
Part-time job	52 (6.2)	3 (6.8)
Unemployed	775 (93.0)	41 (93.2)
<b>Study program, <i>N</i> (%)</b>		
Competitive	483 (58.0)	25 (56.8)
Parallel	319 (38.3)	14 (31.8)
International	31 (3.7)	5 (11.4)
<b>Financial aid</b>		
Self-funded	417 (50.1)	29 (65.9)
Financial aid from military or Royal Court	409 (49.1)	10 (22.7)
Foreign funding (international students)	7 (0.8)	5 (11.4)
<b>Family income, <i>N</i> (%)</b>		
<400 JD	244 (29.3)	19 (43.2)
400–700 JD	251 (30.1)	13 (29.5)
700–1000 JD	171 (20.5)	9 (20.5)
>1000 JD	167 (20.0)	3 (6.8)
<b>Residency</b>		
Northern Jordan	526 (63.1)	30 (68.2)
Central and Southern Jordan	307 (36.9)	14 (31.8)



**FIGURE 1** | A scree plot from Horn's parallel analysis method supporting a five-factor solution.

**TABLE 4** | Model fit indices for the proposed three, four and five-factor solutions.

Solution	$\chi^2$	df	RMSEA (95% CI)	TLI
3-Factor	766.65	117	0.082 (0.076–0.087)	0.706
4-Factor	360.75	101	0.056 (0.049–0.062)	0.864
5-Factor	185.82	86	0.038 (0.03–0.045)	0.938

Similar demographics were shown among the participants of the qualitative arm of the study.

## STUDY I: QUANTITATIVE STUDY

### Factorial Structure and Construct Validity of the Arabic ERI Questionnaire in University Students

All items in effort, reward, and overcommitment scales were entered into exploratory factor analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy was found to be 0.773, which exceeds the 0.6 minimum threshold. The Bartlett's test of sphericity was significant at  $\chi^2 (171), p < 0.0001$ , which renders the scales eligible for factorability. All communalities were higher than 0.60. At first, Horn's parallel analysis method was used to identify the number of factors to be extracted. Results from this analysis suggested a five-factor solution, as shown in **Figure 1**. This solution showed that both effort and overcommitment scales were unidimensional, while reward scale loaded on three separate factors. Furthermore, we determined the number of factors to be extracted based on Kaiser's rule of extracting factors with eigenvalues greater than 1. A three-factor solution was supported with three unidimensional scales. Similar results were obtained by inspecting the scree plot at the breaking point. For the purpose of further exploration of possible solutions, we also forced a four-solution on the data. We investigated the fit indices of the three models as shown below. The results suggested that the fit indices were substantially improved in a five-factor solution compared to three and four factor solutions (**Table 4**).

As the five-factor model showed the best fit to the data, we opted for this solution. The rotated structure matrix is shown in **Table 5**, along with reliability measures for each of the three scales. On the factors 1 and 2, the items for effort (E1, E2, E3, and E4) and overcommitment (OC1, OC2, OC3, OC4, and OC5) loaded respectively. Items measuring reward loaded on three different factors. On *factor 3*, items (R7, R8, and R9) loaded strongly and positively and hence this factor was named as '*security*'. On *factor 4*, items (R2, R5, R6, and R10) loaded positively and this factor was named as '*academic esteem*'. On *factor 5*, items (R1, R3, and R4) loaded strongly and positively, and therefore this factor was named as '*academic support*'. From the data shown, the Arabic ERI questionnaire in university students fits a five-solutions model explaining 56% of the variance (**Table 5**).

### Reliability of ERI Arabic Questionnaire

The reliability measures for all items in the effort, reward, and overcommitment scales are given in **Table 5**. The results suggested that the three scales have satisfactory reliability and internal consistency for measuring effort-reward imbalance in university students in Jordan.

### ERI Ratio

The mean corrected effort-reward imbalance was 1.19 with a standard deviation of 0.43. This ratio can be interpreted as for every 1.19 units of effort students make, a 1 unit of reward was reciprocated.

### Association of ERI With Academic-Related Performance and Exercise

The associations between ERI and academic performance, absenteeism, low physical activity, and self-reported health were explored. The results are shown in **Table 6**. The odds of poor academic performance were 2.31 higher in students showing an imbalance between effort and reward, compared to those who did not. Similarly, students with ERI showed higher odds of absenteeism and also low exercise level. Moreover, ERI was associated with poor self-reported health.

## STUDY II: QUALITATIVE STUDY

Analysis of the qualitative study data generated the themes and sub-themes shown in **Table 7**. The first theme relates to the high academic load on students. Most students agreed that university demands make it impossible to maintain a satisfactory performance level without high efforts. This was a common ground for all students, even when they were performing at different academic levels.

Another theme emerged to associate field of study with high efforts. Students recognized that being enrolled in highly respected fields earns them better social acceptability and social capital, and hence, to maintain this social capital, they had to put in more effort. For instance, several students indicated that their families support them because they secured admission in highly respected fields such as engineering or medical studies at a prestigious university in Jordan. If they were not enrolled in these



**TABLE 5 |** Reliability measures and factorial structure of the effort, reward and overcommitment scales.

Items	Cronbach alpha	McDonald's omega	Factorial loading				
			F1	F2	F3	F4	F5
<b>Effort</b>	0.73	0.81					
E1 I have constant time pressure due to a heavy study load			0.70	–	–	–	–
E2 My study load has become more and more demanding			0.72	–	–	–	–
E3 I am under constant pressure to pass with highest grades			0.81	–	–	–	–
E4 I am under constant pressure in my studies to secure a job			0.68	–	–	–	–
<b>Reward</b>	0.76	0.87					
R1 I receive the respect I deserve from my instructors			–	–	–	–	0.72
R2 I receive the respect I deserve from my parents			–	–	–	0.63	–
R3 I receive proper support in difficult tasks or courses			–	–	–	–	0.70
R4 When I need help, I can get it from my instructors			–	–	–	–	0.73
R5 Overall, my level is good in all courses			–	–	–	0.70	–
R6 I feel that my specialty at the current institution reflect my hard work in the past and at the present			–	–	–	0.43	–
R7 I feel unfit to my current field of study			–	–	0.70	–	–
R8 I feel that studying is useless			–	–	0.83	–	–
R9 I do not think that my university studies should occupy my first priorities			–	–	0.78	–	–
R10 I feel satisfied about my academic performance			–	–	–	0.72	–
<b>Overcommitment</b>	0.69	0.80					
OC1 As soon as I get up in the morning, I start thinking about study problems			–	0.57	–	–	–
OC2 Studying rarely leaves my mind; it is still on my mind when I go to bed			–	0.79	–	–	–
OC3 People close to me say I sacrifice too much for my study			–	0.55	–	–	–
OC4 I miss some lectures regularly			–	0.69	–	–	–
OC5 If I postpone something that I was supposed to be done today, I will have trouble sleeping at night			–	0.69	–	–	–
		<b>VE (%)</b>	18.5	13.7	9.3	8.3	6.1
		<b>CVE (%)</b>	18.5	32.2	41.5	49.8	55.9

F1–F5, factors 1–5 from factor analysis, VE, variance explained; CVE, cumulative variance explained.

**TABLE 6 |** Unadjusted and adjusted odds ratios of the association of effort-reward imbalance with poor academic performance, absenteeism, and self-reported health.

Outcome	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Poor academic performance	2.19 (1.55–3.08)	<0.0001	2.31 (1.60–3.32)	<0.0001
Absenteeism	1.60 (1.18–2.17)	0.003	1.66 (1.21–2.27)	0.002
Low exercise level	2.05 (1.51–2.77)	<0.0001	2.02 (1.49–2.74)	<0.0001
Poor self-reported health	1.20 (1.01–1.45)	0.02	1.12 (1.08–1.30)	0.01

\*Adjusted for age, gender, specialty, and family income.

majors, they would have received less support or were not given the opportunity to pursue their education. A student said: ‘my family respects me because I study in the medical school’. It should be also mentioned that several students showed how maintaining a studentship in a prestigious university in Jordan in a respected field is of utmost importance to them. This added more evidence

**TABLE 7 |** Themes and sub-themes from qualitative study.

Theme	Sub-themes
Academic demands	Highly demanding academic load of exams and assignments
Financial pressure	Pressure from family as source of funding Pressure to maintain scholarship status from granting agencies Stress about finding a job post-graduation Stress about economic challenges in Jordan
Influence on student	Low reward and reciprocity Influence on students' academic performance, health and well-being

to another interconnected theme which demonstrated the role of funding source. It was evident, among students who were not funded by their families, that they were under the stress of maintaining scholarship funding by granting agencies (such as Ministry of Higher Education and Scientific Research, Jordanian Armed Forces, Royal Hashemite Court and local charities). Many students citing financial reasons expressed how difficult it will be for them to pursue their studies if funding was not available.



These results suggest that financial challenges are among the most important drivers of high effort and thereby high ERI.

Another sub-theme showed that the context of Jordan influences how students perceived their studies, as some put more efforts to have higher chances of securing jobs after obtaining their degrees. Some students expressed how important it is for them to secure good jobs to support their families. Much emphasis was given on the economic challenges in Jordan and how students viewed their degrees as a ticket to leave Jordan to find jobs abroad. It was evident from the qualitative findings that poor career prospects and the ambiguity about future all result in low levels of reward and security.

A student said in a gendered tone: *'my family is supporting me now, so I can support them [later]. As a female, my father accepted that I pursue my studies so I can contribute to the financial needs of our household later'*. Another student said: *'there are no available jobs once you graduate. If you want to work abroad, [they] look into your high grades'*, while another added: *'all my family members work currently in the Gulf countries and [I] am planning to travel abroad once I finish my studies'*. This was not only limited to the Middle Eastern region, but also encompassed the wider globe: *'to secure a scholarship to study a master's degree in Europe or [North] America, you need to be an outstanding student. [My] only way to immigrate is to study abroad'*.

These high efforts were perceived to have low reward in return. For instance, students expressed their frustration over challenging level of assessments and their inability to maintain high academic performance.

A student said: *'Whatever I do, I will always get the same grade. Whenever I study and dedicate much of time to my exams, I can hardly pass'*. Moreover, several inputs were made at the influence of high efforts on health and well-being of students. It was highlighted how demanding it is to attend classes daily and how can this push students to skip classes to have more time for exam preparation. The problem of absenteeism was reported by all study participants.

## DISCUSSION

Comparing the quantitative and qualitative results of this study sheds light on the significance of mixed-methods research to help in the interpretation of quantitative data. In this study, we quantified ERI in a sample of university students while offering an account, from the students' perspective, on the drivers of ERI. The qualitative arm of the research has established a link on the intersectionality of socioeconomic inequalities and ERI and the need to examine ERI among university students while considering Jordan as an economically challenged country (11). The research draws our attention to the motivations of high effort which included scholarship status, family support, social capital and not only high demands by academic settings. It also expanded our lens on how students regarded recognition as important as much as grades in an academic context. This study was mostly participatory which meant that its interpretation involved all relevant parties including students, educators and university officials.

The results suggest that the lack of reciprocity may be associated with poor students' health. The germinating corpus of evidence is linking ERI to several diseases and had been used to explain the 'social gradient' of incidence of these diseases such as heart disease and diabetes II (5, 11–14). Other studies have also highlighted a role of failed reciprocity in developing burnout and serious psychiatric disorders such as depressive and anxiety-like symptoms (15, 16). Our results are congruent with evidence from the literature of both working and non-working contexts. A research study done on school children in China ( $n = 1004$ ) showed that ERI was associated with poor self-reported health (10). Similarly, a study done on Swedish students ( $n = 403$ ) gave evidence of the association between ERI and poor self-reported health and somatic pain (17). In terms of university students, a study conducted in Germany ( $n = 698$ ) correlated ERI to symptoms of poor self-reported health and symptoms of anxiety and depression (18). Results from working contexts showed that ERI was associated with absenteeism when applied to employees (19). Interestingly enough, the link between ERI and poor academic performance and low level of exercise reported in this study were not reported elsewhere, which adds new data to the body of knowledge on the criterion validity of the ERI model.

In terms of the psychometric properties of the Arabic ERI questionnaire among university students, the questionnaire had demonstrated satisfactorily reliability. Recent reports on using ERI in measuring academic-related stress in student settings showed similar and comparable results to the findings of this study (20). The main addition this study adds to the body of knowledge on student ERI is its use of mixed-methods design to supplement the quantitative findings with qualitative data that can offer a depth in interpretation. Moreover, results from Horn's parallel analysis supported a five-factor solution, in which both the effort and overcommitment scales were unidimensional while the reward scale showed a three-factorial structure. The unidimensionality of both effort and overcommitment scales had been well documented in the literature within work settings (2, 9, 21). Worth mentioning that while the chi-squared test was used as a test of model fitness in this study and in earlier research, it had been well established that obtaining a non-significant chi-squared test in relatively larger samples is very difficult (7). In this regard, other model fitness indices reported in this paper added further evidence to the five-factor solution which had documented previously in the literature in working contexts (22–24).

The findings of this research have several limitations. Firstly, comparing the evidence from this study with other studies from the literature is limited by the extensive literature on ERI in several contexts which employed varying instruments and scales over years of ERI research (18, 25, 26). Moreover, the evidence of the economic influence and financial struggles on ERI among university students was only captured in the qualitative study and no quantitative data was obtained. It should also be noted that qualitative data was collected in April-May 2018 during Mid-term exams and quantitative data was collected in May-July 2018, which was toward the end of the academic year during final exams. This may have influences how students perceived their effort and reward. Additionally, this study was not longitudinal,

so it did not test and re-test the ERI in university students over a period of time, providing no information on how the ERI model performs under time change and how stable is the instrument. This is important as there were reports in the literature on the time invariance of the ERI model (7). Future work may extend on this study by providing evidence on the model invariance and stability and its association with poor health reported in this study. Moreover, this study recruited students from one university only, and therefore selection bias cannot be ruled out. Hence, the results of this study cannot be generalized to other students at different universities in Jordan.

In conclusion, the ERI model can be used to measure stress among university students, and to generate evidence on ERI association with several alarming health-related issues. There is an urgent need to develop training programs that offer effective strategies for students to help them cope with their academic-related stress. Moreover, any interventional programs can be targeted at reducing academic-related stress by involving all relevant parties, including university officials, granting agencies and families of students. This study demonstrates that any efforts aimed solely at the students, will not yield optimal results.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by King Abdallah University Hospital Institutional

Review Board at Jordan University of Science and Technology (Approval number: 15/114/2018). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

MA conceptualized the study and managed data collection and curation and analysis. TE acquired funding and IRB approvals and supervised data collection. MA drafted the manuscript and TE revised the final manuscript. Both authors contributed to the article and approved the submitted version.

## FUNDING

TE received a grant from the Deanship of Research, Jordan University of Science and Technology (Grant number: 145/2018) to support fieldwork and data collection. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

## ACKNOWLEDGMENTS

This work was supported by a grant from the Deanship of Research, Jordan University of Science and Technology (Grant number: 145/2018). We would like to thank Dr. Samah Shatnawi for her insightful tips and guidance on analyzing the data. Our gratitude goes to Omar Hourani and Heba Abu Al-Foul for their assistance in the recruitment of students during qualitative study and the fruitful discussions on the interpretations of the data.

## REFERENCES

1. Siegrist J. Adverse health effects of high-effort/low-reward conditions. *J Occup Health Psychol.* (1996) 1:27. doi: 10.1037/1076-8998.1.1.27
2. Siegrist J, Li J, Montano D. Psychometric properties of the effort-reward imbalance questionnaire. Düsseldorf: Heinrich Heine University Düsseldorf. (2014).
3. Siegrist J. Effort-reward imbalance at work: Theory, measurement and evidence. Düsseldorf: Heinrich Heine University Düsseldorf. (2012).
4. Kanwal N, Isha ASN. The Moderating Effects of Social Media Activities on the Relationship Between Effort-Reward Imbalance and Health and Wellbeing: A Case Study of the Oil and Gas Industry in Malaysia. *Front Public Health.* (2022) 10. doi: 10.3389/fpubh.2022.805733
5. Backé E-M, Seidler A, Latza U, Rosnagel K, Schumann B. The role of psychosocial stress at work for the development of cardiovascular diseases: a systematic review. *Int Arch Occup Environ Health.* (2012) 85:67–79. doi: 10.1007/s00420-011-0643-6
6. Rantanen J, Feldt T, Hyvönen K, Kinnunen U, Mäkitangas A, Schumann B. Factorial validity of the effort-reward imbalance scale: evidence from multi-sample and three-wave follow-up studies. *Int Arch Occup Environ Health.* (2013) 86:645–56. doi: 10.1007/s00420-012-0798-9
7. De Jonge J, Van Der Linden S, Schaufeli W, Peter R, Siegrist J. Factorial invariance and stability of the effort-reward imbalance scales: a longitudinal analysis of two samples with different time lags. *Int J Behav Med.* (2008) 15:62. doi: 10.1007/BF03003075
8. Almadi T, Cathers I, Chow CM. An Arabic version of the effort-reward imbalance questionnaire: translation and validation study. *Psychol Rep.* (2013) 113:275–90. doi: 10.2466/08.14.PR0.113x10z7
9. Montano D, Li J, Siegrist J. The measurement of Effort-Reward Imbalance (ERI) at work. In: *Work Stress and Health in a Globalized Economy.* Cham, NY: Springer International Publishing. (2016). p. 21–42. doi: 10.1007/978-3-319-32937-6\_2
10. Li J, Shang L, Wang T, Siegrist J. Measuring effort-reward imbalance in school settings: a novel approach and its association with self-rated health. *J Epidemiol.* (2010) 20:111–8. doi: 10.2188/jea.JE20090057
11. Chandola T, Siegrist J, Marmot M. Do changes in effort-reward imbalance at work contribute to an explanation of the social gradient in angina? *Occup Environ Med.* (2005) 62:223–30. doi: 10.1136/oem.2004.016675
12. Aboa-Éboulé C, Brisson C, Blanchette C, Maunsell E, Bourbonnais R, Abdous B, et al. Effort-reward imbalance at work and psychological distress: a validation study of post-myocardial infarction patients. *Psychosom Med.* (2011) 73:448–55. doi: 10.1097/01.PSY.0000399790.82499.d7
13. Kumari M, Head J, Marmot M. Prospective study of social and other risk factors for incidence of type 2 diabetes in the Whitehall II study. *Arch Intern Med.* (2004) 164:1873–80. doi: 10.1001/archinte.164.17.1873
14. Kuper H, Singh-Manoux A, Siegrist J, Marmot M. When reciprocity fails: effort-reward imbalance in relation to coronary heart disease and health functioning within the Whitehall II study. *Occup Environ Med.* (2002) 59:777–84. doi: 10.1136/oem.59.11.777

15. Bourbonnais R, Jauvin N, Dussault J, Vézina M. Psychosocial work environment, interpersonal violence at work and mental health among correctional officers *Int J Law Psychiatry*. (2007) 30:355–68. doi: 10.1016/j.ijlp.2007.06.008
16. Tian M, Zhou X, Yin X, Jiang N, Yafei W, Jiali Zhang, et al. Effort-reward imbalance in emergency department physicians: prevalence and associated factors. *Front Public Health*. (2022) 10. doi: 10.3389/fpubh.2022.793619
17. Låftman SB, Modin B, Östberg V, Hoven H, Plenty S. Effort–reward imbalance in the school setting: Associations with somatic pain and self-rated health. *Scand J Public Health*. (2015) 43:123–9. doi: 10.1177/1403494814561818
18. Hilger-Kolb J, Diehl K, Herr R, Loerbroks A. Effort-reward imbalance among students at German universities: associations with self-rated health and mental health *Int Arch Occup Environ Health*. (2018) 91:1011–20. doi: 10.1007/s00420-018-1342-3
19. Allisey A, Rodwell J, Noblet A. An application of an extended effort-reward imbalance model to police absenteeism behaviour. *Pers Rev*. (2016) 45:663–80. doi: 10.1108/PR-06-2014-0125
20. Wege N, Li J, Muth T, Angerer P, Siegrist J. Student ERI: psychometric properties of a new brief measure of effort-reward imbalance among university students *J Psychosom Res*. (2017) 94:64–7. doi: 10.1016/j.jpsychores.2017.01.008
21. Joksimovic L, Starke D, v.d. Knesebeck O, Siegrist J. Perceived work stress, overcommitment, and self-reported musculoskeletal pain: across-sectional investigation. *Int J Behav Med*. (2002) 9:122–38. doi: 10.1207/S15327558IJBM0902\_04
22. Siegrist J, Starke D, Chandola T, Godin I, Marmot M, Niedhammer I, et al. The measurement of effort–reward imbalance at work: European comparisons. *Soc Sci Med*. (2004) 58:1483–99. doi: 10.1016/S0277-9536(03)00351-4
23. Dragano N, von dem Knesebeck O, Rodel A. Psychosoziale arbeitsbelastungen und muskulo-skeletale beschwerden: bedeutung für die prävention. *J Public Health*. (2003) 11:196. doi: 10.1007/BF02956410
24. van Vegchel N, de Jonge J, Bakker A, Schaufeli W. Testing global and specific indicators of rewards in the effort-reward imbalance model: does it make any difference? *Eur J Work Organ Psychol*. (2002) 11:403–21. doi: 10.1080/13594320244000265
25. Dahlin M, Joneborg N, Runeson B. Stress and depression among medical students: a cross-sectional study. *Med Educ*. (2005) 39:594–604. doi: 10.1111/j.1365-2929.2005.02176.x
26. Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Acad Med*. (2006) 81:354–73. doi: 10.1097/00001888-200604000-00009

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 AbuAlSamen and El-Elmat. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Mental Health Literacy and Mental Health Information-Seeking Behavior in Iranian University Students

Seyed Mohammad Hossein Mahmoodi<sup>1</sup>, Masoud Ahmadzad-Asl<sup>1</sup>, Mohammad Eslami<sup>2</sup>, Mohadeseh Abdi<sup>2</sup>, Yasamin Hosseini Kahnemoui<sup>2</sup> and Maryam Rasoulia<sup>1\*</sup>

<sup>1</sup> Mental Health Research Center, School of Behavioral Sciences and Mental Health, Iran University of Medical Sciences, Tehran, Iran, <sup>2</sup> Faculty of Medicine, Iran University of Medical Sciences, Tehran, Iran

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Say How Ong,  
Institute of Mental Health, Singapore  
Christina Athanasopoulou,  
University of West Attica, Greece  
Ricardo Gusmão,  
University of Porto, Portugal

### \*Correspondence:

Maryam Rasoulia  
rasoulia.m@gmail.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

Received: 10 March 2022

Accepted: 23 May 2022

Published: 13 June 2022

### Citation:

Mahmoodi SMH, Ahmadzad-Asl M,  
Eslami M, Abdi M, Hosseini  
Kahnemoui Y and Rasoulia M (2022)  
Mental Health Literacy and Mental  
Health Information-Seeking Behavior  
in Iranian University Students.  
Front. Psychiatry 13:893534.  
doi: 10.3389/fpsy.2022.893534

**Background:** Inadequate Mental health literacy (MHL) is a problem worldwide. Research is limited in developing countries and about positive MHL. This study measured the disease-oriented MHL and positive MHL and investigated their association. In addition, this study explored the mental health information-seeking behavior among undergraduate students in Iran.

**Methods:** This study recruited undergraduate students of Tehran public universities through multistage stratified random sampling to undertake an analytical cross-sectional study. MHL was measured using Mental Health Literacy Scale (MHLS) and Mental Health Positive Knowledge (MHPK). Participants' most used mental health information sources and their trust in them were also inspected.

**Results:** A total of 543 students participated in this study. On average, the participants achieved about 65% of the total possible MHLS score, and 71% of participants showed sufficient MHPK score. The "internet" was the most used source for receiving and searching for mental health information. The most trusted source was "health care staff". This study detected no correlation between disease-oriented MHL and positive MHL.

**Conclusions:** Mental health literacy of Iranian students still seems to be insufficient. As disease-oriented MHL and positive MHL were not correlated, specific educational interventions for each domain are needed. Although the internet is the main source of mental health knowledge, the trust of student in it is low. This issue should be taken into consideration in designing online educational interventions.

**Keywords:** health literacy, information-seeking behavior, mental health literacy, trust, student

## INTRODUCTION

Mental health literacy (MHL) is receiving increasing attention as a modifiable contributing factor in mental health. Jorm et al. coined the term mental health literacy (MHL) in 1997, inspired by the well-known concept of health literacy (1, 2). Further investigators tried to expand the concept, and recently four domains are suggested to construct the MHL: (1) understanding good mental health, i.e., mental health promotion, which is also known as positive MHL; (2) being familiar with mental disorders and treatments; (3) stigma against mental illness and treatment; and (4) help-seeking behavior competency (3).

Low MHL is related to various adverse mental health outcomes and is considered a significant contributing factor in alleviating mental problems and improving the mental health of individuals and the public (1, 4–7). Inadequate MHL, however, is a global problem, especially in developing countries (4, 6). Studies in the Middle East indicate poor MHL even in health care staff (4, 8–11). Similarly, the limited investigations in Iran showed low depression literacy and high stigma among medical students and other individuals (12–16). Most of the MHL studies around the world are disease-oriented, that is, they are focused on mental disorders, stigma, and help-seeking (3, 6). Positive MHL, therefore, is rarely studied, and it has not been evaluated in Iran.

Mental health information-seeking behavior includes the main channels people use for searching or receiving mental health information and how they assess and trust them (17). In Iran, there is an evident increase in using the internet as a source of health information (12, 18, 19). Iran's internet infrastructure has developed considerably in recent years; hence an updated evaluation of mental health information-seeking behavior in adults is needed.

Despite the number of MHL research, most studies have been conducted in Western countries and are limited to the awareness of depression and schizophrenia (4, 6). Many studies have used vignette-based instrument which is argued as weak methodology (1, 4). In the available studies on MHL, positive MHL is a neglected dimension. Additionally, the relationship between disease-oriented MHL and positive MHL remains unknown. Another gap is that the best methods to educate MHL in Iranians are not identified despite the use of several evidence-based interventions in developed countries (20–22). Understanding students' mental health information-seeking behavior is necessary to design more efficient educational programs, but it is less inspected, especially in developing countries.

This study aimed to (1) assess the level of disease-oriented MHL and positive MHL and examine their correlation in an Iranian population, and (2) explore participants' mental health information-seeking behavior.

## METHODS

### Study Design and Population

This cross-sectional research is carried out in Tehran, the capital of Iran, from April to December 2019. Undergraduate students of public universities in Tehran were the study's target population. All students with basic internet skills could be included. There were no exclusion criteria.

### Sampling

Undergraduate students of Tehran public universities were recruited by multistage random sampling. Strata were the six major disciplines that students can apply for at the beginning of their university education which are as follows: Mathematics & Physics, Natural Sciences, Humanities, Arts, Foreign Languages, and Career & Technical Education. The sample size of each discipline was calculated based on the number of admitted students from each discipline in the last 4 years which was

extracted from annual application forms. One or two universities were selected randomly as clusters from each stratum. Likewise, at each university, some classes were chosen randomly as clusters from the table of the semester's active lessons. The whole of each selected class was included in the study. A sample size of 475 students was calculated using the formula of estimating a mean.

## Assessment

An online form was prepared for data collection. It contained an informed consent form, background data checklist, mental health information-seeking behavior questions, and two MHL questionnaires. The checklist assessed respondents' history of mental health services use or acquaintances with mental illness. Respondents were also asked to specify whether they were originally from a village, a small town, or a big city and indicate their parents' education level. We also asked them to specify the number of their roommates and rooms at their homes to calculate the household crowding index, which is used as an indirect indicator of participants' socioeconomic status. This continuous variable can be divided into three categories <1, 1–2, and more than 2. Higher numbers and especially numbers above 2 are correlated to lower socioeconomic and worse health status (23). The design of health information-seeking behavior questions was inspired by some questions of the Health Information National Trends Survey and assessed information sources that participants mainly used to passively receive and actively search for mental health topics (24). Participants were also requested to indicate how often they can trust each source on Likert's 5 points scale.

## Measurements

*The Mental Health Literacy Scale* (MHLS), introduced by O'Connor and Casey in 2015, assesses 3 of 4 dimensions of MHL, including knowledge about mental disorders, stigma, and help-seeking behavior (25). It is reported as both a valid and reliable tool with Cronbach's  $\alpha$  of 0.873 and test-retest reliability ( $r = 0.797$ ,  $p < 0.001$ ). The original version has 35 questions with a 4 or 5 points Likert scale. The Persian version includes 23 questions and a possible score of 23 to 106, and is reported as a valid and reliable version (26). According to a systematic review that evaluated various MHL measures in 2016, MHLS showed strong properties and was one of the recommended instruments (20).

*Mental Health Positive Knowledge* (MHPK) is invented in 2017 and is the first instrument to evaluate positive MHL, i.e., knowledge about good mental health, which is one of the four dimensions of MHL. The average of all ten short questions of this instrument makes up the final score from 0 to 5. As a preliminary cut-off, developers considered lower than 4.00 averages as an index of insufficient positive MHL. They showed its validity and reliability with McDonald's  $\omega$  of 0.84. The Persian version is also valid and reliable, with Cronbach's  $\alpha$  of 0.81 (27).

## Statistical Analysis

Mean and the standard deviation is used to describe MHL levels. The association between MHLS and MHPK was tested by using Pearson's correlation. The statistical significance and power level were considered 0.05 and 80%, respectively. SPSS Statistics for Windows, version 16 (SPSS Inc., Chicago, Ill., USA) was used.



## RESULTS

A total of 543 undergraduate students participated in this study; background characteristics are presented in **Table 1**. The response rate was 30%.

### Mental Health Literacy

The mean ( $\pm$ SD) MHLS and MHPK were 69.59 ( $\pm$ 7.77) and 4.09 ( $\pm$ 0.73), respectively. There was no statistically significant difference in MHLS scores between study branches ( $p = 0.054$ ), but MHPK was significantly lower in the “Career & Technical Education” branch ( $p = 0.004$ ; **Table 2**). According to the preliminary cut-off, the frequency of students who had an insufficient level of MHPK was 151 (29.2%).

**TABLE 1** | Background characteristics and associated frequencies (%); for age and household crowding index the mean ( $\pm$ SD) is presented.

Age	20.75 ( $\pm$ 2.74)
Household crowding index	1.25 ( $\pm$ 0.62)
<b>Gender</b>	
Females	327 (60.3%)
Males	215 (39.7%)
<b>Mother's university education</b>	
Yes	223 (41.1%)
No	319 (58.9%)
<b>Father's university education</b>	
Yes	264 (49.0%)
No	274 (51.0%)
<b>Habitat of origin</b>	
Village	17 (3.2%)
Town	132 (24.5%)
City	390 (72.3%)
<b>Mental illness in acquaintances</b>	
Yes	160 (29.7%)
No	379 (70.3%)
<b>Mental health service use</b>	
No	350 (64.7%)
Yes	191 (35.3%)

SD, standard deviation.

**TABLE 2** | The frequency of undergraduate students in each study branch and their mental health literacy scores.

	Frequency	MHLS (mean $\pm$ SD)	MHPK (mean $\pm$ SD)
Mathematics & physics	133	70.48 $\pm$ 7.85	4.12 $\pm$ 0.66
Natural sciences	129	70.02 $\pm$ 7.47	4.17 $\pm$ 0.69
Humanities	117	70.13 $\pm$ 7.43	4.23 $\pm$ 0.54
Arts	24	70.56 $\pm$ 8.63	3.92 $\pm$ 0.88
Foreign languages	13	65.76 $\pm$ 5.76	4.00 $\pm$ 1.37
Career & technical education	124	67.98 $\pm$ 8.10	3.88 $\pm$ 0.84
Total	543	69.59 $\pm$ 7.77	4.09 $\pm$ 0.73

MHLS, Mental Health Literacy Scale; MHPK, Mental Health Positive Knowledge; SD, standard deviation.

Parents' higher education showed a significant association with higher MHLS ( $p$ -values  $< 0.001$ ) but not MHPK. A mental illness in acquaintances was also associated only with higher MHLS ( $p$ -value  $< 0.001$ ). In contrast, females scored significantly higher on MHPK ( $p$ -value  $< 0.001$ ) but not MHLS. History of mental health service use showed significant associations with better scores in both measures (both  $p$ -values  $< 0.001$ ). Finally, no significant correlation was detected between MHPK and MHLS scores.

### Mental Health Information-Seeking Behavior

In receiving mental health information, the most used mediums were “internet-based social media” and “school or university education”. The most used sources to search for mental health information were “search engines and websites” and “health care staff”. Students who preferred “School or University Education” or “health care staff” to find information showed the highest MHLS, and those whose choice was “internet-based social media” or “traditional or herbal healer” scored lowest ( $p = 0.002$ ). The most trusted source was “health care staff” followed by “books, magazines or newspapers”. On the other hand, “television & radio”, “internet-based social media”, and “other smartphone applications” were among the least trusted mediums (**Table 3**).

## DISCUSSION

On average, participants achieved about 65% of the total possible disease-oriented MHL score. According to the developers' preliminary cut-off, about 30% of participants showed insufficient positive MHL (7). The most used sources

**TABLE 3** | The percentage of using each source as the main source for receiving and searching for mental health information and rating of trust from 1 (lowest) to 5 (highest) to each one.

Sources of mental health information	Main receiving source	Main searching source	Trust (mean $\pm$ SD)
School or University Education	16.7%	3.0%	3.27 $\pm$ 0.97
Books, magazines or newspapers	12.2%	8.0%	3.51 $\pm$ 0.81
Family or friends	11.9%	8.3%	3.04 $\pm$ 0.87
Traditional or herbal healer	2.0%	3.5%	2.92 $\pm$ 1.07
Health care staff	7.2%	12.8%	4.00 $\pm$ 0.83
Television or radio	8.7%	0.6%	2.98 $\pm$ 0.94
Search engines & websites	16.1%	53.1%	3.35 $\pm$ 0.72
Internet-based social media	24.3%	10.0%	2.78 $\pm$ 0.90
Other smartphone applications	0.9%	0.7%	2.36 $\pm$ 0.85

SD, standard deviation.

for receiving and searching for mental health information were “Internet-based Social Media” and “Search engines and websites”, respectively. The most trusted source was “health care staff”. No correlation was detected between disease-oriented MHL and positive MHL.

Although there are no reference values for MHL in Iranian populations, its level in this study seems to be unsatisfactory, regarding that respondents have not achieved around 35% of the total MHLS score. In a previous investigation using the Persian version of MHLS, the results were lower compared to the current study (26). As participants in our study were young and educated, such a difference is expected. Various studies have concluded that the MHL of different Iranian populations is not adequate (14–16, 28). For example, the depression literacy of Tehran medical students is described as very low in 2015 and of Tehran residents as low in 2019 (12, 13). These results are consistent with known unsatisfactory MHL in the middle east and developing countries (4, 8, 10, 11).

Females have shown higher MHL than males in most of the investigations; however, this result is not replicated in the educated sample of this study and the 2015 study of Tehran medical students (4, 6, 12, 13). To explain the similar MHL level in male and female students in these two studies it can be hypothesized that university education may improve males’ MHL and therefore eliminates such gender differences. It would be consistent with the known improving effect of education on MHL (6). Furthermore, in the current study, “school and university education” was one of the most used and trusted sources of mental health information.

Similar to previous findings, in this study, the lower socioeconomic status estimated by the household crowding index was correlated with lower MHLS, although its strength was minimal (4). According to the literature, rural populations tend to show lower MHL (4). In this study, participants from villages showed less but not statistically significant average MHLS scores. There is no MHL investigation in the rural populations of Iran.

Measuring positive MHL is necessary to attain a comprehensive picture of individuals’ MHL but hasn’t been studied until recently (3, 6, 7). Our educated participants showed lower positive MHL compared to the previous study on Norwegian youth (7). Such differences may arise simply from instrument translation effects or may be considered as a replication of known differences between developing and developed countries’ MHL. Similar to Norwegian youth, females showed higher positive MHL than males in this study.

Examining the association between disease-oriented MHL and positive MHL showed no correlation. It has implications for mental health education interventions in the way that positive MHL may not be improved through conventional disease-oriented mental health education and may need independent interventions.

Similar to developed and some developing countries, the internet was the most used source of mental health information in this study (19, 29, 30). However, television which was as important as the internet in previous surveys is rarely used now (12, 18). However, according to investigations in other countries, increasing the use of the internet for mental health

information-seeking is not necessarily translated to more help-seeking behavior so it needs to be explored in Iran (31).

Although respondents showed shallow trust in “Internet-based Social Media”, they declared that they receive most of their mental health information from this channel. It suggests that users may be exposed to a massive amount of inaccurate data. It is known that incorrect health information is harmful, and it can be addressed by improving people’s e-health literacy, another area of future research in Iranian populations (32).

Unlike social media, participants show high trust in health staff, but they don’t receive much information from them. This can raise questions about the attitude and practice of staff in improving clients’ health knowledge and clients’ potential barriers to receiving such education. Sayarifard et al. in their 2015 study of Tehran medical students discussed that the low trust in the mental health system might be the cause of low help-seeking (12). However, the high trust in health care staff in the current study is contrary to that explanation and shows the need for further exploration.

This study was novel to evaluate the MHL of different study branches of university students, assess positive MHL, and examine its correlation to disease-oriented MHL. Using the random sampling method is a strength. A limitation of the findings is the considerable reduction of the number of questions in the Persian version of MHLS which has happened during its translation and validation process (26). Although the resulting version has satisfactory psychometric properties, its coverage has been reduced compared to the original version. Nevertheless, using MHLS which is not limited to one disorder like depression and is not vignette-based is a strength of the current study. Finally, our response rate is less than what is expected in academic samples and this is a potential source of selection bias (33).

This study provides a comprehensive evaluation of mental health literacy (MHL) in a sample of Iranian undergraduate university students and shows that some deficiencies are still noticeable. Current educational interventions, therefore, need to be improved. Regarding the significant portion of participants with insufficient positive MHL, it can also be considered to create educational programs focused on mental health improving factors. Our findings don’t show a correlation between positive MHL and disease-oriented MHL so designing specific educational materials for each domain seems reasonable. Implementing such programs and evaluating their efficacy can be the next move in future research in this field. For designing such interventions, our results on mental health information-seeking behavior and trust would help to find the most efficient mediums.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the Iran

University of Medical Sciences with the reference number of IR.IUMS.FMD.REC.1397.173. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

SM contributed to the design of the work, data acquisition, analysis, interpretation, and drafting of the manuscript. MA-A and MR contributed to the conception and design, data interpretation, and revising of the manuscript critically. ME,

MA, and YH contributed to designing the study, data collection, statistical analysis, and constructing the final manuscript. All authors approved the final version.

## ACKNOWLEDGMENTS

The authors would like to appreciate the valuable contributions made by Marzieh Rastkardar, Zahra Jabari, Sahar Emami, Kiyana Shirsavar, and Elaheh Khodadust, medical students of Iran University of Medical Sciences, in preparing requirements for implementation and data acquisition.

## REFERENCES

- Spiker DA, Hammer JH. Mental health literacy as theory: current challenges and future directions. *J Mental Health*. (2019) 28:238–42. doi: 10.1080/09638237.2018.1437613
- Jorm AF. Mental health literacy: empowering the community to take action for better mental health. *Am Psychol*. (2012) 67:231–43. doi: 10.1037/a0025957
- Wei Y, McGrath PJ, Hayden J, Kutcher S. Mental health literacy measures evaluating knowledge, attitudes and help-seeking: a scoping review. *BMC Psychiatry*. (2015) 15:291. doi: 10.1186/s12888-015-0681-9
- Furnham A, Swami V. Mental health literacy: A review of what it is and why it matters. *Int Perspect Psychol Res Pract Consult*. (2018) 7:240–57. doi: 10.1037/ipp0000094
- Noroozi A, Khademolhosseini F, Lari H, Tahmasebi R. The mediator role of mental health literacy in the relationship between demographic variables and health-promoting behaviours. *Iran J Psychiatry Behav Sci*. (2018) 12:e12603. doi: 10.5812/ijpbs.12603
- Venkataraman S, Patil R, Balasundaram S. Why mental health literacy still matters: a review. *Int J Commun Med Public Health*. (2019) 6:2723. doi: 10.18203/2394-6040.ijcmph20192350
- Bjornsen HN, Eilertsen MEB, Ringdal R, Espnes GA, Moksnes UK. Positive mental health literacy: development and validation of a measure among Norwegian adolescents. *BMC Public Health*. (2017) 17:717. doi: 10.1186/s12889-017-4733-6
- Ghuloum S, Bener A, Burgut FT. Epidemiological survey of knowledge, attitudes and health literacy concerning mental illness in a national community sample: a global burden. *J Prim Care Community Health*. (2010) 1:111–8. doi: 10.1177/2150131910372970
- Bener A, Ghuloum S. Gender differences in the knowledge, attitude and practice towards mental health illness in a rapidly developing Arab society. *Int J Soc Psychiatry*. (2011) 57:480–6. doi: 10.1177/0020764010374415
- Al-Yateem N, Rossiter R, Robb W, Ahmad A, Elhalik MS, Albloshi S, et al. Mental health literacy among pediatric hospital staff in the United Arab Emirates. *BMC Psychiatry*. (2017) 17:390. doi: 10.1186/s12888-017-1556-z
- Al-Yateem N, Rossiter RC, Robb WF, Slewa-Younan S. Mental health literacy of school nurses in the United Arab Emirates. *Int J Ment Health Syst*. (2018) 12:1–13. doi: 10.1186/s13033-018-0184-4
- Sayarifard A, Ghadirian L, Mohit A, Eftekhari M, Badpa M, Rajabi F. Assessing mental health literacy: what medical sciences students' know about depression. *Med J Islam Repub Iran*. (2015) 29:161.
- Ghadirian L, Sayarifard A. Depression literacy in urban and suburban residents of Tehran, the Capital of Iran; Recognition, help seeking and stigmatizing attitude and the predicting factors. *Int J Prev Med*. (2019) 10:134. doi: 10.4103/ijpvm.IJPVM\_166\_18
- Bahrami MA, Bahrami D, Chaman-Ara K. The correlations of mental health literacy with psychological aspects of general health among Iranian female students. *Int J Ment Health Syst*. (2019) 13:59. doi: 10.1186/s13033-019-0315-6
- Safa M, Farhadi ali, Khordbin B. Attitude of Khorramabad high school students towards psychiatric disorders. *Safa Yafteh*. (2003) 5:51–6.
- Sharifi V, Mojtabai R, Shahrivar Z, Alagband-Rad J, Zarafshan H, Wissow L. Child and adolescent mental health care in Iran: current status and future directions. *Arch Iran Med*. (2016) 19:797–804.
- Lambert SD, Loiseleur CG. Health information-seeking behavior. *Qual Health Res*. (2007) 17:1006–19. doi: 10.1177/1049732307305199
- Alishahi-Tabriz A, Sohrabi M-R, Kiapour N, Faramarzi N. Addressing the changing sources of health information in Iran. *Int J Prev Med*. (2013) 4:33–41.
- Esmailzadeh S, Ashrafi-Rizi H, Shahrzadi L, Mostafavi F. A survey on adolescent health information seeking behavior related to high-risk behaviors in a selected educational district in Isfahan. *PLoS ONE*. (2018) 13:206647. doi: 10.1371/journal.pone.0206647
- Wei Y, McGrath PJ, Hayden J, Kutcher S. Measurement properties of tools measuring mental health knowledge: a systematic review. *BMC Psychiatry*. (2016) 16:297. doi: 10.1186/s12888-016-1012-5
- Gilham C, Austen EL, Wei Y, Kutcher S. Improving mental health literacy in post-secondary students: field testing the feasibility and potential outcomes of a peer-led approach. *Can J Commun Ment Health*. (2018) 37:1–12. doi: 10.7870/cjcmh-2018-002
- Conceição V, Rothes I, Gusmão R. The effects of a video-based randomized controlled trial intervention on depression stigma and help-seeking attitudes in university students. *Psychiatry Res*. (2022) 308:114356. doi: 10.1016/j.psychres.2021.114356
- Melki IS, Beydoun HA, Khogali M, Tamim H, Yunis KA. Household crowding index: a correlate of socioeconomic status and inter-pregnancy spacing in an urban setting. *J Epidemiol Commun Health*. (2004) 58:476–80. doi: 10.1136/jech.2003.012690
- National Cancer Institute. *Health Information National Trends Survey (HINTS)*. (2018). 22. Available from: <https://hints.cancer.gov/about-hints/learn-more-about-hints.aspx> (accessed October 22, 2018).
- O'Connor M, Casey L. The Mental Health Literacy Scale (MHLS): a new scale-based measure of mental health literacy. *Psychiatry Res*. (2015) 229:511–6. doi: 10.1016/j.psychres.2015.05.064
- Ghaedamini Harouni G, Sajjadi H, Forouzan AS, Ahmadi S, Ghafari M, Vameghi M. Validation of the Persian version of the mental health literacy scale in Iran. *Asia Pac Psychiatry*. (2021) 14:e12447. doi: 10.1111/appy.12447
- Mahmoodi MH, Ahmadzad-Asl M, Rasoulzadeh M. Mental health positive knowledge questionnaire: translation and cultural adaptation and psychometric properties. *Yektaweb J*. (2021) 21:139–59.
- Sayarifard A, Ghadirian L. Mental health literacy in Iran: an urgent need for a remedy. *Int J Prev Med*. (2013) 4:741–4.
- Montagni I, Donisi V, Tedeschi F, Parizot I, Motrico E, Horgan A. Internet use for mental health information and support among European university students: the e-MentH project. *Digital Health*. (2016) 2:205520761665384. doi: 10.1177/2055207616653845
- Alduraywish SA, Altamimi LA, Aldhuwayhi RA, AlZamil LR, AlZeghayer LY, Alsaleh FS, et al. Sources of health information and their impacts on medical knowledge perception among the Saudi Arabian population: Cross-sectional study. *J Med Int Res*. (2020) 22:e14414. doi: 10.2196/14414
- Kauer SD, Mangan C, Sanci L. Do online mental health services improve help-seeking for young people? a systematic review. *J Medical Int Res*. (2014) 16:e66. doi: 10.2196/jmir.3103
- Tennant B, Stellefson M, Dodd V, Chaney B, Chaney D, Paige S, et al. eHealth literacy and Web 2.0 health information seeking behaviors among baby boomers and older adults. *J Med Int Res*. (2015) 17:e70. doi: 10.2196/jmir.3992

33. Baruch Y. Response rate in academic studies — a comparative analysis. *Hum Relat.* (1999) 52:421–38. doi: 10.1177/001872679905200401

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in

this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Mahmoodi, Ahmadzad-Asl, Eslami, Abdi, Hosseini Kahnamoui and Rasouljan. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Internet Addiction, Symptoms of Anxiety, Depressive Symptoms, Stress Among Higher Education Students During the COVID-19 Pandemic

Beata Gavurova<sup>1\*</sup>, Samer Khouri<sup>2</sup>, Viera Ivankova<sup>2</sup>, Martin Rigelsky<sup>3</sup> and Tawfik Mudarri<sup>2</sup>

<sup>1</sup> Department of Addictology, First Faculty of Medicine, Charles University and General University Hospital in Prague, Prague, Czechia, <sup>2</sup> Institute of Earth Resources, Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, Košice, Slovakia, <sup>3</sup> Department of Marketing and International Trade, Faculty of Management and Business, University of Prešov, Prešov, Slovakia

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Ravi Philip Rajkumar,  
Jawaharlal Institute of Postgraduate  
Medical Education and Research  
(JIPMER), India  
Ana Querido,  
Polytechnic Institute of Leiria, Portugal  
Rui Raposo,  
University of Aveiro, Portugal

### \*Correspondence:

Beata Gavurova  
beata.gavurova@lf1.cuni.cz

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 10 March 2022

**Accepted:** 16 May 2022

**Published:** 14 June 2022

### Citation:

Gavurova B, Khouri S, Ivankova V,  
Rigelsky M and Mudarri T (2022)  
Internet Addiction, Symptoms of  
Anxiety, Depressive Symptoms, Stress  
Among Higher Education Students  
During the COVID-19 Pandemic.  
Front. Public Health 10:893845.  
doi: 10.3389/fpubh.2022.893845

Poor mental health is a growing concern among young people during the coronavirus disease 2019 (COVID-19) pandemic. The aim of this study was to assess the associations of Internet addiction with depressive symptoms, anxiety symptoms, and stress in higher education students during the COVID-19 pandemic, as well as to examine these mental health problems in the context of study-related characteristics. The research sample consisted of 3,099 participants from the Czech Republic (CZ: 1,422) and Slovak Republic (SK: 1,677). The Internet Addiction Test (IAT), the Generalized Anxiety Disorder (GAD-7) scale, the Patient Health Questionnaire for depressive symptoms (PHQ-9), and the Perceived Stress Scale (PSS) were used to measure mental health problems. The analyses also included demographic data (gender and age) and study-related characteristics (form of study, degree of study, field of study, distance between college and home, and housing during the semester). Based on the results of frequency and descriptive analyses, the prevalence of mental health problems was high. The most serious levels of Internet addiction (IAT cut-off point  $\geq 50$ ), to which attention should be paid, were found in 3.5% of Czech and 6.2% of Slovak students. Using the standard cut-off point of GAD-7  $\geq 10$ , 14.1% of Czech and 11.6% of Slovak students were identified with anxiety symptoms. Regarding the PHQ-9 with the cut-off point  $\geq 10$ , 23.4% of Czech and 19.1% of Slovak students had depressive symptoms, which should be addressed. Using the PSS cut-off point  $\geq 27$ , 12.9% of Czech students and 9.1% of Slovak students perceived high stress. The quantile regression analysis showed that Internet addiction was positively associated with anxiety symptoms, depressive symptoms, and stress in all of the analyzed cases ( $p$ -value  $< 0.001$ ). In terms of study-related characteristics, the binomial logistic regression analysis revealed that risk factors for mental health problems in Czech and Slovak students were mainly full-time form of study and living away from home during the semester. Internet addiction, anxiety symptoms, depressive symptoms, and stress are issues that require increased attention,



and professionals and policy-makers should implement interventions to effectively prevent and help students with psychological problems.

**Keywords:** mental health problems, young people, college, IAT, GAD-7, PHQ-9, PSS

## INTRODUCTION

Mental health is a fundamental value that covers various areas of people's everyday lives, including psychological, emotional, and social wellbeing. It plays a crucial role in how individuals feel, think, and act. Mental health is important throughout life, and the college years are no exception. It is at this time of life that psychological problems are common and college students are often considered one of the most vulnerable population groups (1–3). This may be due to the fact that studying at college is a stressful and challenging time. Higher education students are exposed to academic pressure, many tasks, a new community, and individuation from family (4). In addition, there are many other psychological, academic, biological, lifestyle, social, and financial factors for poor mental problems among students (5–8). All of the above-mentioned facts call for increased attention to students in mental health research.

To make matters worse, the coronavirus disease 2019 (COVID-19) pandemic added to the difficulties and stressors of students (9–13). The pandemic disrupted their daily routine, exposed them to previously unknown conditions and situations, and required them to adapt to online learning. These additional challenges affected students' wellbeing and their ability to learn successfully, resulting in poor academic performance (12, 14). The seriousness of the problem is underlined by the fact that during the COVID-19 pandemic, college students reported significantly higher rates of depression, anxiety, and stress compared to the general population (15). Students' health concerns are definitely a risk factor for future psychological problems (16); following this, fear of COVID-19 has been shown in many studies to be a significant predictor of mental health disorders (17, 18). In addition to health concerns, many other factors related to lockdown have contributed to this situation, such as sudden changes in lifestyle, distant relationship with parents, lack of social support and social interaction, increased concerns on academic performance, increased concerns on financial situation, or disruptions to sleeping patterns (13, 17, 19). Changes in study context and habits also played an important role, with distance learning affecting students' mental health (14). It is also possible to note that, during the COVID-19 pandemic, internet-addicted students had lower learning satisfaction in online learning environments (20). Thus, in the context of the COVID-19 pandemic, it is also possible to speak of a mental health crisis (21). Psychological problems worsened as the lockdown time increased (22).

The COVID-19 pandemic also showed how digital technologies are intertwined with many areas of students' lives. In fact, digital technologies and the Internet provided many students around the world with important connections to university or college, fellow students, friends, and family during the long weeks to months of lockdown, as well as entertainment

and distraction, which are much needed in challenging times. This underlines the positive aspect of digital technologies and the Internet, but there are also concerns about their impact on young minds (23). In fact, the time spent on these types of technologies is directly related to poor mental health (24). Even before the pandemic, evidence clearly pointed to the dark side of the Internet and its problematic use (25). In this context, Lozano-Blasco et al. (26) investigated this issue using a meta-analysis and found that Internet addiction in young adults was high in recent years. Many studies also revealed that problematic Internet usage by students was associated with mental health problems such as depression, anxiety, and stress (27–31). In other words, students with Internet addiction have a high likelihood developing mental health problems (32). In addition, it should be pointed out that Internet addiction is associated with academic burnout in college students (33). Thus, the same technologies that were useful tools in educating students during the pandemic may be a threatening element in terms of their mental health. This is the reason there is a need to strengthen the monitoring of Internet use among college students during the COVID-19 pandemic (27).

Following the above-mentioned facts, college students around the world often suffered from stress, depression, and anxiety during the COVID-19 pandemic, as evidenced by the high prevalence rates found in various studies (13, 15, 18, 34–36). These problems vary from student to student, but it is well-known that study-related characteristics such as degree of study (37–39), form of study (39, 40), field of study (3, 41–43), and distance from home and family while studying (44–47) play an important role. Evidence shows that all of the mentioned mental health problems are positively associated with inadequate-self and hated-self among college students (48). These problems can seriously damage students' mental health, and thus disrupt their educational and psychosocial functioning, as well as the future direction of their lives. The fact is that mental health problems may lead to many academic, social, and physical health consequences (49, 50). These problems are also highly related to the use of addictive substances, emphasizing the importance of the issue (51–53). In addition, students with mental health symptoms are more often isolated in their social communities, which can make their problems even worse (50). Although evidence points to low levels of stigmatizing attitudes toward psychological problems among students, to which education may have contributed, there is still a reluctance to interact with an individual who has psychological problems (54). These experiences can further exacerbate poor mental health and lead to serious consequences (55, 56).

In Czech Republic and Slovak Republic, the COVID-19 situation was critical. By comparing the pre-pandemic and pandemic periods, Hajduk et al. (57) found that there was a clear increase in mental health problems, such as depression and anxiety, among Slovak college students. Similar results have been

shown in the Czech general population (58, 59). In addition to depression and anxiety (60), Slovak students also showed increased levels of stress during the pandemic (61). There is less evidence in Czech Republic, but even in that country, it was possible to speak of worrying levels of stress, depression, and anxiety during the pandemic, not only among students but also in the general population (48, 62). In fact, action is needed at the social, professional, legislative, and political levels (23, 63, 64).

The studies mentioned in the previous paragraph focused on students' mental health problems against the background of online learning during the lockdown, but studies examining the associations between the use of digital technologies, including the Internet, and psychological problems are lacking. Despite the importance of the issue, Czech Republic and Slovak Republic are neighboring countries with a common history and social priorities, where, to the knowledge of the authors of this study, no similar research can be found. Moreover, this issue is poorly addressed at a practical level in both countries (65), which is reflected in the lack of effective interventions and measures in the higher education environment. For these reasons, this study examines how Internet addiction was associated with depressive symptoms, anxiety symptoms, and perceived stress among Czech and Slovak college students during the COVID-19 pandemic, when education was predominantly distant based and online tools were used. At the same time, this study focuses on mental health problems in the context of study-related characteristics. This may provide novel and valuable findings for professionals and policy-makers in Czech Republic and Slovak Republic. Understanding the presented issue is important in the design and implementation of programs aimed at reducing and preventing mental disorders in the higher education environment during and after the pandemic.

## MATERIALS AND METHODS

The aim of this study was to assess the associations of Internet addiction with depressive symptoms, anxiety symptoms, and stress in higher education students from Czech Republic and Slovak Republic during the COVID-19 pandemic, as well as to examine these mental health problems in the context of study-related characteristics. With regard to the main aim, the following research questions (RQ) and hypotheses (H) were formulated:

RQ1: Are there significant associations of Internet addiction with symptoms of depression, symptoms of anxiety, and stress among higher education students in Czech Republic and Slovak Republic?

H1a: It is assumed that there is a significant association between Internet addiction and depressive symptoms in the selected countries.

H1b: It is assumed that there is a significant association between Internet addiction and anxiety symptoms in the selected countries.

H1c: It is assumed that there is a significant association between Internet addiction and stress in the selected countries.

RQ2: Are there significant relationships of Internet addiction, symptoms of depression, symptoms of anxiety, and stress

with selected study-related characteristics of Czech and Slovak students?

H2a: It is assumed that there is a significant relationship of Internet addiction, depressive symptoms, anxiety symptoms, and stress with the degree of study in the selected countries.

H2b: It is assumed that there is a significant relationship of Internet addiction, depressive symptoms, anxiety symptoms, and stress with the form of study in the selected countries.

H2c: It is assumed that there is a significant relationship of Internet addiction, depressive symptoms, anxiety symptoms, and stress with the field of study in the selected countries.

H2d: It is assumed that there is a significant relationship of Internet addiction, depressive symptoms, anxiety symptoms, and stress with housing during the semester in the selected countries.

H2e: It is assumed that there is a significant relationship of Internet addiction, depressive symptoms, anxiety symptoms, and stress with distance between home and college in the selected countries.

## Research Sample

Data collection was conducted through an electronic survey (Google Forms) during the COVID-19 pandemic in both countries. All questionnaire items were mandatory. For all forms of data collection, all information and the same instructions were provided to participants. The questionnaire was shared in Czech Republic in the Czech language and in Slovak Republic in the Slovak language. The selected scales were translated from English to Slovak. The verification of the translation was carried out by assessing the English and Slovak versions by three experts. After incorporating the comments, the scales were sent to a group of students ( $n = 20$ ) who were asked to evaluate the comprehensibility of the items. After incorporating the students' comments, the questionnaire was translated from Slovak into Czech. The translation and clarity were assessed by three experts (assessing the English, Slovak, and Czech versions) and the comments were subsequently incorporated. The Slovak version was chosen for translation into Czech on the basis of the great similarity between the Slovak and Czech languages. The national language versions of the questionnaires are provided in **Supplementary Tables 1–4**.

The data collection took place in two phases. The first phase was implemented in both countries from March to May 2020, while the second phase was implemented after the summer vacation, i.e., from October to December 2020. It should be noted that ~80% of all data were collected in both countries during the first phase. In the first phase, college and university authorities (deans, vice deans, study officers) as well as student councils were contacted by emails and asked to provide a questionnaire to students with a request to complete it. In this phase, the questionnaire was also shared on social media not only in an organic way (free sharing in student groups and on fan pages) but also in a paid way (paid advertising). In the second phase, emails were sent to teachers (addresses were obtained from publicly available contact databases) asking them to share the questionnaire with students of specific study fields at individual colleges and universities. The purpose was to complete the planned sample structure. In the data

collection process, the effort was to obtain a research sample as representative as possible with respect to the population under study. Sample characteristics were fitted on the basis of two main criteria. Ensuring an appropriate representation of colleges and universities was a primary concern, and thus 80% of all colleges and universities in both countries were included in the research. At the same time, fields of study were controlled in order to obtain a reasonable proportion of study fields with a minimum of 30 observations.

In the data cleaning process, the following numbers of statistical units were excluded from the sample: 179 (5.3%)—based on a control item in the questionnaire to filter out “automated” responses (agreeing that one million has six zeros, while a numerical value of 1,000,000 was also given); 27 (0.8%)—based on the identification of a system error in the recording of responses; 87 (2.6%)—based on students’ foreign nationality (the research was focused on domestic students only). The final research sample consisted of 3,099 participants (Czech Republic = 1,422; Slovak Republic = 1,677). Some identifying characteristics were incorrectly reported by the participants (e.g., 1,000 as the year of birth); therefore, these responses were deleted and treated as missing data in the analyses. **Table 1** presents the sample structure separately for Czech Republic (CZ) and Slovak Republic (SK).

## Ethical Considerations

All aspects of the research were conducted in adherence to the Declaration of Helsinki. The study was approved by the General University Hospital in Prague as individual research (Ref. 915/20 S-IV). Informed consent to participate in the research was provided by all study participants, who received adequate information about the study objectives, required data, and expected benefits. The participants were informed that their responses would not be judged and their confidentiality would be respected. They were also informed that all participation was confidential, anonymous, voluntary, and harmless. The participants did not receive any financial reward. Also, all study participants completed the questionnaire consisting of demographic data, items assessing Internet addiction, items assessing anxiety symptoms, items assessing depressive symptoms, and items assessing perceived stress.

## Measures

The analyses included four measures of mental health (anxiety symptoms, depressive symptoms, stress, Internet addiction) based on existing scales presented in previous studies. The study conducted by Kroenke et al. (66) provided measures of anxiety and depressive symptoms. These were the *Generalized Anxiety Disorder* (GAD-7) as a 7-item scale, and the *Patient Health Questionnaire* for depressive symptoms (PHQ-9) as a 9-item scale. Both scales offered the following possible responses: (0) not at all, (1) several days, (2) more than half the days, and (3) nearly every day. The total GAD-7 score was the sum of the coded responses and its ranges indicated: no anxiety symptoms (0–4), mild anxiety symptoms (5–9), moderate anxiety symptoms (10–14), and severe anxiety symptoms (15 and more). The severity ranges of the total PHQ-9 score were as follows:

no depressive symptoms (0–4), mild depressive symptoms (5–9), moderate depressive symptoms (10–14), moderately severe depressive symptoms (15–19), and severe depressive symptoms (20 and more).

Another measure was the *Perceived Stress Scale* (PSS) developed by Cohen et al. (67). This scale consisted of 10 items and offered the following responses: (0) never, (1) almost never, (2) sometimes, (3) fairly often, and (4) very often. The total PSS score was the sum of the coded responses and its ranges indicated low stress (0–13), moderate stress (14–26), and high stress (27–40).

The last fourth measure was the *Internet Addiction Test* (IAT) based on an existing scale developed by Young (68). This 20-item scale offered possible responses using a Likert scale: (0) not applicable to your life, (1) rarely, (2) occasionally, (3) frequently, (4) often, and (5) always. The total IAT score could take on a value in ranges indicating no addiction (a normal level of Internet usage) (0–30), mild addiction (31–49), moderate addiction (50–79), and severe addiction (80 and more). Based on the above-mentioned, the higher the total score, the more severe the mental health problem.

The level of reliability (Cronbach’s alpha) was acceptable in all of the analyzed cases (i.e., higher than 0.7). For GAD-7, it was 0.878 in the Czech sample and 0.865 in the Slovak sample. For PHQ-9, it was 0.867 in the Czech sample and 0.861 in the Slovak sample. For PSS, it was 0.757 in the Czech sample and 0.708 in the Slovak sample. For IAT, it was 0.888 in the Czech sample and 0.899 in the Slovak sample.

## Statistical Procedure

The statistical analysis of the data consisted of several analytical procedures. First, frequency and descriptive analyses were used to provide a first look at the data using statistical measures such as mean, standard deviation, 25th percentile, median, 75th percentile, minimum, and maximum. Non-parametric tests of differences were also applied when assessing the descriptive dimension of the data. The Mann-Whitney *U*-test was used for differences between two categories and the Kruskal-Wallis *H*-test was used for differences between three or more categories. In subsequent analytical steps, the quantile regression analysis (with the 25th, 50th, and 75th percentiles) was used to evaluate the associations between Internet addiction (IAT) and mental health problems such as anxiety symptoms (GAD-7), depressive symptoms (PHQ-9), and stress (PSS). In addition, the binomial logistic regression analysis was chosen to assess the relationships between selected study-related characteristics and Internet addiction, anxiety symptoms, depressive symptoms, and stress in higher education students. In this case, the IAT, GAD-7, PHQ-9, and PSS scores were adjusted to a binomial form, with 0 representing the lowest range and 1 representing the other higher ranges of the total scores.

## RESULTS

This section presents the results of the analytical processing, organized according to the applied analysis. The section begins with a statistical description of the data. Subsequently,

**TABLE 1** | Sample structure.

Variable	CZ			SK		
	<i>n</i>	%	% Without missing	<i>n</i>	%	% without missing
<b>Gender</b>						
Male	349	24.5	24.5	606	36.1	36.1
Female	1,073	75.5	75.5	1,071	63.9	63.9
<b>Age</b>						
≤20	193	13.6	13.6	206	12.3	12.3
21–25	891	62.7	62.7	1,239	73.9	74.1
26–30	171	12.0	12.0	143	8.5	8.5
≥31	166	11.7	11.7	85	5.1	5.1
Missing	1	0.1	–	4	0.2	–
<b>Degree of study</b>						
1st degree	658	46.3	46.3	1,140	68.0	68.0
2nd degree	380	26.7	26.7	428	25.5	25.5
Combined 1st and 2nd degree	50	3.5	3.5	41	2.4	2.4
3rd degree	334	23.5	23.5	68	4.1	4.1
<b>Form of study</b>						
Full-time	1,041	73.2	73.2	1,550	92.4	92.4
Part-time	381	26.8	26.8	127	7.6	7.6
<b>Field of study</b>						
Education	277	19.5	19.5	80	4.8	4.8
Humanities & Arts	101	7.1	7.1	78	4.7	4.7
Social, Economic & Legal Sciences	665	46.8	46.8	671	40.0	40.0
Natural Science	50	3.5	3.5	73	4.4	4.4
Design, Technology, Production & Communications	93	6.5	6.5	164	9.8	9.8
Agricultural & Veterinary Sciences	67	4.7	4.7	53	3.2	3.2
Health Service	54	3.8	3.8	180	10.7	10.7
Services (tourism, sports, security, transport, logistics)	69	4.9	4.9	240	14.3	14.3
Informatics, Mathematics & ICT	46	3.2	3.2	138	8.2	8.2
<b>Housing during the semester</b>						
Dormitory	243	17.1	17.1	702	41.9	41.9
Rented accommodation	287	20.2	20.2	139	8.3	8.3
Living with relatives	202	14.2	14.2	68	4.1	4.1
Living with a friend	40	2.8	2.8	30	1.8	1.8
At home	650	45.7	45.7	738	44.0	44.0
<b>Distance between home and college</b>						
≤20.0 kilometers	461	32.4	32.4	400	23.9	24.0
20.1–50.0 kilometers	318	22.4	22.4	357	21.3	21.4
50.1–100.0 kilometers	349	24.5	24.5	424	25.3	25.5
≥100.1 kilometers	294	20.7	20.7	485	28.9	29.1
Missing	0	–	–	11	0.7	–

CZ, Czech Republic; SK, Slovak Republic; *n*, frequency; ICT, Information and Communication Technologies.

it presents the results of a quantile regression analysis evaluating the associations between Internet addiction and anxiety symptoms, depressive symptoms, and stress. This analysis was used to answer RQ1. It concludes by examining the relationships between selected study-related characteristics and Internet addiction, depressive symptoms, anxiety symptoms, and stress among higher education students during the COVID-19 pandemic. The logistic regression analysis was used to answer RQ2.

All analyses were sorted by country as Czech Republic and Slovak Republic are different entities (Czech Republic is a more developed country), despite their common history. Also, the Mann-Whitney U test revealed significant differences between these countries in all variables except IAT ( $p$ -value: PHQ-9 = 0.0015, GAD-7 = 0.0005, PSS = 0.0061, IAT = 0.2562).

**Table 2** shows the results of the descriptive analysis and difference tests of the total scores for Internet addiction (IAT), anxiety symptoms (GAD-7), depressive symptoms (PHQ-9), and

**TABLE 2 |** Results of descriptive analysis and difference tests.

	CZ				SK			
	IAT	GAD-7	PHQ-9	PSS	IAT	GAD-7	PHQ-9	PSS
Mean	25.13	4.71	6.34	19.82	26.01	4.15	5.77	19.28
Standard deviation	12.46	4.61	5.50	5.57	13.45	4.26	5.29	5.27
25th percentile	16.0	1.0	2.0	16.0	16.0	1.0	2.0	16.0
Median	24.0	3.0	5.0	20.0	24.0	3.0	4.0	19.0
75th percentile	33.0	7.0	9.0	24.0	34.0	6.0	8.0	22.0
Minimum	0	0	0	4	0	0	0	2
Maximum	81	21	27	38	90	21	27	39
<b>Test of differences and median measure across sample categories</b>								
<b>Gender</b> (Diff.)	179,496*	140,009.5	157,274*	127,457.5*	280,752*	280,983*	309,466.5	256,159*
Male	25	2	4	17	26.5	2	4	18
Female	24	4	5	20	23	3	4	20
<b>Age</b> (Diff.)	67.87*	25.28*	49.09*	52.69*	22.92*	15.78*	31.66*	18.68*
≤20	25	4	7	21	26	3	5	20
21–25	25	4	5	20	24	3	4	19
26–30	21	3	4	19	25	3	4	19
≥31.00	17	2	3	17	18	1	2	17
<b>Degree of study</b> (Diff.)	6.99	4.28	8.61*	11.53*	2.18	2.92	2.45	4.80
1st degree	24	3	5	20	24	3	4	19
2nd degree	23	3	4	19	24	3	4	19
Combined 1st and 2nd degree	27.5	4	7	21	27	2	3	18
3rd degree	24.5	4	5	20	23	3.5	5	19
<b>Form of study</b> (Diff.)	153,938.5*	178,619.5*	166,294.5*	165,358*	78,613.5*	87,018.5*	78,542*	84,908*
Full-time	25	4	5	20	25	3	4	19
Part-time	20	3	4	19	19	2	3	17
<b>Field of study</b> (Diff.)	22.97*	32.50*	39.63*	47.89*	16.68*	13.99	18.38*	11.89
Education	24	4	6	21	23	3	4	19
Humanities & Arts	24	4	4	19	26.5	4	5.5	20
Social, Economic & Legal Sciences	23	3	4	19	24	3	4	19
Natural Science	27	3	4	19.5	24	2	4	19
Design, Technology, Production & Communications	22	2	3	16	24	2.5	4.5	18
Agricultural & Veterinary Sciences	28	5	9	22	25	4	6	19
Health Service	23.5	5	6	20	23.5	3	4.5	19
Services (tourism, sports, security, transport, logistics)	23	4	4	19	25	3	4	19
Informatics, Mathematics & ICT	30.5	2	5	19.5	28	3	5	19
<b>Housing during the semester</b> (Diff.)	39.74*	6.86*	19.87*	14.79*	31.21*	8.56	11.82*	8.59
Dormitory	27	4	6	20	26	3	4	19
Rented accommodation	25	3	5	19	23	3	5	20
Living with relatives	26	4	5	20	28	3	5	19
Living with a friend	21.5	4	5	20	22.5	2.5	4.5	17
At home	22	3	4	19	22.5	2.5	4	19
<b>Distance between home and college</b> (Diff.)	2.51	1.53	1.81	0.20	4.43	4.09	9.57*	3.00
≤20.0	25	3	5	19	23	3	4	19
20.1–50.0	24	3	5	20	24	3	4	19
50.1–100.0	24	4	5	19	24.5	3	4	19
≥100.1	23	3	5	20	25	3	5	19

CZ, Czech Republic; SK, Slovak Republic; IAT, Internet Addiction Test; GAD-7, Generalized Anxiety Disorder instrument; PHQ-9, Patient Health Questionnaire for depressive symptoms; PSS, Perceived Stress Scale; Diff., difference.

\*significant difference at  $\alpha < 0.05$ .



stress (PSS). With a focus on IAT, it can be pointed out that a score below 30 means no Internet addiction. Based on this, it was possible to conclude that Czech and Slovak students did not report addiction problems, as their mean scores were lower than 30 (IAT mean: CZ =  $25.13 \pm 12.46$ ; SK =  $26.01 \pm 13.45$ ). In both countries, the upper quartile (75th percentile) indicated that 25% of students reported mild or more severe problem behaviors related to Internet addiction. The maximum values indicated that the problem of Internet addiction was very serious for some students. In terms of GAD-7, a score higher than four indicates mild anxiety symptoms, while the mean scores for Czech and Slovak students were slightly above this threshold (GAD-7 mean: CZ =  $4.71 \pm 4.61$ ; SK =  $4.15 \pm 4.26$ ). However, a median score was 3 in both countries, indicating that no anxiety symptoms were present. Based on the 75th percentile, it was possible to state that 25% of students reported mild or more severe anxiety symptoms. The maximum values of the total GAD-7 score achieved in both countries also indicated severe anxiety symptoms in some students. When focusing on PHQ-9, it was possible to confirm that Czech and Slovak students reported mild depressive symptoms, as their mean total scores were in a range from 5 to 9 (PHQ-9 mean: CZ =  $6.34 \pm 5.50$ ; SK =  $5.77 \pm 5.29$ ). Higher scores were also found for stress, where a range of 14–26 indicated moderate stress. The mean PSS score was  $19.82 \pm 5.57$  in Czech Republic and  $19.28 \pm 5.27$  in Slovak Republic.

Regarding the results of the difference tests, significant differences between countries were identified in almost all mental health indicators. The only exception was Internet addiction as measured by the IAT [Mann-Whitney *U*-test statistic (*p*-value): IAT = 976,891.0 (0.137); GAD-7 = 949,355.0 (0.006); PHQ-9 = 951,687.0 (0.008); PSS = 954,841.0 (0.012)]. **Table 2** also presents an analysis of the differences in median scores between the individual categories of students. For comparison purposes, this analysis included the median scores reported by students categorized by age, gender, and study-related characteristics. In most categories, differences were confirmed at the significance level of  $\alpha < 0.05$ . The lowest number of significant differences was found in the categories related to the study degree and distance between college and home. Overall, significant differences in the IAT, GAD-7, PHQ-9, and PSS scores were found between categories related to age, gender, and study-related characteristics in the majority of the analyzed cases.

**Table 3** provides a closer look at the prevalence of mental health problems among Czech and Slovak students during the COVID-19 pandemic. In this context, the focus was on mild (moderate in the case of PSS) and higher levels of severity of mental health problems. On this basis, 27.2% of Czech students met the criteria for mild Internet addiction, 3.4% for moderate Internet addiction, and 0.1% for severe Internet addiction. In the case of Slovak students, these severity ranges were 27, 6, and 0.2%, respectively. The prevalence of mild, moderate, and severe anxiety symptoms among Czech students were 26.2, 9.2, and 4.9%, respectively. In Slovak Republic, mild, moderate, and severe anxiety symptoms occurred in 23, 8.1, and 3.5% of students, respectively. Depressive symptoms among Czech students were as follows: 28.6% of students had mild symptoms, 13.6% had moderate symptoms,

6.4% had moderately severe symptoms, and 3.4% had severe symptoms. Slovak students reported depressive symptoms as follows: 28.6% of students had mild symptoms, 11% had moderate symptoms, 5.4% had moderately severe symptoms, and 2.7% had severe symptoms. The highest prevalence was found for stress. Moderate and high stresses were reported by 74.1 and 12.9% of Czech students, respectively. In Slovak Republic, 79.4% of students reported moderate and 9.1% high stress.

The following quantile regression analysis was used to evaluate the associations between Internet addiction as an independent variable and anxiety symptoms, depressive symptoms, and stress as dependent (explanatory) variables. The analysis included total scores of IAT, GAD-7, PHQ-9, and PSS and was applied in three intervals of the dependent variables:  $\lambda = 0.25$  students with the lowest rate of mental health problem,  $\lambda = 0.5$  students with moderate rate of mental health problem, and  $\lambda = 0.75$  students with the highest rate of mental health problem in terms of GAD-7, PHQ-9, or PSS.

**Table 4** provides the results for the stated hypotheses H1a, H1b, and H1c. Based on the results of the quantile regression analysis, it was possible to confirm the significant and positive associations between Internet addiction and anxiety symptoms, depressive symptoms, and stress in all of the analyzed cases. In other words, higher scores of IAT were associated with higher scores of GAD-7, PHQ-9, and PSS, regardless of the rate of these mental health problems. For a better understanding of the associations, a visualization (**Figure 1**) was created showing the individual observations as well as the linear curves corresponding to the outputs of the regression models. As noted above, a positive trend was evident in all of the analyzed cases.

The following logistic regression analyses were used to assess the relationships between selected study-related characteristics and mental health problems (IAT, GAD-7, PHQ-9, PSS) in their binomial form. For this purpose, the scores for Internet addiction, anxiety symptoms, depressive symptoms, and stress were adjusted as follows: the lowest possible range (“No” for IAT, GAD-7, PHQ-9; “Low” for PSS) was coded as 0, while the other ranges indicating an increased severity of mental health problems were coded as 1. Thus, in binomial form, 0 represented the case where students did not report an increased level of mental health problems, and 1 represented the case where students reported an increased level of mental health problems. The selected study-related characteristics are arranged in separate (**Tables 5–9**). The analysis was also conducted in the variant with the included control variable, which was gender with the reference category—female. A relationship whose significance was evident in both the model without the control variable and the model with the included control variable proved to be more reliable.

**Table 5** focuses on H2a and shows the results of the logistic regression analysis, in which the study degree was considered an independent variable. In terms of Internet addiction (IAT), there was no significant relationship at the level of  $\alpha < 0.05$ . However, a significant relationship at the level of  $\alpha < 0.1$  was observed for the combined first and second degrees. This was evident especially in Czech Republic, where significance was observed in both models. In this case, it was possible to state with caution that

**TABLE 3** | Frequency of mental health problems in severity classification.

IAT		GAD-7		PSS		PHQ-9	
Range	n (%)	Range	n (%)	Range	n (%)	Range	n (%)
<b>CZ</b>							
No	984 (69.2%)	No	849 (59.7%)	Low	186 (13.1%)	No	683 (48%)
Mild	387 (27.2%)	Mild	372 (26.2%)	Moderate	1,053 (74.1%)	Mild	406 (28.6%)
Moderate	49 (3.4%)	Moderate	131 (9.2%)	High	183 (12.9%)	Moderate	193 (13.6%)
Severe	2 (0.1%)	Severe	70 (4.9%)	–	–	Moderately severe	91 (6.4%)
–	–	–	–	–	–	Severe	49 (3.4%)
<b>SK</b>							
No	1,122 (66.9%)	No	1,097 (65.4%)	Low	193 (11.5%)	No	877 (52.3%)
Mild	452 (27%)	Mild	385 (23%)	Moderate	1,331 (79.4%)	Mild	479 (28.6%)
Moderate	100 (6%)	Moderate	136 (8.1%)	High	153 (9.1%)	Moderate	185 (11%)
Severe	3 (0.2%)	Severe	59 (3.5%)	–	–	Moderately severe	90 (5.4%)
–	–	–	–	–	–	Severe	46 (2.7%)

IAT, Internet Addiction Test; GAD-7, Generalized Anxiety Disorder instrument; PHQ-9, Patient Health Questionnaire for depressive symptoms; PSS, Perceived Stress Scale; n, frequency; CZ, Czech Republic; SK, Slovak Republic.

**TABLE 4** | Results of quantile regression analysis—associations between Internet addiction as an independent variable and mental health problems as dependent (explanatory) variables.

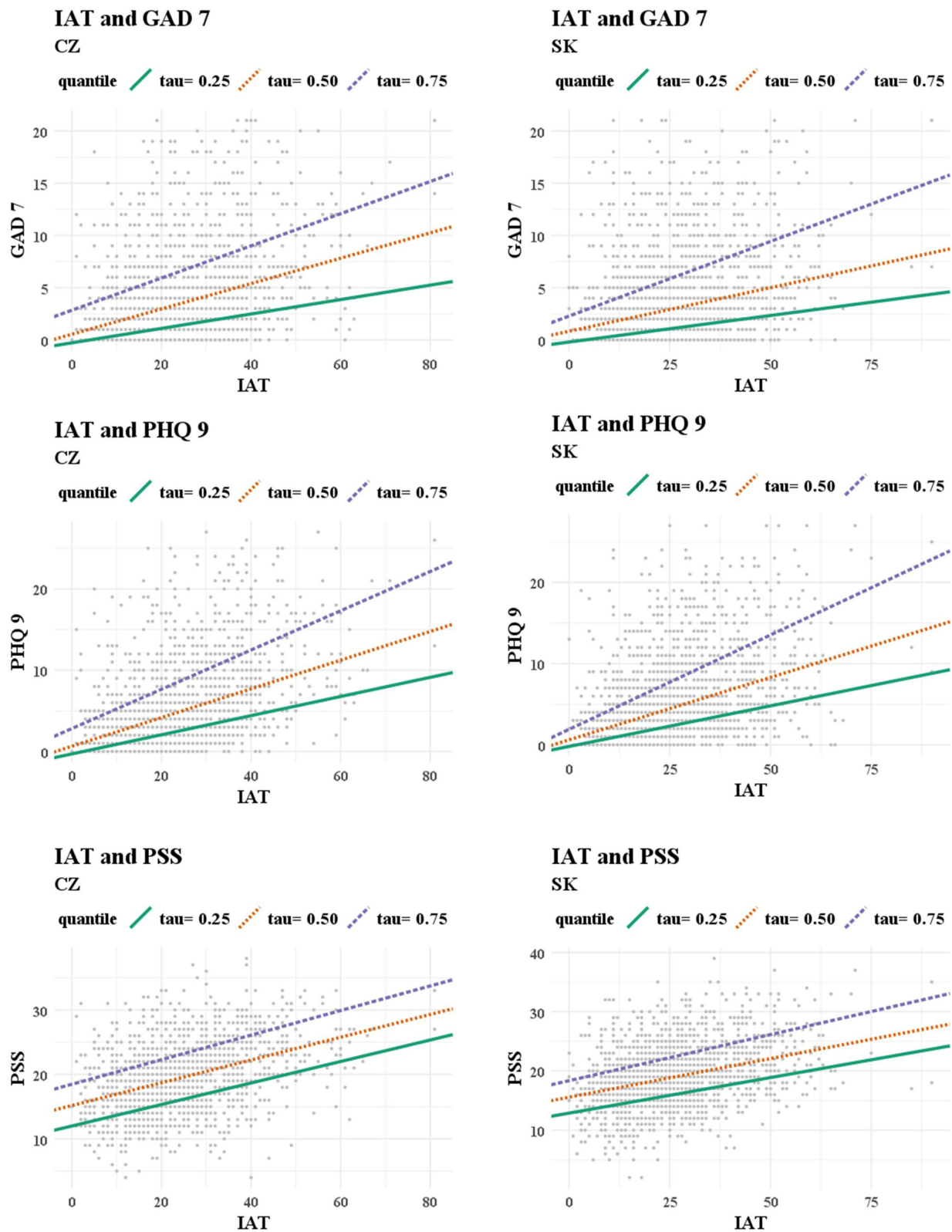
	CZ			SK		
	$\lambda = 0.25$	$\lambda = 0.50$	$\lambda = 0.75$	$\lambda = 0.25$	$\lambda = 0.50$	$\lambda = 0.75$
	Coef. (p-value)	Coef. (p-value)	Coef. (p-value)	Coef. (p-value)	Coef. (p-value)	Coef. (p-value)
<b>H1a (IAT → GAD-7)</b>						
$\alpha$	–0.276 (0.22)	0.545 (0.048)	2.846 (<0.001)	–0.203 (0.241)	0.833 (<0.001)	2.286 (<0.001)
$\beta$	0.069 (<0.001)	0.121 (<0.001)	0.154 (<0.001)	0.05 (<0.001)	0.083 (<0.001)	0.143 (<0.001)
$R^2$	0.041	0.056	0.057	0.021	0.042	0.065
<b>H1b (IAT → PHQ-9)</b>						
$\alpha$	–0.294 (0.265)	0.647 (0.036)	2.828 (<0.001)	–2.0 (0.331)	0.615 (0.016)	1.907 (<0.001)
$\beta$	0.118 (<0.001)	0.176 (<0.001)	0.241 (<0.001)	0.10 (<0.001)	0.154 (<0.001)	0.233 (<0.001)
$R^2$	0.070	0.092	0.107	0.057	0.090	0.115
<b>H1c (IAT → PSS)</b>						
$\alpha$	12.0 (<0.001)	15.18 (<0.001)	18.476 (<0.001)	12.88 (<0.001)	15.565 (<0.001)	18.356 (<0.001)
$\beta$	0.167 (<0.001)	0.176 (<0.001)	0.190 (<0.001)	0.12 (<0.001)	0.13 (<0.001)	0.165 (<0.001)
$R^2$	0.067	0.076	0.080	0.052	0.054	0.072

CZ, Czech Republic; SK, Slovak Republic; Coef., coefficient; IAT, Internet Addiction Test; GAD-7, Generalized Anxiety Disorder instrument; PHQ-9, Patient Health Questionnaire for depressive symptoms; PSS, Perceived Stress Scale.

combined-degree students were more likely to report Internet addiction compared to third-degree students. With a focus on anxiety symptoms (GAD-7), significant relationships were identified for first- and second-degree studies in both countries. The negative  $\beta$  coefficients indicated a lower likelihood of anxiety symptoms in first- and second-degree students compared to third-degree students. Regarding depressive symptoms (PHQ-9), a significant relationship was confirmed for the second degree, especially in Czech Republic. Czech second-degree students were less likely to suffer from depressive symptoms than third-degree students. In Slovak Republic, the significance of this relationship was observed at the level of  $\alpha < 0.1$ . In the case of stress

(PSS), no significant relationship was found at the level of  $\alpha < 0.05$ .

**Table 6** focuses on H2b and presents the results of the logistic regression analysis, in which the form of study was used as an independent variable. Significant relationships were found in most of the analyzed cases. In these significant cases, the results showed that full-time students were more likely to have mental health problems such as Internet addiction (IAT), anxiety symptoms (GAD-7), depressive symptoms (PHQ-9), and stress (PSS) compared to part-time students. Closer and more significant relationships were especially in Czech Republic.



**FIGURE 1 |** Visualization of the associations between Internet addiction and mental health problems (outcomes of regression models).

The results of the logistic regression analysis with the field of study as an independent variable are shown in **Table 7**, which focuses on H2c and evidently provides many diverse results. The study field of Informatics, Mathematics, and Information and Communication Technologies (ICT) was used as the reference category in the regression models. For Internet addiction as measured by the IAT, there were several significant relationships with a negative  $\beta$  coefficient. Based on these results, a lower likelihood of Internet addiction was observed in students of study fields other than Informatics, Mathematics, and ICT. In Czech Republic, they were students of Education, Humanities and Arts; Social, Economic, and Legal Sciences; Design, Technology, Production, and Communications; Health Service, but also Services (tourism, sports, security, transport, logistics). Regarding anxiety symptoms (GAD-7), some significant results were confirmed with apparent discrepancies between countries. Significant relationships with a positive  $\beta$  coefficient were observed especially in Czech students of individual study fields such as Education, Agricultural and Veterinary Sciences, and Health Service. In other words, Czech students of these study fields were more likely to be anxious than students of Informatics, Mathematics, and ICT. Significant relationships with a negative  $\beta$  coefficient were observed especially in Slovak Republic. In this respect, especially Slovak students of Natural Science were less likely to have anxiety symptoms than students of Informatics, Mathematics, and ICT. Several significant results were also found for depressive symptoms (PHQ-9), with countries showing some inconsistencies. Slovak Republic was characterized by a higher number of significant relationships with negative  $\beta$  coefficients. Thus, in particular, Slovak students of study fields other than Informatics, Mathematics, and ICT were less prone to depressive symptoms. With a focus on perceived stress as measured by the PSS, the results pointed in particular to the fact that Czech students of Design, Technology, Production, and Communications were less likely to be stressed compared to students of Informatics, Mathematics, and ICT. At the same time, it was possible to note that Slovak students of Humanities and Arts had a higher likelihood of stress than students of Informatics, Mathematics, and ICT.

**Table 8** focuses on H2d and shows the results of the logistic regression analysis, in which housing during the semester was an independent variable in its binomial form [Away from home (dormitory, rented accommodation, living with relatives, living with a friend) compared to Home]. In terms of Internet addiction (IAT) and depressive symptoms (PHQ-9), significant relationships with a positive  $\beta$  coefficient were confirmed in all of the analyzed cases. In both countries, the results clearly indicated that students who lived away from home during the semester were more likely to suffer from Internet addiction and depressive symptoms than students who lived at home. In the case of anxiety symptoms (GAD-7), a significant relationship was revealed only in Slovak Republic. In this context, being a student living away from home during the semester increased the likelihood of anxiety symptoms during the COVID-19 pandemic. Focusing on perceived stress (PSS), no significant relationship was found at the level of  $\alpha < 0.05$ . The only relationship was observed at the significance level of  $\alpha < 0.1$  in Slovak Republic.

**Table 9** focuses on H2e and presents the results of the logistic regression analysis, in which the distance between home and college was considered an independent variable. It is clear that most of the analyzed cases were not significant. Specifically, only two significant relationships were found in Slovak Republic. In the first case, Slovak students who traveled between 50.1 and 100 km from home to college were less prone to suffer from depressive symptoms than students who traveled more than 100 km. In the second case, Slovak students who traveled 20 km or less from home to college had a lower likelihood of stress than students traveling more than 100 km.

**Figure 2** visualizes the outputs of the logistic regression analyses presented in **Tables 5–9**. The odds ratios of the relationships from the regression models without the control variable are shown separately for both Czech Republic and Slovak Republic. The reference categories (Contrast) are displayed on the right side of the visualization. The size of the squares represents the frequency of observations in each category. The gray squares represent relationships that were not significant even at the level of  $\alpha < 0.1$ . The values in the visualization represent odds ratios, and the further to the right the value is from 1 (vertical line), the higher the likelihood of a mental health problem compared to the reference category. Conversely, the further to the left is the value from 1 (vertical line), the lower the likelihood of a mental health problem compared to the reference category.

## DISCUSSION

### Internet Addiction, Anxiety Symptoms, Depressive Symptoms, and Stress Among Students

Czech and Slovak students showed significant differences in scores for anxiety symptoms, depressive symptoms, and stress. In this respect, Czech students reported higher mean scores indicating their more frequent mental health problems. This means that, despite shared social priorities and a common history in which these countries formed a single entity, each country behaves as a unique living organism and is characterized by its own social specificities. The importance of cross-cultural differences when examining the mental health of students from more than one country was also highlighted by Ochnik et al. (69). Additionally, this study revealed differences between most of the study-specific categories. All these results could be explained by the different measures implemented in the countries during the pandemic.

The overall prevalence of Internet addiction ( $IAT > 30$ ) was 30.7% among Czech and 33.2% among Slovak students during the first wave of the COVID-19 pandemic. The most serious levels of Internet addiction requiring increased attention were identified in 3.5% (moderate: 3.4%, severe: .1%) and 6.2% (moderate: 6%, severe: .2%) of Czech and Slovak students, respectively. Zhu et al. (33) found a similar prevalence and revealed that 28.4% of Chinese students developed Internet addiction, which correlated with their academic burnout. In view of these results, the cut-off point for IAT was  $\geq 50$ . Using the same



**TABLE 5 |** Results of logistic regression analysis with the degree of study as an independent variable.

Ref. cat.: 3rd degree	IAT		GAD-7		PHQ-9		PSS	
	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)
<b>CZ</b>								
1st degree	0.001	1 (0.75–1.33)	−0.408***	0.67 (0.51–0.87)	−0.131	0.88 (0.67–1.14)	0.01	1.01 (0.68–1.5)
2nd degree	−0.196	0.82 (0.6–1.13)	−0.364**	0.7 (0.52–0.94)	−0.299**	0.74 (0.55–1)	−0.184	0.83 (0.54–1.28)
Combined 1st and 2nd	0.539*	1.71 (0.94–3.14)	−0.052	0.95 (0.52–1.72)	0.459	1.58 (0.85–2.95)	0.053	1.05 (0.42–2.63)
Nagelkerke $R^2$		0.006		0.051		0.008		0.002
<b>SK</b>								
1st degree	0.409	1.51 (0.86–2.64)	−0.431*	0.65 (0.4–1.06)	−0.205	0.81 (0.5–1.33)	−0.034	0.97 (0.43–2.16)
2nd degree	0.388	1.47 (0.82–2.64)	−0.609**	0.54 (0.32–0.91)	−0.45*	0.64 (0.38–1.07)	−0.292	0.75 (0.33–1.71)
Combined 1st and 2nd	0.652	1.92 (0.83–4.42)	−0.59	0.55 (0.25–1.25)	−0.623	0.54 (0.24–1.18)	−0.748	0.47 (0.16–1.42)
Nagelkerke $R^2$		0.002		0.011		0.006		0.005
<b>Model with gender as a control variable (Ref. cat.: Female)</b>								
<b>CZ</b>								
1st degree	0.006	1.01 (0.76–1.34)	−0.445 <sup>†</sup>	0.64 (0.49–0.84)	−0.146	0.86 (0.66–1.13)	−0.033	0.97 (0.64–1.45)
2nd degree	−0.201	0.82 (0.59–1.13)	−0.353**	0.7 (0.52–0.95)	−0.289*	0.75 (0.56–1.01)	−0.151	0.86 (0.55–1.34)
Combined 1st and 2nd	0.541*	1.72 (0.94–3.14)	−0.064	0.94 (0.51–1.72)	0.458	1.58 (0.84–2.96)	0.038	1.04 (0.41–2.64)
CV – Gender (Male)	0.161	1.17 (0.91–1.52)	−0.89 <sup>†</sup>	0.41 (0.31–0.54)	−0.475 <sup>†</sup>	0.62 (0.49–0.79)	−1.258 <sup>†</sup>	0.28 (0.21–0.39)
Nagelkerke $R^2$		0.008		0.01		0.021		0.075
<b>SK</b>								
1st degree	0.463	1.59 (0.9–2.8)	−0.467*	0.63 (0.38–1.03)	−0.22	0.8 (0.49–1.31)	−0.15	0.86 (0.38–1.94)
2nd degree	0.435	1.54 (0.86–2.78)	−0.642**	0.53 (0.31–0.89)	−0.463*	0.63 (0.38–1.05)	−0.399	0.67 (0.29–1.55)
Combined 1st and 2nd	0.734*	2.08 (0.9–4.82)	−0.645	0.52 (0.23–1.19)	−0.647	0.52 (0.24–1.15)	−0.95*	0.39 (0.13–1.18)
CV – Gender (Male)	0.419 <sup>†</sup>	1.52 (1.23–1.88)	−0.296***	0.74 (0.6–0.92)	−0.131	0.88 (0.72–1.07)	−0.958 <sup>†</sup>	0.38 (0.28–0.52)
Nagelkerke $R^2$		0.015		0.005		0.007		0.049

Significance: \* $p$ -value < 0.1, \*\* $p$ -value < 0.05, \*\*\* $p$ -value < 0.01, <sup>†</sup> $p$ -value < 0.001.

Ref. cat., reference category, IAT, Internet Addiction Test, GAD-7, Generalized Anxiety Disorder instrument, PHQ-9, Patient Health Questionnaire for depressive symptoms, PSS, Perceived Stress Scale, Sig, significance, OR, odds ratio, 95% CI, 95% confidence interval, CZ, Czech Republic, SK, Slovak Republic, CV, control variable.

cut-off point, a similar prevalence (5.8%) was found in students from Thailand (70), while a higher prevalence was observed in American students (16.8%) (31), Spanish students (12.4%) (71), Iraqi students (23%) (32), Bangladeshi students (32.6%) (72), Chinese students (28.4%) (73), Indian students (10.1%) (47), as well as Brazil students (20%) (74). Interestingly, Khazaie et al. (75) found up to 68.8% prevalence of Internet addiction among Iranian medical students. The mean IAT scores indicated a normal level of Internet usage in both countries examined in this study. In comparison, similar scores were reported by students from Turkey (76), while higher scores indicating a mild Internet addiction were found in students from Iran (41), Japan (77), and Australia (78). Overall, it was possible to conclude that Czech and Slovak college students reported less Internet addiction than students from other countries. A possible explanation is cultural differences, which were highlighted in the study by Lozano-Blasco et al. (26).

In Czech Republic, 40.3% of students suffered from anxiety symptoms ( $GAD-7 \geq 5$ ), of whom 26.2% met the criteria for mild anxiety symptoms, 9.2% for moderate anxiety symptoms, and 4.9% for severe anxiety symptoms. For Slovak Republic, anxiety symptoms occurred in 34.6% of students, with 23, 8.1, and 3.5% of students reporting mild, moderate, and severe

anxiety symptoms, respectively. Using the standard cut-off point of  $GAD-7 \geq 10$ , it was possible to identify 14.1% of Czech and 11.6% of Slovak students with anxiety symptoms requiring increased attention. Interestingly, Hajduk et al. (57) used the same cut-off point and found a considerable higher prevalence of anxiety symptoms among Slovak higher education students (43.3%). This can be explained by the fact that the research in this study was conducted during the first wave, when the situation in the country was not so critical. On the contrary, Hajduk et al. (57) conducted their research at the end of 2020, when the situation was much more serious and this may have been reflected in the mental health outcomes. A higher prevalence was also found in Saudi medical students (32.4%) (79), Pakistani medical students (30.3%) (80), Portuguese students (23.9%) (81), Polish students (38.4%) (82), Turkish students (44.5%) (83), and Brazilian students (53.8%) (84). The mean GAD-7 score was 4.71 for Czech students and 4.15 for Slovak students. Czech students reported a similar mean score also in the study conducted by Ochnik et al. (69) during the first wave of the COVID-19 pandemic. Compared to the study examining nine countries (38), higher mean scores were reported by students from Poland (9.2), Slovenia (7.37), Russia (7.48), Turkey (10.41), Israel (7.92), Colombia (8.45), and Ukraine (6.15), while only students from



**TABLE 6 |** Results of logistic regression analysis with the form of study as an independent variable.

Ref. cat.: Part-time	IAT		GAD-7		PHQ-9		PSS	
	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)
<b>CZ</b>								
Full-time	0.639 <sup>†</sup>	1.9 (1.44–2.5)	0.234*	1.26 (0.99–1.61)	0.374***	1.45 (1.15–1.84)	0.475***	1.61 (1.16–2.23)
Nagelkerke $R^2$		0.022		0.003		0.009		0.010
<b>SK</b>								
Full-time	0.458**	1.58 (1.04–2.4)	0.19	1.21 (0.82–1.79)	0.623 <sup>†</sup>	1.86 (1.27–2.73)	0.462*	1.59 (0.97–2.6)
Nagelkerke $R^2$		0.004		0.001		0.009		0.004
<b>Model with gender as a control variable (Ref. cat.: Female)</b>								
<b>CZ</b>								
Full-time	0.632 <sup>†</sup>	1.88 (1.43–2.48)	0.295**	1.34 (1.05–1.72)	0.41 <sup>†</sup>	1.51 (1.19–1.91)	0.605 <sup>†</sup>	1.83 (1.31–2.57)
CV – Gender (Male)	0.112	1.12 (0.86–1.45)	–0.898 <sup>†</sup>	0.41 (0.31–0.53)	–0.51 <sup>†</sup>	0.6 (0.47–0.77)	–1.321 <sup>†</sup>	0.27 (0.19–0.37)
Nagelkerke $R^2$		0.022		0.046		0.025		0.089
<b>SK</b>								
Full-time	0.488**	1.63 (1.07–2.48)	0.174	1.19 (0.8–1.76)	0.617***	1.85 (1.27–2.71)	0.414	1.51 (0.92–2.5)
CV – Gender (Male)	0.418 <sup>†</sup>	1.52 (1.23–1.87)	–0.282***	0.75 (0.61–0.93)	–0.115	0.89 (0.73–1.09)	–0.94 <sup>†</sup>	0.39 (0.29–0.53)
Nagelkerke $R^2$		0.017		0.006		0.010		0.046

Significance: \* $p$ -value < 0.1, \*\* $p$ -value < 0.05, \*\*\* $p$ -value < 0.01, <sup>†</sup> $p$ -value < 0.001.

Ref. cat., reference category; IAT, Internet Addiction Test; GAD-7, Generalized Anxiety Disorder instrument; PHQ-9, Patient Health Questionnaire for depressive symptoms; PSS, Perceived Stress Scale; Sig, significance; OR, odds ratio; 95% CI, 95% confidence interval; CZ, Czech Republic; SK, Slovak Republic; CV, control variable.

Germany reported a lower mean score (2.92). The mean GAD-7 score of Czech students was consistent with this study. A slightly higher mean score was found in China (5.38) (85). It is clear that students from Czech Republic and Slovak Republic suffered from anxiety symptoms during the COVID-19 pandemic to a lesser extent than students from other countries.

During the COVID-19 pandemic, depressive symptoms were prevalent in 52% of Czech students and 47.7% of Slovak students. More specifically, mild depressive symptoms occurred in the same proportion of Czech and Slovak students, i.e., in 28.6%. Moderate depressive symptoms were reported by 13.6% of Czech and 11% of Slovak students, while moderately severe depressive symptoms were reported by 6.4% of Czech and 5.4% of Slovak students. The most severe depressive symptoms were identified in a not negligible proportion of students, i.e., in 3.4% of Czech students and 2.7% of Slovak students. In terms of the cut-off point of PHQ-9  $\geq 10$ , 23.4% of Czech students and 19.1% of Slovak students had depressive symptoms, which needs to be addressed. As seen in anxiety symptoms, this study revealed a lower prevalence of depressive symptoms among Slovak students than the study by Hajduk et al. (57), who conducted their research at the peak of the second wave of the pandemic, when the situation was more dramatic than in the first wave. Slovak students also reported more depression than anxiety, which is in line with the results revealed by Hajduk et al. (57). In comparison, a similar prevalence was observed among Indian doctoral students (26.7%) (86), Chinese students (15.8%) (87), and Korean students (14%) (88), while a higher prevalence was observed among students from Germany (37%) (89), Bangladesh (48.8%) (90), and Malaysia (33.8%) (91). The mean score was 6.34 for Czech students and 5.77 for Slovak students, indicating

mild depressive symptoms. Based on the mean score, mild depressive symptoms were also reported by German (6.77) and Chinese (6.99) students (85). A higher mean score reported Bangladeshi students (9.5) (90), Polish students (11.3) (92), and Greek students (9.36) (93).

In Czech Republic, 74.1 and 12.9% of students reported moderate and high stress, respectively. In Slovak Republic, 79.4% of students reported moderate and 9.1% high stress. Using the cut-off point of PSS  $\geq 27$ , a higher prevalence of stress showed students from India (31.5%) (94) and Saudi Arabia (19.6%) (79). On the other hand, a similar prevalence was found in Sri Lanka (11.8%) (95) and Polish students (43%) (96). The mean PSS score was 19.82 in Czech Republic and 19.28 in Slovak Republic. The perception of stress by Slovak students in this study was in line with the study by Rutkowska et al. (61). A slightly higher mean score was reported by French students (21.9) (97). When comparing the results of this study with those of the study on the mental health of students from nine countries (38), similar mean scores were found in Slovenia (19.83), Ukraine (19.93), Israel (21.51), and Colombia (21.37), while slightly higher mean scores were found in Turkey (22.71), Poland (22.69), Germany (22.54), and Russia (21.98). Czech students' perception of stress was consistent with this study (18.16).

## Associations of Internet Addiction With Anxiety Symptoms, Depressive Symptoms, and Stress

The quantile regression analysis used in this study revealed the significant positive associations of Internet addiction with anxiety symptoms, depressive symptoms, and stress. These findings indicated that higher scores of IAT were associated with higher

**TABLE 7 |** Results of logistic regression analysis with the field of study as an independent variable.

Ref. cat.: Informatics, Mathematics & ICT	IAT		GAD-7		PHQ-9		PSS	
	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)
<b>CZ</b>	−0.764**	0.47 (0.25–0.88)	0.991***	2.69 (1.34–5.42)	0.213	1.24 (0.66–2.32)	0.121	1.13 (0.41–3.1)
Education								
Humanities & Arts	−0.909**	0.4 (0.2–0.83)	0.536	1.71 (0.79–3.7)	−0.393	0.67 (0.34–1.36)	−0.434	0.65 (0.22–1.89)
Social, Economic & Legal Sciences	−0.887***	0.41 (0.23–0.75)	0.579*	1.78 (0.91–3.51)	−0.201	0.82 (0.45–1.49)	−0.143	0.87 (0.33–2.26)
Natural Science	−0.663	0.52 (0.23–1.17)	0.719	2.05 (0.86–4.87)	−0.254	0.78 (0.35–1.73)	0.338	1.4 (0.35–5.58)
Design, Technology, Production & Communications	−1.001***	0.37 (0.18–0.77)	−0.015	0.99 (0.44–2.21)	−0.369	0.69 (0.34–1.41)	−1.362***	0.26 (0.09–0.71)
Agricultural & Veterinary	−0.27	0.76 (0.36–1.62)	1.071***	2.92 (1.29–6.59)	0.474	1.61 (0.75–3.47)	−0.106	0.9 (0.27–2.95)
Health Service	−1.149***	0.32 (0.14–0.74)	1.116***	3.05 (1.31–7.12)	0.278	1.32 (0.59–2.93)	−0.025	0.98 (0.28–3.43)
Services	−0.896**	0.41 (0.19–0.89)	0.413	1.51 (0.66–3.44)	−0.261	0.77 (0.36–1.63)	−0.073	0.93 (0.28–3.04)
Nagelkerke $R^2$	0.015	0.027	0.015	0.037				
SK	−0.618**	0.54 (0.3–0.98)	0.272	1.31 (0.75–2.29)	−0.401	0.67 (0.38–1.16)	0.125	1.13 (0.53–2.42)
Education								
Humanities & Arts	−0.173	0.84 (0.48–1.49)	0.002	1 (0.57–1.77)	0.065	1.07 (0.61–1.88)	1.609**	5 (1.45–17.24)
Social, Economic & Legal Sciences	−0.421**	0.66 (0.45–0.96)	−0.307	0.74 (0.5–1.08)	−0.6***	0.55 (0.38–0.8)	0.419	1.52 (0.92–2.52)
Natural Science	−0.362	0.7 (0.38–1.26)	−0.645**	0.52 (0.28–0.99)	−0.544*	0.58 (0.33–1.03)	0.231	1.26 (0.56–2.81)
Design, Technology, Production & Communications	−0.252	0.78 (0.49–1.24)	−0.104	0.9 (0.56–1.44)	−0.351	0.7 (0.45–1.11)	0.204	1.23 (0.65–2.3)
Agricultural & Veterinary	−0.149	0.86 (0.45–1.65)	0.129	1.14 (0.6–2.17)	−0.162	0.85 (0.45–1.61)	1.204*	3.33 (0.96–11.61)
Health Service	−0.604**	0.55 (0.34–0.87)	0.09	1.09 (0.69–1.72)	−0.351	0.7 (0.45–1.1)	0.528	1.69 (0.88–3.26)
Services	−0.286	0.75 (0.49–1.16)	−0.259	0.77 (0.5–1.19)	−0.603***	0.55 (0.36–0.84)	0.684**	1.98 (1.06–3.71)
Nagelkerke $R^2$		0.008		0.013		0.019		0.017
<b>Model with gender as a control variable (Ref. cat.: Female)</b>								
<b>CZ</b>	−0.691**	0.5 (0.26–0.95)	0.671*	1.96 (0.96–4.01)	0.005	1 (0.53–1.91)	−0.461	0.63 (0.22–1.78)
Education								
Humanities & Arts	−0.849**	0.43 (0.21–0.89)	0.263	1.3 (0.59–2.86)	−0.572	0.56 (0.28–1.15)	−0.922*	0.4 (0.13–1.19)
Social, Economic & Legal Sciences	−0.826***	0.44 (0.24–0.81)	0.307	1.36 (0.68–2.72)	−0.379	0.68 (0.37–1.26)	−0.619	0.54 (0.2–1.43)
Natural Science	−0.598	0.55 (0.24–1.26)	0.429	1.54 (0.64–3.71)	−0.445	0.64 (0.28–1.45)	−0.165	0.85 (0.21–3.46)
Design, Technology, Production & Communications	−1.022***	0.36 (0.17–0.75)	0.086	1.09 (0.48–2.47)	−0.316	0.73 (0.36–1.49)	−1.285**	0.28 (0.1–0.78)
Agricultural & Veterinary	−0.199	0.82 (0.38–1.76)	0.765*	2.15 (0.94–4.93)	0.275	1.32 (0.6–2.87)	−0.67	0.51 (0.15–1.72)
Health Service	−1.087**	0.34 (0.14–0.79)	0.852*	2.35 (0.99–5.56)	0.103	1.11 (0.49–2.49)	−0.503	0.6 (0.17–2.18)
Services	−0.873**	0.42 (0.19–0.91)	0.306	1.36 (0.59–3.14)	−0.335	0.72 (0.34–1.52)	−0.244	0.78 (0.24–2.61)
CV – Gender (Male)	0.163	1.18 (0.89–1.55)	−0.771 <sup>†</sup>	0.46 (0.35–0.62)	−0.458 <sup>†</sup>	0.63 (0.49–0.82)	−1.175 <sup>†</sup>	0.31 (0.22–0.44)
Nagelkerke $R^2$		0.016		0.054		0.030		0.091
<b>SK</b>	−0.465	0.63 (0.34–1.15)	0.132	1.14 (0.65–2.01)	−0.491*	0.61 (0.35–1.07)	−0.271	0.76 (0.35–1.67)
Education								
Humanities & Arts	0.015	1.02 (0.57–1.82)	−0.167	0.85 (0.47–1.52)	−0.042	0.96 (0.54–1.71)	1.142*	3.13 (0.89–10.97)
Social, Economic & Legal Sciences	−0.278	0.76 (0.51–1.11)	−0.44**	0.64 (0.44–0.95)	−0.684 <sup>†</sup>	0.5 (0.34–0.74)	0.064	1.07 (0.63–1.8)
Natural Science	−0.249	0.78 (0.43–1.42)	−0.753**	0.47 (0.25–0.89)	−0.61**	0.54 (0.3–0.97)	−0.047	0.95 (0.42–2.16)
Design, Technology, Production & Communications	−0.295	0.74 (0.47–1.19)	−0.065	0.94 (0.59–1.5)	−0.328	0.72 (0.46–1.14)	0.298	1.35 (0.71–2.54)
Agricultural & Veterinary	−0.001	1 (0.52–1.93)	−0.005	1 (0.52–1.91)	−0.247	0.78 (0.41–1.49)	0.853	2.35 (0.66–8.29)
Health Service	−0.406	0.67 (0.41–1.08)	−0.089	0.91 (0.57–1.47)	−0.465**	0.63 (0.4–1)	0.01	1.01 (0.51–2)
Services	−0.165	0.85 (0.55–1.31)	−0.372	0.69 (0.44–1.08)	−0.674***	0.51 (0.33–0.78)	0.397	1.49 (0.78–2.82)
CV – Gender (Male)	0.38***	1.46 (1.16–1.83)	−0.344***	0.71 (0.56–0.9)	−0.214*	0.81 (0.65–1)	−0.963 <sup>†</sup>	0.38 (0.27–0.53)
Nagelkerke $R^2$		0.017		0.020		0.018		0.055

Significance: \* $p$ -value < 0.1, \*\* $p$ -value < 0.05, \*\*\* $p$ -value < 0.01, <sup>†</sup> $p$ -value < 0.001.

Ref. cat., reference category, IAT, Internet Addiction Test, GAD-7, Generalized Anxiety Disorder instrument, PHQ-9, Patient Health Questionnaire for depressive symptoms, PSS, Perceived Stress Scale, Sig, significance, OR, odds ratio, 95% CI, 95% confidence interval, CZ, Czech Republic, SK, Slovak Republic, CV, control variable.

**TABLE 8 |** Results of logistic regression analysis with housing during the semester as an independent variable.

Ref. cat.: Home	IAT		GAD-7		PHQ-9		PSS	
	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)
<b>CZ</b>								
Away from home	0.434 <sup>†</sup>	1.54 (1.23–1.94)	0.164	1.18 (0.95–1.46)	0.236**	1.27 (1.03–1.56)	0.124	1.13 (0.83–1.54)
Nagelkerke $R^2$		0.014		0.002		0.005		0.001
<b>SK</b>								
Away from home	0.458 <sup>†</sup>	1.58 (1.28–1.95)	0.25**	1.28 (1.05–1.58)	0.195**	1.22 (1–1.47)	0.284*	1.33 (0.98–1.79)
Nagelkerke $R^2$	0.015	0.005	0.003	0.004				
<b>Model with gender as a control variable (Ref. cat.: Female)</b>								
<b>CZ</b>								
Away from home	0.433 <sup>†</sup>	1.54 (1.23–1.94)	0.178	1.19 (0.96–1.48)	0.244**	1.28 (1.03–1.57)	0.145	1.16 (0.84–1.59)
CV – Gender (Male)	0.145	1.16 (0.89–1.5)	–0.88 <sup>†</sup>	0.41 (0.32–0.54)	–0.484 <sup>†</sup>	0.62 (0.48–0.79)	–1.266 <sup>†</sup>	0.28 (0.21–0.39)
Nagelkerke $R^2$		0.015		0.043		0.019		0.075
<b>SK</b>								
Away from home	0.466 <sup>†</sup>	1.59 (1.29–1.97)	0.248**	1.28 (1.04–1.57)	0.194**	1.21 (1–1.47)	0.28*	1.32 (0.98–1.79)
CV – Gender (Male)	0.418 <sup>†</sup>	1.52 (1.23–1.87)	–0.283***	0.75 (0.61–0.93)	–0.123	0.88 (0.72–1.08)	–0.945 <sup>†</sup>	0.39 (0.29–0.53)
Nagelkerke $R^2$		0.028		0.010		0.004		0.047

Significance: \* $p$ -value < 0.1, \*\* $p$ -value < 0.05, \*\*\* $p$ -value < 0.01, <sup>†</sup> $p$ -value < 0.001.

Ref. cat., reference category, IAT, Internet Addiction Test, GAD-7, Generalized Anxiety Disorder instrument, PHQ-9, Patient Health Questionnaire for depressive symptoms, PSS, Perceived Stress Scale, Sig, significance, OR, odds ratio, 95% CI, 95% confidence interval, CZ, Czech Republic, SK, Slovak Republic, CV, control variable.

scores of GAD-7, PHQ-9, and PSS, regardless of the rate of the mental health problems. The stated hypotheses H1a, H1b, and H1c were supported. On this basis, it was possible to agree that Internet addiction is associated with other mental health problems in young people, pointing to a threatening element in their lives. Similar findings can be found in previous studies from other countries (28, 29, 31, 32, 98). In this context, problematic Internet use may be a predictor in screening high-risk students for mental health problems (30). Jiang et al. (27) also revealed that internet addiction was directly related to college students' depression and indirectly predicted students' depression *via* the mediator of social support and sleep quality. On the other hand, under the mediation of fear of missing out, young people with anxiety are more likely to develop Internet gaming disorder, while young people with depression or stress may be susceptible to other types of Internet use disorders (99). In this context, Yang et al. (100) confirmed that baseline Internet addiction had a significant net-predictive effect on follow-up depression, but it was also true that baseline depression had a significant net-predictive effect on follow-up Internet addiction. Thus, the issue can also be considered from the opposite perspective, in which mental health problems such as anxiety, depression, and stress are associated with Internet addiction in students (47, 72–74, 77).

The co-occurrence of Internet addiction and anxiety symptoms, depressive symptoms, and stress in students suggests that Internet addiction is positively associated with other mental health problems (41). The results could be explained by the ongoing pandemic and by the fact that excessive use of the Internet impairs psychological wellbeing, which can be a driver of psychological distress (27–31). Particularly in the context of the COVID-19 pandemic, the Internet has been used as

an effective tool to provide distance education. In this way, the pandemic may have raised concerns about the mental health of young adults and contributed to the development of problematic Internet use by students, which may have further undesirable consequences (101). The Internet can provide a short-term reward during difficult times, but it can also lead to other behavioral addictions (102), with adolescence and young adulthood being the most vulnerable period of life (103). It is important to note that although digital technologies have dramatically changed the environment in which college students connect with each other, gain knowledge, and have fun, they also appear to have some detrimental effects on mental health (24). In addition, these problems adversely affect both academic performance and quality of life and lead to many other social and health consequences (48–53, 55, 56, 104–106). For these reasons, digital technologies should be used with caution, the higher education environment should adapt to this situation (107), and students at risk of Internet addiction should also be monitored for other psychological problems.

## Study-Related Predictors of Mental Health Problems

This study revealed that first- and second-degree students from Czech Republic and Slovak Republic were less likely to suffer from anxiety symptoms than third-degree students. In addition, especially Czech second-degree students were less prone to depressive symptoms compared to third-degree students. This could be due to the fact that the third degree of study is considered to be very demanding and challenging for students. Finally, it was found with caution that mainly Czech students of the combined study were more likely to be addicted to the

**TABLE 9 |** Results of logistic regression analysis with distance between home and college as an independent variable.

Ref. cat.: $\geq 100.1$	IAT		GAD-7		PHQ-9		PSS	
	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)	$\beta$ (Sig)	OR (95% CI)
<b>CZ</b>								
$\leq 20.0$	0.134	1.14 (0.83–1.57)	−0.074	0.93 (0.69–1.25)	−0.137	0.87 (0.65–1.17)	0.061	1.06 (0.69–1.64)
20.1–50.0	0.089	1.09 (0.77–1.54)	0.054	1.06 (0.77–1.46)	−0.112	0.89 (0.65–1.23)	−0.022	0.98 (0.61–1.56)
50.1–100.0	0.04	1.04 (0.74–1.46)	−0.041	0.96 (0.7–1.32)	−0.006	0.99 (0.73–1.36)	0.007	1.01 (0.64–1.59)
Nagelkerke $R^2$		0.001		0.001		0.001		<0.001
<b>SK</b>								
$\leq 20.0$	−0.2	0.82 (0.62–1.09)	−0.232	0.79 (0.6–1.05)	−0.064	0.94 (0.72–1.22)	−0.478**	0.62 (0.41–0.93)
20.1–50.0	−0.135	0.87 (0.65–1.17)	−0.098	0.91 (0.68–1.21)	−0.055	0.95 (0.72–1.24)	−0.134	0.87 (0.56–1.37)
50.1–100.0	0.032	1.03 (0.79–1.36)	−0.099	0.91 (0.69–1.19)	−0.27**	0.76 (0.59–0.99)	−0.174	0.84 (0.55–1.29)
Nagelkerke $R^2$	0.003	0.002	0.004	0.007				
<b>Model with gender as a control variable (Ref. cat.: Female)</b>								
<b>CZ</b>								
$\leq 20.0$	0.124	1.13 (0.82–1.56)	−0.017	0.98 (0.73–1.33)	−0.104	0.9 (0.67–1.21)	0.175	1.19 (0.76–1.86)
20.1–50.0	0.086	1.09 (0.77–1.54)	0.074	1.08 (0.78–1.49)	−0.103	0.9 (0.66–1.24)	0.012	1.01 (0.63–1.63)
50.1–100.0	0.036	1.04 (0.74–1.46)	−0.02	0.98 (0.71–1.35)	0.006	1.01 (0.74–1.38)	0.051	1.05 (0.66–1.68)
CV – Gender (Male)	0.143	1.15 (0.89–1.49)	−0.874 <sup>†</sup>	0.42 (0.32–0.55)	−0.474 <sup>†</sup>	0.62 (0.49–0.79)	−1.274 <sup>†</sup>	0.28 (0.2–0.38)
Nagelkerke $R^2$		0.002		0.041		0.015		0.075
<b>SK</b>								
$\leq 20.0$	−0.211	0.81 (0.61–1.08)	−0.227	0.8 (0.6–1.06)	−0.062	0.94 (0.72–1.23)	−0.469**	0.63 (0.41–0.95)
20.1–50.0	−0.142	0.87 (0.65–1.16)	−0.094	0.91 (0.68–1.21)	−0.053	0.95 (0.72–1.25)	−0.121	0.89 (0.56–1.39)
50.1–100.0	0.036	1.04 (0.79–1.36)	−0.101	0.9 (0.69–1.19)	−0.271**	0.76 (0.59–0.99)	−0.186	0.83 (0.54–1.28)
CV – Gender (Male)	0.41 <sup>†</sup>	1.51 (1.22–1.86)	−0.275**	0.76 (0.61–0.94)	−0.116	0.89 (0.73–1.09)	−0.949 <sup>†</sup>	0.39 (0.29–0.53)
Nagelkerke $R^2$		0.015		0.007		0.005		0.050

Significance: \*\* $p$ -value < 0.05, <sup>†</sup> $p$ -value < 0.001.

Ref. cat., reference category; IAT, Internet Addiction Test; GAD-7, Generalized Anxiety Disorder instrument; PHQ-9, Patient Health Questionnaire for depressive symptoms; PSS, Perceived Stress Scale; Sig, significance; OR, odds ratio; 95% CI, 95% confidence interval; CZ, Czech Republic; SK, Slovak Republic; CV, control variable.

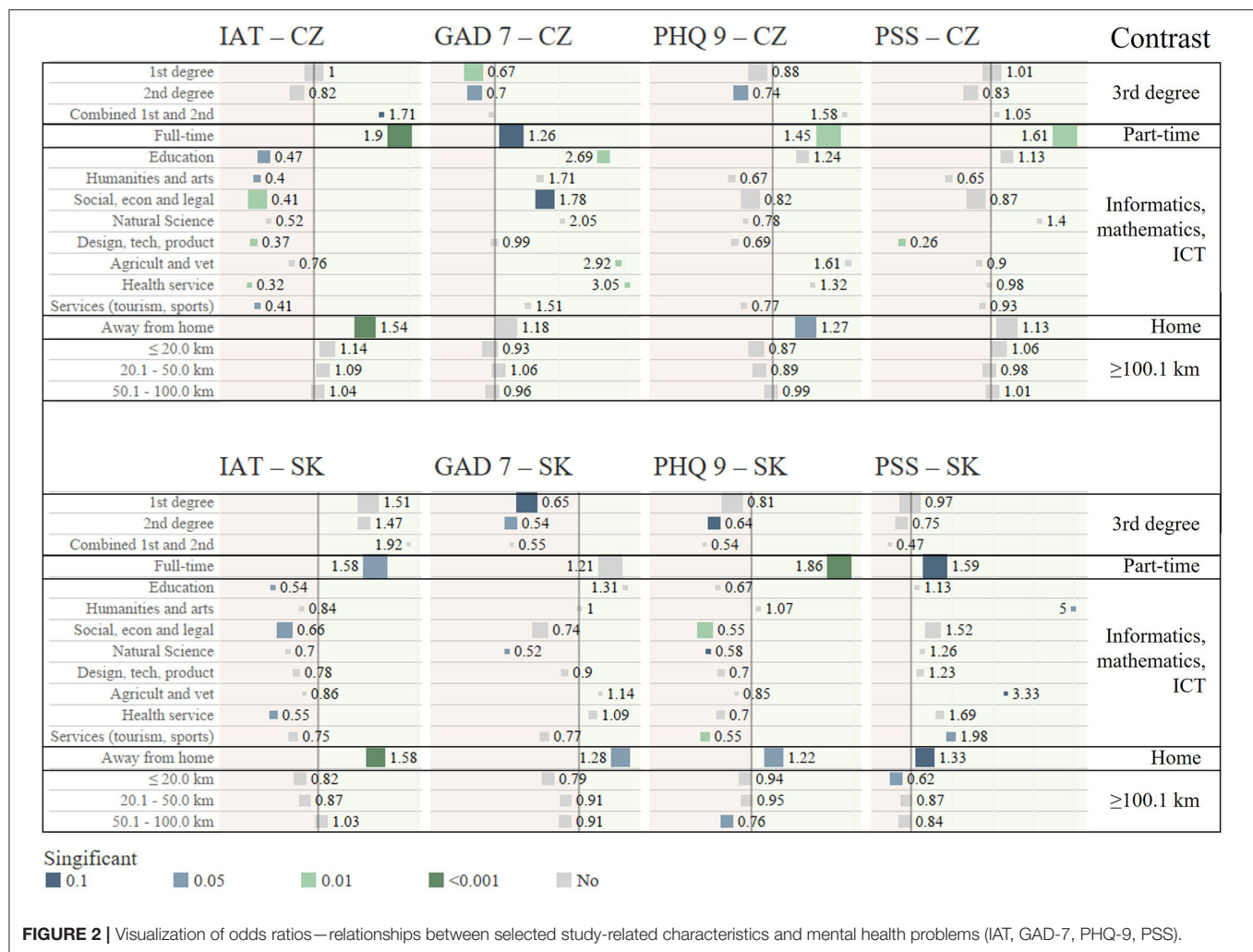
Internet compared to third-degree students. Overall, it can be concluded that the degree of study is a factor that needs increased attention, especially in terms of anxiety. In view of the results, there is a need to monitor third-degree students, as emphasized by Kowalczyk et al. (37). Other studies have also shown that the study degree is an important factor in examining mental health problems among students (38, 39).

This study also contributes to the knowledge that full-time study can be considered a risk factor for students' mental health, as indicated in the studies conducted by Aristovnik et al. (39) or Stallman (40). This fact was observed among both Czech and Slovak students. More specifically, Czech full-time students were more likely to have Internet addiction, anxiety symptoms, depressive symptoms, and stress compared to part-time students, while Slovak full-time students were more likely to have Internet addiction and depressive symptoms than part-time students. A possible explanation may be that full-time students were more vulnerable in terms of the COVID-19 pandemic (108). Also, full-time students are generally under more pressure in the higher education environment. However, the opposite result was found by Esmaeizadeh et al. (109), in which part-time students were considered a risk group. In any case, the findings of this study can be followed up with

further insights into the form of study and mental health in the college environment.

With a focus on the field of study, most of the results indicated that students of Informatics, Mathematics, and ICT were more prone to mental health problems than students of other fields. These findings are indicative of the fact that the field of study should not be underestimated and overlooked when examining students' psychological problems. This has also been demonstrated in other studies, the results of which differ from those of this study (3, 41). For instance, in the study by Lipson et al. (42), students of Humanities and Art and Design were at higher risk for mental health problems, while in the study by Odriozola-González et al. (43), students of Humanities and Arts and Social Sciences and Law appeared to be more vulnerable than students of Engineering and Architecture. A possible explanation for these results could be different difficulties and demands placed on students across various fields of study, which may have been reflected in their psychological distress.

Housing during the semester was also one of the important predictors of psychological problems during the COVID-19 pandemic. Living away from home was considered a risk factor for Internet addiction and depressive symptoms in both countries, and for anxiety symptoms in Slovak Republic. In



these cases, students who lived away from home during the semester were more likely to have mental health problems compared to students who lived at home during the semester. This finding can be explained by distance from family support, infrequent contact, and less satisfaction with living in a dormitory (44, 45). In fact, parents and sufficient time spent with family members play an important role in students' wellbeing (44, 46). The results are consistent with those of Anand et al. (47), who found higher Internet addiction among students staying in rented accommodations. According to Romero-Rodríguez et al. (71), living outside the parents' house indicated higher rates of problematic Internet use, with parents at home showing a positive effect on reducing addictive online behaviors. Thus, the presence of parents at home may be an influential factor in terms of Internet addiction.

Regarding the distance between home and college, most of the analyzed cases were not significant. Slovak students who traveled between 50.1 and 100 km from home to college were less likely to be depressed compared to students who traveled more than 100 km. Also, Slovak students who traveled 20 km or less from home to college were less likely to be stressed than students

traveling more than 100 km. Overall, the stated hypotheses H2a – H2e could be partially supported.

## Implications for Mental Health Policy

In the light of the presented findings, the need for increased mental health monitoring of higher education students can be emphasized. In this case, it appears crucial to identify effective interventions aimed at improving the mental health of Czech and Slovak youth during a difficult period in their lives, such as the COVID-19 pandemic. Professionals and policy-makers in both countries should therefore develop and implement strategies to effectively prevent mental health problems, including Internet addiction, anxiety, depression, as well as perceived stress. Overall, campaigns and programs should focus on full-time students and students living away from home during the semester. Problematic Internet use needs particular attention, as Internet addiction has been found to be associated with other problems that can further impair the mental state of young people. Therefore, efforts to help students addicted to the Internet are more than desirable. In this respect, the results showed that attention should be focused on full-time students, students



living away from home during the semester, and students in Informatics, Mathematics, and ICT. With a reduction of Internet addiction, improvements in mental health in terms of anxiety symptoms, depressive symptoms, and stress can also be expected. Internet use should also be monitored during distance learning, when parents play an important role.

To improve the situation not only during the pandemic, a college-wide approach to students' mental health is needed in both countries, with teachers, assistants, professionals, and parents, but also policy-makers play an important role. It is crucial that Czech and Slovak policy-makers realize the importance of investing sufficient resources in special education and support for mental health care. In this sense, they should focus on strengthening the provision of early interventions and the development of open access mental health services for young people. Colleges and universities themselves should have the right conditions in place, including accessible counseling and equipping teachers with standardized mental health interviews to identify who needs help. Several colleges already have their own support centers that do activities to prevent and help students who need it. However, there are still colleges that do not provide such assistance to students or, on the other hand, do not have the capacity to help everyone. If a college does not have its own capacity, it is still possible to refer students to other organizations that provide this service, even virtually. Internet interventions in particular seem to have great potential in addressing this problem among today's college students. In this sense, a threat can turn into a help. The key is for colleges to communicate these opportunities. In the future, it is essential to collaborate more and help to improve the mental wellbeing of students studying in Czech Republic and Slovak Republic. Last but not least, the connections between colleges and families need to be improved. All of these efforts can lead to more intensive help, reduced stigma, and improved mental health literacy. In this respect, the COVID-19 pandemic can be seen as an opportunity to address a hitherto overlooked problem.

## Strengths and Limitations

The strengths of the study include in particular the large research sample in both countries (given their size) and the coverage of almost all universities and colleges, which increases the credibility of the results. This study also offers an in-depth insight into a serious social problem not only during the pandemic in the two countries that were directly compared. At this point, it should be emphasized that during the pandemic, most Slovak and Czech colleges opted for distance learning, which may increase the likelihood of internet addiction. Therefore, there is a need for research in this area to contribute to the knowledge and understanding of this phenomenon not only in the individual phases of the pandemic but also after the pandemic. Despite the importance of the issue, there is a lack of Slovak and Czech studies focusing on Internet addiction and its relationship with other mental health problems. Thus, this study contributes to addressing the limitations in the current literature by providing valuable findings and a better understanding of the issue. This can be seen as a strength from both a theoretical and practical point of view.

The study did not avoid certain limitations. The first limitation was that the approach to dealing with the pandemic in a higher education environment was not identical in the examined countries. Moreover, it was not the same even within individual colleges in one country. This may have created different conditions for students. In order to eliminate the risk of bias in the results due to different pandemic measures in the countries, the analyses were performed separately for Czech Republic and Slovak Republic. Sorting the analyses by individual colleges would not be practical, but although this step has not been taken, no significant bias in the data is expected. The second potential limitation was a certain disproportionality of the sample, as well as a lower number of observations in some categories. In this context, it should be noted that obtaining an ideal sample during a pandemic is considerably challenging. This is also due to the online survey, which has some limitations in capturing respondents. Given the situation, efforts have been made to obtain as representative a sample as possible. Regarding the lower number of observations, more caution is needed in interpreting the results, especially those related to the study field. Future research ambitions should focus on comparing the pandemic and post-pandemic periods in terms of the mental health problems of higher education students. Future research should also cover more countries.

## CONCLUSIONS

The Internet is an important service and is present in the lives of students for many purposes, such as gaining knowledge for study and having fun. On the other hand, it can be seen as a threat to their mental health, especially during distance learning. This study highlighted the importance of research on the mental health of higher education students during the COVID-19 pandemic in countries such as Czech Republic and Slovak Republic. This research revealed a high prevalence of mental health problems; confirmed the significant associations of Internet addiction with anxiety symptoms, depressive symptoms, and stress; as well as identified study-related characteristics associated with mental health problems in Czech and Slovak students. Therefore, the study provided a deeper insight into poor mental health as a growing concern among young people during the COVID-19 pandemic. Overall, the findings indicated that Internet addiction, anxiety, depression, and stress are issues that need to be addressed among higher education students from Czech Republic and Slovak Republic. There is a need to monitor their psychological problems, while full-time students and students living away from home require special attention. The valuable platform of results revealed by this research can help policy-makers and professionals in their efforts to improve the mental health of young people.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The research was approved by the Ethics Committee of the General University Hospital in Prague as individual research (Ref. 915/20 S-IV). The study was conducted according to the guidelines of the Declaration of Helsinki. The participants provided their informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

BG: conceptualization, writing—original draft preparation, writing—review and editing, visualization, supervision, project administration, and funding acquisition. SK: conceptualization, investigation, writing—original draft preparation, writing—review and editing, supervision, project administration, and funding acquisition. VI: conceptualization, methodology, investigation, resources, writing—original draft preparation, writing—review and editing, visualization, and supervision. MR: conceptualization, methodology, software, data curation, formal analysis, investigation, visualization, writing—original draft preparation, and writing—review and editing. TM: conceptualization, resources, writing—original draft preparation, writing—review and editing, visualization, supervision, and project administration. All authors contributed to the manuscript revision, read, and approved the submitted version.

## FUNDING

This research was funded by the Scientific Grant Agency of the Ministry of Education, Science, Research, and Sport of Slovak Republic and the Slovak Academy Sciences as part of the research project VEGA 1/0797/20: Quantification of Environmental Burden Impacts of the Slovak Regions on Health, Social and Economic System of the Slovak Republic. This research was supported by the Slovak Research and Development Agency under the contract No. APVV-17-0360: Multidimensional analysis of significant determinants of public procurement efficiency with emphasis on the application of Health Technology Assessment in the procurement preparation phase.

## ACKNOWLEDGMENTS

The authors thank the journal editor and reviewers for their guidance and constructive suggestions.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.893845/full#supplementary-material>

## REFERENCES

- Auerbach RP, Alonso J, Axinn WG, Cuijpers P, Ebert DD, Green JG, et al. Mental disorders among college students in the World Health Organization World Mental Health Surveys. *Psychol Med.* (2016) 46:2955–70. doi: 10.1017/S0033291716001665
- Islam S, Akter R, Sikder T, Griffiths MD. Prevalence and factors associated with depression and anxiety among first-year university students in bangladesh: a cross-sectional study. *Int J Ment Health Addict.* (2020). doi: 10.1007/s11469-020-00242-y
- Schofield MJ, O'Halloran P, McLean SA, Forrester-Knauss C, Paxton SJ. Depressive symptoms among Australian university students: who is at risk? *Aust Psychol.* (2016) 51:135–44. doi: 10.1111/ap.12129
- Pedrelli P, Nyer M, Yeung A, Zulauf C, Wilens T. College students: mental health problems and treatment considerations. *Acad Psychiatry.* (2015) 39:503–11. doi: 10.1007/s40596-014-0205-9
- Beiter R, Nash R, McCrady M, Rhoades D, Linscomb M, Clarahan M, et al. The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *J Affect Disord.* (2015) 173:90–6. doi: 10.1016/j.jad.2014.10.054
- Mofatteh M. Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health.* (2020) 8:36–65. doi: 10.3934/publichealth.2021004
- Mohamad NE, Sidik SM, Akhtari-Zavare M, Gani NA. The prevalence risk of anxiety and its associated factors among university students in Malaysia: a national cross-sectional study. *BMC Public Health.* (2021) 21:438. doi: 10.1186/s12889-021-10440-5
- Ladejo J, A. thematic analysis of the reported effect anxiety has on university students. *Educ Urban Soc.* (2021). doi: 10.1177/00131245211062512
- Alyoubi A, Halstead EJ, Zambelli Z, Dimitriou D. The impact of the COVID-19 pandemic on students' mental health and sleep in Saudi Arabia. *Int J Environ Res Public Health.* (2021) 18:9344. doi: 10.3390/ijerph18179344
- Guse J, Weegen AS, Heinen I, Bergelt C. Mental burden and perception of the study situation among undergraduate students during the COVID-19 pandemic: a cross-sectional study and comparison of dental and medical students. *BMJ Open.* (2021) 11:e054728. doi: 10.1136/bmjopen-2021-054728
- Liang Z, Kang D, Zhang M, Xia Y, Zeng Q. The impact of the COVID-19 pandemic on Chinese postgraduate students' mental health. *Int J Environ Res Public Health.* (2021) 18:11542. doi: 10.3390/ijerph182111542
- Salimi N, Gere B, Talley W, Iriooqbe B. College students mental health challenges: concerns and considerations in the COVID-19 pandemic. *J College Stud Psychother.* (2021). doi: 10.1080/87568225.2021.1890298
- Schröpfer K, Schmidt N, Kus S, Koob C, Coenen M. Psychological stress among students in health-related fields during the COVID-19 pandemic: results of a cross-sectional study at selected Munich universities. *Int J Environ Res Public Health.* (2021) 18:6611. doi: 10.3390/ijerph18126611
- Giusti L, Mammarella S, Salza A, Del Vecchio S, Ussorio D, Casacchia M, et al. Predictors of academic performance during the COVID-19 outbreak: impact of distance education on mental health, social cognition and memory abilities in an Italian university student sample. *BMC Psychol.* (2021) 9:142. doi: 10.1186/s40359-021-00649-9
- Kreménková L, Novotný JS, Kvintová J. Two waves of COVID-19 in university setting: mental health and underlying risk factors. *Front Psychol.* (2021) 12:780071. doi: 10.3389/fpsyg.2021.780071
- Borst JM, Frings-Dresen MH, Sluiter JK. Prevalence and incidence of mental health problems among Dutch medical students and the study-related and personal risk factors: a longitudinal study. *Int J Adolesc Med Health.* (2016) 28:349–55. doi: 10.1515/ijamh-2015-0021
- Son C, Hegde S, Smith A, Wang X, Sasangohar F. Effects of COVID-19 on college students' mental health in the United States: Interview survey study. *J Med Internet Res.* (2020) 22:e21279. doi: 10.2196/21279
- Vilca LW, Chávez BV, Fernández YS, Caycho-Rodríguez T, White M. Impact of the fear of catching COVID-19 on mental health in undergraduate students: a predictive model for anxiety, depression, and insomnia. *Curr Psychol.* (2022). doi: 10.1007/s12144-021-02542-5
- Xu Y, Su S, Jiang Z, Guo S, Lu Q, Liu L, et al. Prevalence and risk factors of mental health symptoms and suicidal behavior among university students in Wuhan, China during the COVID-19 pandemic. *Front Psychiatry.* (2021) 12:695017. doi: 10.3389/fpsyg.2021.695017

20. Besalti M, Satıcı SA. Online learning satisfaction and internet addiction during covid-19 pandemic: a two-wave longitudinal study. *TechTrends*. (2022). doi: 10.1007/s11528-022-00697-x
21. Xiong J, Lipsitz O, Nasri F, Lui LMW, Gill H, Phan L, et al. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord*. (2020) 277:55–64. doi: 10.1016/j.jad.2020.08.001
22. Wang D, Zhao J, Ross B, Ma Z, Zhang J, Fan F, et al. Longitudinal trajectories of depression and anxiety among adolescents during COVID-19 lockdown in China. *J Affect Disord*. (2022) 299:628–35. doi: 10.1016/j.jad.2021.12.086
23. UNICEF. *The State of the World's Children 2021. On My Mind: Promoting, Protecting and Caring for Children's Mental Health*. Available online at: <https://www.unicef.org/media/114636/file/SOWC-2021-full-report-English.pdf> (accessed March 3, 2022).
24. Lattie EG, Lipson SK, Eisenberg D. Technology and college student mental health: challenges and opportunities. *Front Psychiatry*. (2019) 10:246. doi: 10.3389/fpsy.2019.00246
25. Kircaburun K, Griffiths MD. The dark side of internet: preliminary evidence for the associations of dark personality traits with specific online activities and problematic internet use. *J Behav Addict*. (2018) 7:993–1003. doi: 10.1556/2006.7.2018.109
26. Lozano-Blasco R, Robres AQ, Sanchez AS. Internet addiction in young adults: a meta-analysis and systematic review. *Comput Hum Behav*. (2022) 130:107201. doi: 10.1016/j.chb.2022.107201
27. Jiang M, Zhao Y, Wang J, Hua L, Chen Y, Yao Y, et al. Serial multiple mediation of the correlation between internet addiction and depression by social support and sleep quality of college students during the COVID-19 epidemic. *Psychiatry Investig*. (2022) 19:9–15. doi: 10.30773/pi.2021.0147
28. Christakis DA, Moreno MM, Jelenchick L, Myaing MT, Zhou C. Problematic internet usage in US college students: a pilot study. *BMC Med*. (2011) 9:77. doi: 10.1186/1741-7015-9-77
29. Wan Ismail WS, Sim ST, Tan KA, Bahar N, Ibrahim N, Mahadevan R, et al. The relations of internet and smartphone addictions to depression, anxiety, stress, and suicidality among public university students in Klang Valley, Malaysia. *Perspect Psychiatr Care*. (2020) 56:949–55. doi: 10.1111/ppc.12517
30. Xie X, Zhu K, Xue Q, Zhou Y, Liu Q, Wu H, et al. Problematic Internet use was associated with psychological problems among university students during COVID-19 outbreak in China. *Front Public Health*. (2021) 9:675380. doi: 10.3389/fpubh.2021.675380
31. Younes F, Halawi G, Jabbour H, El Osta N, Karam L, Hajj A, et al. Internet addiction and relationships with insomnia, anxiety, depression, stress and self-esteem in university students: a cross-sectional designed study. *PLoS ONE*. (2016) 11:e0161126. doi: 10.1371/journal.pone.0161126
32. Al Shawi AF, Hameed AK, Shalal AI, Abd Kareem SS, Majeed MA, Humidy ST. Internet addiction and its relationship to gender, depression and anxiety among medical students in Anbar Governorate-West of Iraq. *Int Q Community Health Educ*. (2021) 42:253–56. doi: 10.1177/0272684X20985708
33. Zhu K, Xie X, Liu Q, Meng H, Song R. Internet addiction: prevalence and relationship with academic burnout among undergraduates during widespread online learning. *Perspect Psychiatr Care*. (2022). doi: 10.1111/ppc.13060
34. AlJhiani S, Alateeq D, Alwabili A, Alamro A. Mental health and online learning among medical students during the COVID-19 pandemic: a Saudi national study. *J Ment Health Train Educ Pract*. (2021). doi: 10.1108/JMHTEP-04-2021-0037
35. Cullinan J, Walsh S, Flannery D, Kennelly B. A cross-sectional analysis of psychological distress among higher education students in Ireland. *Ir J Psychol Med*. (2022). doi: 10.1017/ipm.2022.2
36. Wathélet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic. *JAMA Netw Open*. (2020) 3:e2025591. doi: 10.1001/jamanetworkopen.2020.25591
37. Kowalczyk M, Karbownik MS, Kowalczyk E, Sienkiewicz M, Talarowska M. Mental health of PhD students at Polish universities—Before the COVID-19 outbreak. *Int J Environ Res Public Health*. (2021) 18:12068. doi: 10.3390/ijerph182212068
38. Ochnik D, Rogowska AM, Kuśnierz C, Jakubiak M, Schütz A, Held MJ, et al. Mental health prevalence and predictors among university students in nine countries during the COVID-19 pandemic: a cross-national study. *Sci Rep*. (2021) 11:18644. doi: 10.1038/s41598-021-97697-3
39. Aristovnik A, Keržič D, Ravšelj D, Tomažević N, Umek L. Impacts of the COVID-19 pandemic on life of higher education students: a global perspective. *Sustainability*. (2020) 12:8438. doi: 10.3390/su12208438
40. Stallman HM. Psychological distress in university students: a comparison with general population data. *Aust Psychol*. (2010) 45:249–57. doi: 10.1080/00050067.2010.482109
41. Arzani-Birgani A, Zarei J, Favaregh L, Ghanaatiyan E. Internet addiction, mental health, and sleep quality in students of medical sciences, Iran: a cross-sectional study. *J Educ Health Promot*. (2021) 10:409. doi: 10.4103/jehp.jehp\_1506\_20
42. Lipson SK, Zhou S, Wagner B, Beck K, Eisenberg D. Major differences: variations in undergraduate and graduate student mental health and treatment utilization across academic disciplines. *J College Stud Psychother*. (2016) 30:23–41. doi: 10.1080/87568225.2016.1105657
43. Odrozola-González P, Planchuelo-Gómez A, Irurtia MJ, de Luis-García R. Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. *Psychiatry Res*. (2020) 290:113108. doi: 10.1016/j.psychres.2020.113108
44. Gray RS, Chamratrithirong A, Pattaravanich U, Prasartkul P. Happiness among adolescent students in Thailand: family and non-family factors. *Soc Indic Res*. (2013) 110:703–19. doi: 10.1007/s11205-011-9954-y
45. Ozgur G, Gumus AB, Durdu B. Life satisfaction of university students living at home or in the dormitory. *J Psychiatr Nurs*. (2010) 1:25–32.
46. Herke M, Knöchelmann A, Richter M. Health and well-being of adolescents in different family structures in Germany and the importance of family climate. *Int J Environ Res Public Health*. (2020) 17:6470. doi: 10.3390/ijerph17186470
47. Anand N, Jain PA, Prabhu S, Thomas C, Bhat A, Prathyusha PV, et al. Internet use patterns, Internet Addiction, and psychological distress among engineering university students: a study from India. *Indian J Psychol Med*. (2018) 40:458–67. doi: 10.4103/IJPSYM.IJPSYM\_135\_18
48. Kotera Y, Dosedlova J, Andrzejewski D, Kaluzeviciute G, Sakai M. From stress to psychopathology: relationship with self-reassurance and self-criticism in Czech university students. *Int J Ment Health Addict*. (2021). doi: 10.1007/s11469-021-00516-z
49. Andrews B, Wilding JM. The relation of depression and anxiety to life-stress and achievement in students. *Br J Psychol*. (2004) 95:509–21. doi: 10.1348/0007126042369802
50. Elmer T, Stadtfeld C. Depressive symptoms are associated with social isolation in face-to-face interaction networks. *Sci Rep*. (2020) 10:1444. doi: 10.1038/s41598-020-58297-9
51. Bartholomay EM, Stone BM, Lyons GA. Depression and social anxiety symptoms explain substance use problems beyond amount/frequency of substance use. *Curr Psychol*. (2021). doi: 10.1007/s12144-021-01984-1
52. Böke BN, Mills DJ, Mettler J, Heath NL. Stress and coping patterns of university students. *J Coll Stud Dev*. (2019) 60:85–103. doi: 10.1353/csd.2019.0005
53. Tareman F, Yaghubi H, Pairavi H, Hosseini SR, Zafar M, Moloodi R. Risk and protective factors for substance use among Iranian university students: a national study. *Subst Abuse Treat Prev Policy*. (2018) 13:46. doi: 10.1186/s13011-018-0181-2
54. King SC, Rebar AL, Oliveri P, Stanton R. Australian paramedic students' mental health literacy and attitudes towards mental health. *J Ment Health Train Educ Pract*. (2022) 17:61–72. doi: 10.1108/JMHTEP-03-2021-0027
55. Becker SP, Holdaway AS, Luebke AM. Suicidal behaviors in college students: frequency, sex differences, and mental health correlates including sluggish cognitive tempo. *J Adolesc Health*. (2018) 63:181–8. doi: 10.1016/j.jadohealth.2018.02.013
56. Hirsch JK, Rabon JK, Reynolds EE, Barton AL, Chang EC. Perceived stress and suicidal behaviors in college students: conditional indirect effects of depressive symptoms and mental health stigma. *Stigma Health*. (2019) 4:98–106. doi: 10.1037/sah0000125
57. Hajduk M, Dancik D, Januska J, Strakova A, Turcek M, Heretik A, et al. Depression and anxiety among college students in Slovakia - Comparison of the year 2018 and during COVID-19 pandemic. *Bratisl Lek Listy*. (2022) 123:44–9. doi: 10.4149/BLL\_2022\_007



58. Winkler P, Formanek T, Mlada K, Kagstrom A, Mohrova Z, Mohr P, et al. Increase in prevalence of current mental disorders in the context of COVID-19: analysis of repeated nationwide cross-sectional surveys. *Epidemiol Psychiatr Sci.* (2020) 29:E173. doi: 10.1017/S2045796020000888
59. Winkler P, Mohrova Z, Mlada K, Kuklova M, Kagstrom A, Mohr P, et al. Prevalence of current mental disorders before and during the second wave of COVID-19 pandemic: an analysis of repeated nationwide cross-sectional surveys. *J Psychiatr Res.* (2021) 139:167–71. doi: 10.1016/j.jpsychires.2021.05.032
60. Dragasek J, Seabrook M. Prevalence of mental health issues amongst slovak and international medical students at university of pavol jozef šafárik: a cross-sectional study. *Eur Psychiatry.* (2021) 64:S370. doi: 10.1192/j.eurpsy.2021.992
61. Rutkowska A, Liska D, Ciešlik B, Wrzeciono A, Brodání J, Barcalová M, et al. Stress levels and mental well-being among slovak students during e-learning in the COVID-19 pandemic. *Healthcare.* (2021) 9:1356. doi: 10.3390/healthcare9101356
62. Sandora J, Novak L, Brnka R, van Dijk JP, Tavel P, Malinakova K. The abbreviated Overall Anxiety Severity and Impairment Scale (OASIS) and the abbreviated Overall Depression Severity and Impairment Scale (ODSIS): psychometric properties and evaluation of the Czech versions. *Int J Environ Res Public Health.* (2021) 18:10337. doi: 10.3390/ijerph181910337
63. Vojčík P, Molnár P. Súdna a mimosúdna ochrana duševného vlastníctva: kapitola 18. In: Križ J, Mazák J, editor. *Právo duševného vlastníctva*. Plzen: Vydavatelství a nakladatelství Aleš Čeněk (2014). p. 360–404.
64. Molnár P. *Dokazná núdza a právo na spravodlivý proces*. Bratislavské právnické fórum 2013: zborník príspevkov z medzinárodnej vedeckej konferencie organizovanej Univerzitou Komenského, Právnickou fakultou. Bratislava: Univerzita Komenského v Bratislave (2013). p. 345–54.
65. Volfová A, Miovský M. Undergraduate education in addictology of students of general medicine: study protocol of a pilot research study in the Czech and Slovak Republics. *Adiktologie.* (2021) 21:115–20.
66. Kroenke K, Spitzer RL, Williams JB, Löwe B. The patient health questionnaire somatic, anxiety, and depressive symptom scales: a systematic review. *Gen Hosp Psychiatry.* (2010) 32:345–59. doi: 10.1016/j.genhosppsych.2010.03.006
67. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* (1983) 24:385–96. doi: 10.2307/2136404
68. Young KS. Internet addiction: the emergence of a new clinical disorder. *Cyber Psychol Behav.* (1998) 1:237–44. doi: 10.1089/cpb.1998.1.237
69. Ochnik D, Rogowska AM, Kuśnierz C, Jakubiak M, Schütz A, Held MJ, et al. A comparison of depression and anxiety among university students in nine countries during the COVID-19 pandemic. *J Clin Med.* (2021) 10:2882. doi: 10.3390/jcm10132882
70. Wongpakaran N, Wongpakaran T, Pinyopornpanish M, Simcharoen S, Kuntawong P. Loneliness and problematic internet use: testing the role of interpersonal problems and motivation for internet use. *BMC Psychiatry.* (2021) 21:447. doi: 10.1186/s12888-021-03457-y
71. Romero-Rodríguez J-M, Marín-Marín J-A, Hinojo-Lucena F-J, Gómez-García G. An explanatory model of problematic Internet use of Southern Spanish university students. *Soc Sci Comput Rev.* (2021). doi: 10.1177/0894439321998650
72. Mamun MA, Hossain MS, Siddique AB, Sikder MT, Kuss DJ, Griffiths MD. Problematic internet use in Bangladeshi students: the role of socio-demographic factors, depression, anxiety, and stress. *Asian J Psychiatry.* (2019) 44:48–54. doi: 10.1016/j.ajp.2019.07.005
73. Zhao Y, Jiang Z, Guo S, Wu P, Lu Q, Xu Y, et al. Association of symptoms of attention deficit and hyperactivity with problematic internet use among university students in Wuhan, China during the COVID-19 pandemic. *J Affect Disord.* (2021) 286:220–7. doi: 10.1016/j.jad.2021.02.078
74. Corrêa Rangel T, Falcão Raposo MC, Sampaio Rocha-Filho PA. Internet addiction, headache, and insomnia in university students: a cross-sectional study. *Neurol Sci.* (2022) 43:1035–41. doi: 10.1007/s10072-021-05377-x
75. Khazaie H, Lebni JY, Abbas J, Mahaki B, Chaboksavar F, Kianipour N, et al. Internet addiction status and related factors among medical students: a cross-sectional study in western iran. *Int Q Community Health Educ.* (2021). doi: 10.1177/0272684X211025438
76. Öztürk N, Öter EG, Abacıgil F. The relationship between the activity level, internet addiction, and depressive symptoms of university students during the coronavirus disease-2019 outbreak cross-sectional study. *Meandros Med Dent J.* (2021) 22:324–31. doi: 10.4274/meandros.galenos.2021.70457
77. Kitazawa M, Yoshimura M, Murata M, Sato-Fujimoto Y, Hitokoto H, Mimura M, et al. Associations between problematic Internet use and psychiatric symptoms among university students in Japan. *Psychiatry Clin Neurosci.* (2018) 72:531–9. doi: 10.1111/pcn.12662
78. Lyvers M, Senturk C, Thorberg FA. Alexithymia, impulsivity and negative mood in relation to internet addiction symptoms in female university students. *Aust J Psychol.* (2021) 73:548–56. doi: 10.1080/00049530.2021.1942985
79. Hakami AY, Ahmad RG, Alsharif A, Ashqar A, AlHarbi FA, Sayes M, et al. Prevalence of behavioral addictions and their relationship with stress and anxiety among medical students in Saudi Arabia: a cross-sectional study. *Front Psychiatry.* (2021) 12:727798. doi: 10.3389/fpsy.2021.727798
80. Abbas A, Muzaffar MN, Amjad F. Prevalence of generalized anxiety disorder among students of doctor of physical therapy. *Rawal Medical J.* (2021) 46:423–5.
81. Bártolo A, Monteiro S, Pereira A. Factor structure and construct validity of the Generalized Anxiety Disorder 7-item (GAD-7) among Portuguese college students. *Cad Saude Publica.* (2017) 33:e00212716. doi: 10.1590/0102-311x00212716
82. Rogowska AM, Ochnik D, Kuśnierz C, Chilicka K, Jakubiak M, Paradowska M, et al. Changes in mental health during three waves of the COVID-19 pandemic: a repeated cross-sectional study among Polish university students. *BMC Psychiatry.* (2021) 21:627. doi: 10.1186/s12888-021-03615-2
83. Çimen ID, Alvrur TM, Coşkun B, Sükür NEÖ. Mental health of Turkish medical students during the COVID-19 pandemic. *Int J Soc Psychiatry.* (2022). doi: 10.1177/00207640211066734
84. Fernandez MDS, Vieira IS, Silva NRJD, Cardoso TA, Bielavski CH, Rakovski C, et al. Anxiety symptoms and alcohol abuse during the COVID-19 pandemic: a cross-sectional study with Brazilian dental undergraduate students. *J Dent Educ.* (2021) 85:1739–48. doi: 10.1002/jdd.12742
85. Zhou Y, Xu J, Rief W. Are comparisons of mental disorders between Chinese and German students possible? An examination of measurement invariance for the PHQ-15, PHQ-9 and GAD-7. *BMC Psychiatry.* (2020) 20:480. doi: 10.1186/s12888-020-02859-8
86. LT L, Hense S, Kodali PB, Thankappan KR. Prevalence and underlying factors of depressive disorders among PhD students: a mixed-method study in the Indian context. *J Appl Res High Educ.* (2021). doi: 10.1108/JARHE-04-2021-0131
87. Yu J, Yang Z, Wu Y, Ge M, Tang X, Jiang H. Prevalence of and factors associated with depressive symptoms among college students in Wuhan, China during the normalization stage of COVID-19 prevention and control. *Front Psychiatry.* (2021) 12:742950. doi: 10.3389/fpsy.2021.742950
88. Lee J, Kim SG, Youn H, Lee SI. Childhood emotional abuse is associated with the desire to get married and have children in Korean young adults. *Psychiatry Investig.* (2021) 18:1117–24. doi: 10.30773/pi.2021.0211
89. Kohls E, Baldofski S, Moeller R, Klemm SL, Rummel-Kluge C. Mental health, social and emotional well-being, and perceived burdens of university students during COVID-19 pandemic lockdown in Germany. *Front Psychiatry.* (2021) 12:643957. doi: 10.3389/fpsy.2021.643957
90. Biswas MAAJ, Hasan MT, Samir N, Alin SI, Homaira N, Hassan MZ, et al. The prevalence and associated factors of depressive symptoms among medical students in Bangladesh during the COVID-19 pandemic: a cross-sectional pilot study. *Front Public Health.* (2022) 9:811345. doi: 10.3389/fpubh.2021.811345
91. Yap SY, Foo CN, Lim YM, Ng FL, Mohd-Sidik S, Tang PY, et al. Traditional Chinese medicine body constitutions and psychological determinants of depression among university students in Malaysia: a pilot study. *Int J Environ Res Public Health.* (2021) 18:5366. doi: 10.3390/ijerph18105366
92. Korolkiewicz PK, Skrzypkowska P, Ali S, Grabowski J, A. descriptive study of welfare and mental health issues among health-related sciences undergraduate students at the Medical University of Gdansk. *Int J Soc Psychiatry.* (2022). doi: 10.1177/00207640211068982
93. Eleftheriou A, Rokou A, Arvaniti A, Nena E, Steiropoulos P. Sleep quality and mental health of medical students in Greece

- during the COVID-19 pandemic. *Front Public Health*. (2021) 9:775374. doi: 10.3389/fpubh.2021.775374
94. Khan RA, Sheikh FA, Najeeb Q, Lone SS, Afaq B, Naikoo NA, et al. Critical analysis of perceived stress among medical students studying in government medical colleges at Srinagar, Anantnag and Baramulla, Union Territory Jammu and Kashmir, India- A cross-sectional study. *J Clin Diagnostic Res*. (2021) 15:11–6. doi: 10.7860/JCDR/2021/52267.15780
  95. Jagoda T, Rathnayake S. Perceived stress and learning environment among nursing students: a cross-sectional study. *Collegian*. (2021) 28:587–94. doi: 10.1016/j.colegn.2021.03.003
  96. Sredniawa A, Drwiła D, Krotos A, Wojtaś D, Kostecka N, Tomasik T. Insomnia and the level of stress among students in Krakow, Poland. *Trends Psychiatry Psychother*. (2019) 41:60–8. doi: 10.1590/2237-6089-2017-0154
  97. Kokou-Kpolou CK, Jumageldinov A, Park S, Nieuviarts N, Noorishad PG, Cénat JM. Prevalence of depressive symptoms and associated psychosocial risk factors among French university students: the moderating and mediating effects of resilience. *Psychiatr Q*. (2021) 92:443–57. doi: 10.1007/s11266-020-09812-8
  98. Javaeed A, Zafar MB, Iqbal M, Ghauri SK. Correlation between Internet addiction, depression, anxiety and stress among undergraduate medical students in Azad Kashmir. *Pak J Med Sci*. (2019) 35:506–9. doi: 10.12669/pjms.35.2.169
  99. Wang Y, Liu B, Zhang L, Zhang P. Anxiety, depression, and stress are associated with internet gaming disorder during COVID-19: fear of missing out as a mediator. *Front Psychiatry*. (2022) 13:827519. doi: 10.3389/fpsy.2022.827519
  100. Yang X, Guo WJ, Tao YJ, Meng YJ, Wang HY, Li XJ, et al. A bidirectional association between internet addiction and depression: a large-sample longitudinal study among Chinese university students. *J Affect Disord*. (2022) 299:416–24. doi: 10.1016/j.jad.2021.12.013
  101. Jain A, Sharma R, Gaur KL, Yadav N, Sharma P, Sharma N, et al. Study of internet addiction and its association with depression and insomnia in university students. *J Family Med Prim Care*. (2020) 9:1700–6. doi: 10.4103/jfmpc.jfmpc\_1178\_19
  102. Robbins T, Clark L. Behavioral addictions. *Curr Opin Neurobiol*. (2015) 30:66–72. doi: 10.1016/j.conb.2014.09.005
  103. Hammond CJ, Mayes LC, Potenza MN. Neurobiology of adolescent substance use and addictive behaviors: treatment implications. *Adolesc Med State Art Rev*. (2014) 25:15–32. doi: 10.1542/9781581108903-neurobiology
  104. Cai H, Xi HT, Zhu Q, Wang Z, Han L, Liu S, et al. Prevalence of problematic Internet use and its association with quality of life among undergraduate nursing students in the later stage of COVID-19 pandemic era in China. *Am J Addict*. (2021) 30:585–92. doi: 10.1111/ajad.13216
  105. Elbilgahy AA, Sweelam RK, Eltaib FA, Bayomy HE, Elwasefy SA. Effects of electronic devices and internet addiction on sleep and academic performance among female Egyptian and Saudi nursing students: a comparative study. *SAGE Open Nurs*. (2021) 7:23779608211055614. doi: 10.1177/23779608211055614
  106. Aigelová E, Charvát M, Miovsky M. Personality disorders: the treatment of gambling disorders in male patients from the perspective of Cloninger's theory. *Adiktologie*. (2020) 20:7–18.
  107. Christakis DA. Internet addiction: A 21st century epidemic? *BMC Med*. (2010) 8:61. doi: 10.1186/1741-7015-8-61
  108. Chang CJ, Feinstein BA, Chu BC, Selby EA. The negative impact of COVID-19 on sexual minority young adults: demographic differences and prospective associations with depression. *Psychol Sex Orientat Gend Divers*. (2021) 8:220–7. doi: 10.1037/sgd0000494
  109. Esmaelzadeh S, Moraros J, Thorpe L, Bird Y. The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatr Dis Treat*. (2018) 14:3241–51. doi: 10.2147/NDT.S187419

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Gavurova, Khouri, Ivankova, Rigelsky and Mudarri. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





# Family and Academic Stress and Their Impact on Students' Depression Level and Academic Performance

Yuwei Deng<sup>1,2</sup>, Jacob Cherian<sup>3</sup>, Noor Un Nisa Khan<sup>4</sup>, Kalpina Kumari<sup>5</sup>,  
Muhammad Safdar Sial<sup>6\*</sup>, Ubaldo Comite<sup>7</sup>, Beata Gavurova<sup>8</sup> and József Popp<sup>9,10</sup>

<sup>1</sup> School of Mechatronics Engineering, Daqing Normal University, Daqing, China, <sup>2</sup> School of Marxism, Heilongjiang University, Harbin, China, <sup>3</sup> College of Business, Abu Dhabi University, Abu Dhabi, United Arab Emirates, <sup>4</sup> Faculty of Business Administration, Iqra University Karachi Pakistan, Karachi, Pakistan, <sup>5</sup> Faculty of Department of Business Administration, Greenwich University Karachi, Karachi, Pakistan, <sup>6</sup> Department of Management Sciences, COMSATS University Islamabad (CU), Islamabad, Pakistan, <sup>7</sup> Department of Business Sciences, University Giustino Fortunato, Benevento, Italy, <sup>8</sup> Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Kosice, Kosice, Slovakia, <sup>9</sup> Hungarian National Bank—Research Center, John von Neumann University, Kecskemét, Hungary, <sup>10</sup> College of Business and Economics, University of Johannesburg, Johannesburg, South Africa

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Raquel Artuch Garde,  
Public University of Navarre, Spain  
Syed Far Abid Hossain,  
International University of Business  
Agriculture and  
Technology, Bangladesh  
John White,  
Eastern Mediterranean  
University, Turkey  
Misbah Habib,  
Forman Christian College, Pakistan

### \*Correspondence:

Muhammad Safdar Sial  
safdarsial@comsats.edu.pk

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

**Received:** 04 February 2022

**Accepted:** 19 April 2022

**Published:** 16 June 2022

### Citation:

Deng Y, Cherian J, Khan NUN,  
Kumari K, Sial MS, Comite U,  
Gavurova B and Popp J (2022) Family  
and Academic Stress and Their  
Impact on Students' Depression Level  
and Academic Performance.  
Front. Psychiatry 13:869337.  
doi: 10.3389/fpsy.2022.869337

Current research examines the impact of academic and familial stress on students' depression levels and the subsequent impact on their academic performance based on Lazarus' cognitive appraisal theory of stress. The non-probability convenience sampling technique has been used to collect data from undergraduate and postgraduate students using a modified questionnaire with a five-point Likert scale. This study used the SEM method to examine the link between stress, depression, and academic performance. It was confirmed that academic and family stress leads to depression among students, negatively affecting their academic performance and learning outcomes. This research provides valuable information to parents, educators, and other stakeholders concerned about their childrens' education and performance.

**Keywords:** academic stress, depression, university students, academic performance, academic learning, higher education, structural equation modeling (SEM)

## INTRODUCTION

Higher education institutions (HEIs) are believed to be one of the strongest pillars in the growth of any nation (1). Being the principal stakeholder, the performance of HEIs mainly relies on the success of its students (2). To successfully compete in the prevailing dynamic industrial environment, students are not only supposed to develop their knowledge but are also expected to have imperative skills and abilities (3). In the current highly competitive academic environment, students' performance is largely affected by several factors, such as social media, academic quality, family and social bonding, etc. (4). Aafreen et al. (2) stated that students continuously experience pressure from different sources during academic life, which ultimately causes stress among students.

Stress is a common factor that largely diminishes individual morale (5). It develops when a person cannot handle their inner and outer feelings. When the stress becomes chronic or exceeds a certain level, it affects an individual's mental health and may lead to different psychological disorders, such as depression (6). Depression is a worldwide illness marked by feelings of sadness

and the inability to feel happy or satisfied (7). Nowadays, it is a common disorder, increasing day by day. According to the World Health Organization (8, 9), depression was ranked third among the global burden of disease and predicted to take over first place by 2030.

Depression leads to decreased energy, difficulty thinking, concentrating, and making career decisions (6). Students are a pillar of the future in building an educated society. For them, academic achievement is a big goal of life and can severely be affected if the students fall prey to depression (10, 11). There can be several reasons for this: family issues, exposure to a new lifestyle in colleges and universities, poor academic grades, favoritism by teachers, etc. Never-ending stress or academic pressure of studies can also be a chief reason leading to depression in students (12). There is a high occurrence of depression in emerging countries, and low mental health literacy has been theorized as one of the key causes of escalating rates of mental illness (13).

Several researchers, such as (6, 14, 15) have studied stress and depression elements from a performance perspective and reported that stress and depression negatively affect the academic performance of students. However, Aafreen et al. (2) reported contradictory results and stated that stress sharpens the individual's mind and reflexes and enables workers to perform better in taxing situations. Ardalan (16) conducted a study in the United States (US). They reported that depression is a common issue among students in the US, and 20 percent of them may have a depressive disorder spanning 12 months or more. It affects students' mental and physical health and limits their social relationships and professional career.

However, the current literature provides mixed results on the relationship between stress and performance. Therefore, the current research investigates stress among students from family and academic perspectives using Lazarus's theory which describes stress as a relation between an individual and his environment and examines how it impacts students' depression level, leading to their academic performance. Most of the available studies on stress and depression are from industrial perspectives, and limited attention is paid to stress from family and institutional perspectives and examines its impact on students' depression level, leading to their academic performance, particularly in Pakistan, the place of the study. Besides, the present study follows a multivariate statistical technique, followed by structural equation modeling (SEM) to examine the relationship between stated variables which is also a study's uniqueness.

This paper is divided into five main sections. The current section provided introduction, theoretical perspective, and background of the study. In the second section, a theoretical framework, a detailed literature review and research hypotheses of the underlying relationships are being proposed. In the third and fourth section, methodology and analysis have been discussed. Finally, in the last section, the conclusion, limitations, implications, and recommendations for future research have been proposed.

## THEORY AND LITERATURE

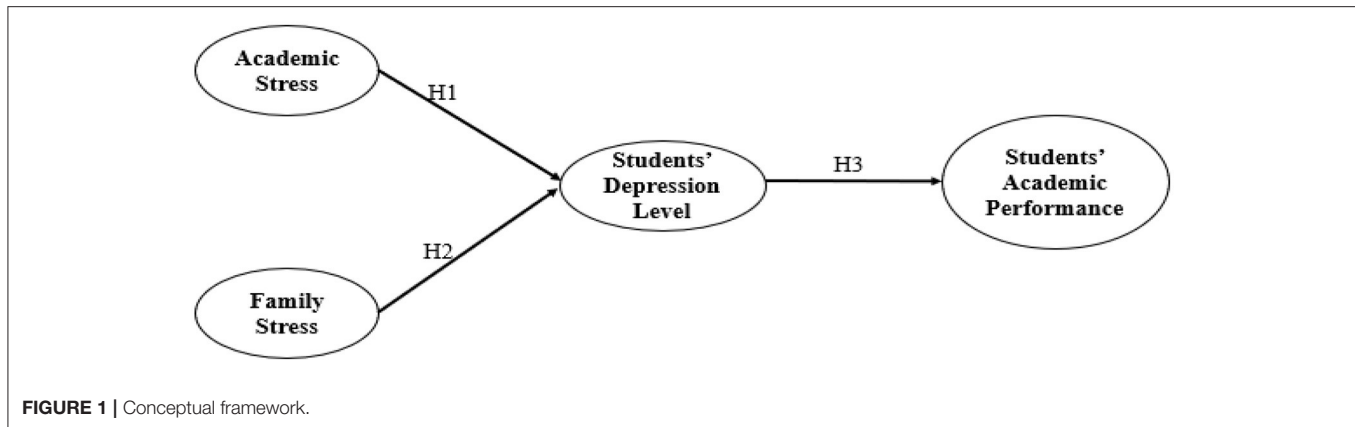
The idea of cognitive appraisal theory was presented in 1966 by psychologist Richard Lazarus in *Psychological Stress and Coping Process*. According to this theory, appraisal and coping are two concepts that are central to any psychological stress theory. Both are interrelated. According to the theory, stress is the disparity between stipulations placed on the individuals and their coping resources (17). Since its first introduction as a comprehensive theory (18), a few modifications have been experienced in theory later. The recent adaptation states that stress is not defined as a specific incitement or psychological, behavioral, or subjective response. Rather, stress is seen as a relation between an individual and his environment (19). Individuals appraise the environment as significant for their well-being and try to cope with the exceeding demands and challenges.

Cognitive appraisal is a model based on the idea that stress and other emotional processes depend on a person's expectancies regarding the significance and outcome of an event, encounter, or function. This explains why there are differences in intensity, duration, and quality of emotions elicited in people in response to the environment, which objectively, are equal for all (18). These appraisals may be influenced by various factors, including a person's goals, values, motivations, etc., and are divided into primary and secondary appraisals, specific patterns of which lead to different kinds of stress (20). On the other hand, coping is defined as the efforts made by a person to minimize, tolerate, or master the internal and external demands placed on them, a concept intimately related to cognitive appraisal and, therefore, to the stress-relevant person-environment transactions.

Individuals experience different mental and physiological changes when encountering pressure, such as stress (21, 22). The feelings of stress can be either due to factors in the external environment or subjective emotions of individuals, which can even lead to psychological disorders such as anxiety and depression. Excess stress can cause health problems. A particularly negative impact has been seen in students due to the high level of stress they endure, affecting their learning outcomes. Various methods are used to tackle stress. One of the methods is trying to pinpoint the causes of stress, which leads us to different terms such as family stress and academic stress. The two factors, stress and depression, have greatly impacted the students' academic performances. This research follows the Lazarus theory based on stress to examine the variables. See the conceptual framework of the study in **Figure 1**.

### Academic Stress

Academic issues are thought to be the most prevalent source of stress for college students (23). For example, according to Yang et al. (24), students claimed that academic-related pressures such as ongoing study, writing papers, preparing for tests, and boring professors were the most important daily problems. Exams and test preparation, grade level competitiveness, and gaining a big quantity of knowledge in a short period of



time all contribute to academic pressure. Perceived stress refers to a condition of physical or psychological arousal in reaction to stressors (25, 26). When college students face excessive or negative stress, they suffer physical and psychological consequences. Excessive stress can cause health difficulties such as fatigue, loss of appetite, headaches, and gastrointestinal issues. Academic stress has been linked to a variety of negative effects, including ill health, anxiety, depression, and poor academic performance. Travis et al. (27), in particular, discovered strong links between academic stress and psychological and physical health.

## Family Stress

Parental participation and learning effect how parents treat their children, as well as how they handle their children's habits and cognitive processes (28). This, in turn, shapes their children's performance and behaviors toward them. As a result, the parent-child relationship is dependent on the parents' attitudes, understanding, and perspectives. When parents have positive views, the relationship between them and their children will be considerably better than when they have negative attitudes. Parents respond to unpleasant emotions in a variety of ways, which can be classified as supportive or non-supportive (29). Parents' supportive reactions encourage children to explore their emotions by encouraging them to express them or by assisting them in understanding and coping with an emotion-eliciting scenario. Non-supportive behaviors, such as downplaying the kid's emotional experience, disciplining the child, or getting concerned by the child's display, transmit the child the message that expressing unpleasant emotions is inappropriate and unacceptable. Supportive parental reactions to unpleasant emotions in children have been linked to dimensions of emotional and social competence, such as emotion comprehension and friendship quality. Non-supportive or repressive parental reactions, on the other hand, have been connected to a child's stored negative affect and disordered behaviors during emotion-evoking events, probably due to an inability or unwillingness to communicate unpleasant sentiments (30, 31).

## Academic Stress and Students' Depression Levels

Generally, it is believed that mental health improves as we enter into adulthood, and depression disorder starts to decline between the age of 18 and 25. On the other hand, excessive depression rates are the highest pervasiveness during this evolution (15), and many university students in the particular screen above clinical cut-off scores for huge depression (14, 32). Afreen et al. (2) stated that 30% of high school students experience depression from different perspectives. This means a major chunk of fresh high school graduates are more likely to confront depression or are more vulnerable to encountering depression while enrolling in the university. As the students promote to a higher level of education, there are many factors while calculating the stress like, for example, the syllabus is tough to comprehend, assignments are quite challenging with unrealistic deadlines, and accommodation problems for the students who are shifted from other cities, etc. (33). Experiences related to university can also contribute while studying depression. The important thing to consider is depression symptoms vary from time to time throughout the academic years (34); subjective and objective experiences are directly connected to the depression disorder (6), stress inherent in the university situation likely donates to the difference in university students' depressing experiences.

Stress negatively impacts students' mental peace, and 42.3% of students of Canadian university respondents testified devastating levels of anxiety and stress (35, 36). Moreover, there were (58.1%) students who stated academic projects are too tough to handle for them. In Germany, Bulgaria, and Poland, a huge sample of respondents consider assignments a burden on their lives that cannot stand compared to relationships or any other concern in life (14).

In several countries, university students were studied concerning stress, and results show that depression disorder and apparent anxiety are correlated to educational needs and demands (37). In their cross-sectional study conducted on a sample of 900 Canadian students, Lörz et al. (38) concluded that strain confronted due to academic workload relatively has high bleak symptoms even after controlling 13 different risk affecting factors for depression (e.g., demographic features, abusive

past, intellectual way, and personality, currently experienced stressful trials in life, societal support). Few have exhibited that students who are tired of educational workload or the students who name them traumatic tend to have more depressing disorders (15).

These relations can be described by examining the stress and coping behaviors that highlight the role of positive judgments in the stress times (39), containing the Pancer and colleagues' university modification framework (40, 41). The evaluation concept includes examining the circumstances against the available resources, for instance, the effectiveness of coping behavior and societal support. As per these frameworks, if demand is considered unapproachable and resources are lacking, confronted stress and interrelated adverse effects will be high, conceivably giving birth to difficulties in an adjustment like mental instability. Stress triggering situations and the resources in the educational area led to excessive workload, abilities, and study and enhanced time managing skills.

Sketching the overall evaluation frameworks, Pancer et al. (40) established their framework to exhibit the constructive and damaging adjustment results for the university students dealing with the academic challenges. They stated that while students enroll in the university, they evaluate all the stress-related factors that students confront. They consider them manageable as long as they have sufficient resources. On the other hand, if the available resources do not match the stress factors, it will surely result in a negative relationship, which will lead students to experience depression for sure. Based on the given arguments, the researcher formulates the following hypothesis:

H1: Increased academic stress results in increased depression levels in students.

## Family Stress and Students' Depression Levels

According to Topuzoglu et al. (42), 3% to 16.9% of individuals are affected by depression worldwide. There are fewer chances for general people to confront depression than university students (43, 44). In Mirza et al.'s (45) study, 1/3 of students encounter stress and depression (a subjective mean occurrence of 30.6%) of all participant students, which suggests students have a 9% higher rate of experiencing depression than general people. Depression can destroy life; it greatly impacts living a balanced life. It can impact students' personal and social relationships, educational efficiency, quality of life, affecting their social and family relationships, academic productivity, and bodily operations (46, 47). This declines their abilities, and they get demotivated to learn new things, resulting in unsatisfactory performances, and it can even result in university dropouts (48). Depression is a continuous substantial risk aspect for committing suicide for university students (49); thus, it is obliged to discover the factors that can give rise to students' depression.

Seventy-five percentage of students in China of an intermediate school are lucky enough to enroll in higher education. The more students pursue higher education, the more they upsurge for depression (in 2002, the depression rate was 5 to 10%, 2011 it rises 24 to 38%) (5). Generally, University

students' age range is late teens to early twenties, i.e., 18–23 years. Abbas (50) named the era of university students as “post-adolescence. Risk factors for teenage depression have several and complicated problems of individual characteristics and family and educational life (51). Amongst the huge depression factors, relationship building with family demands a major chunk of attention and time since factors like parenting and family building play an important role in children's development (52, 53). Halonen et al. (54) concluded that factors like family binding play a major role in development, preservation, and driving adolescent depression. Generally speaking, depressed teenagers tend to have a weaker family relationship with their parents than non-depressed teenagers.

There are two types of family risk factors, soft and hard. Hard factors are encountered in families with a weak family building structure, parents are little to no educated at all, and of course, the family status (economically). Several studies have proved that students of hard risk factors are more likely to encounter depression. Firstly, students from broken families have low confidence in every aspect of life, and they are weak at handling emotional breakdowns compared to students from complete and happy families (55–57). Secondly, the university students born in educated families, especially mothers (at least a college degree or higher degree), are less likely to confront depression than the university students born in families with little to no educated families. Secondly, children born with educated mothers or mothers who at least have a college degree tend to be less depressive than the children of less-educated mothers (58). However, Parker et al. and Mahmood et al. (59, 60) stated a strong relationship between depression and mothers with low literacy levels.

On the other hand, Chang et al. (46) couldn't prove the authentication of this relationship in university students. Thirdly, university students who belong to lower class families tend to have more unstable mental states and are more likely to witness depression than middle or upper-class families (61). Jadoon et al. and Abbas et al. (62, 63) said that there is no link between depression and economic status. Their irrelevance can be because medical students often come from educated and wealthy families and know their jobs are guaranteed as soon as they graduate. Therefore, the relationship between the hard family environment and depression can be known by targeting a huge audience, and there are several factors to consider while gauging this relationship.

The soft family environment is divided into clear factors (parenting style example, family guidelines, rules, the parent with academic knowledge, etc.) and implied factors (family norm, parent-child relationship, communication within the family, etc.). The soft factor is the key factor within the family that cannot be neglected while studying the teenagers' mental state or depression. Families make microsystems within the families, and families are the reason to build and maintain dysfunctional behavior by multiple functional procedures (64). Amongst the soft family environmental factors, consistency and struggles can be helpful while forecasting the mental health of teenagers. The youth of broken families, family conflict, weak family relationships, and marital issues, especially unhappy married life,



are major factors for youth depression (65). Ruchkin et al. (66) stated that African Americans usually have weak family bonding, and their teenagers suffer from depression even when controlling for source bias. Whereas, few researchers have stated, family unity is the most serious factor while foreseeing teenagers' depression. Eaton noted that extreme broken family expressions might hurt emotionality and emotional regulation (67, 68).

Social circle is also considered while studying depression in teenagers (69–71). The traditional Pakistani culture emphasizes collectivism and peace and focuses on blood relations and sensitive sentiments. Adolescents with this type of culture opt to get inspired by family, but students who live in hostels or share the room with other students lose this family inspiration. This transformation can be a big risk to encounter depression (72). Furthermore, in Pakistan securing employment is a big concern for university students. If they want a good job in the future, they have to score good grades and maintain GPA from the beginning. They have to face different challenges all at once, like aggressive educational competition, relationships with peers and family, and of course the biggest employment stress all alone. The only source for coping with these pressures is the family that can be helpful for fundings. If the students do not get ample support the chances are of extreme depression. The following hypothesis is suggested:

H2: Increased family stress level results in increased depression levels in students.

## Students' Depression Levels and Students' Academic Performance

University students denote many people experiencing a crucial conversion from teenagers to adulthood: a time that is generally considered the most traumatic time in one's (73). This then gets accumulated with other challenges like changes in social circle and exams tension, which possibly puts students' mental health at stake. It has been concluded that one-third of students experience moderate to severe depression in their entire student life (74). This is the rate that can be increased compared to the general people (75, 76). Students with limited social-class resources tend to be more helpless. Additionally, depressed students in attainable-focused environments (for instance, higher academic institutes) are likely to score lower grades with a sense of failure and more insufficient self-assurance because they consider themselves failures, find the world unfair, and have future uncertainties. Furthermore, students with low self-esteem are rigid to take on challenging assignments and projects, hence they are damaging their educational career (77).

Depression can be defined as a blend of physical, mental, bodily processes, and benightedness which can make themselves obvious by symptoms like, for example, poor sleep schedule, lack of concentration, ill thoughts, and state of remorse (78, 79). But, even after such a huge number of depressions in students and the poor academic system, research has not explored the effect of depression on educational performance. A study has shown that the relationship between emotional stability and academic performance in university students and financial status directly results in poor exam performance. As the study

further concluded, it was verified depression is an independent factor (80). Likewise, students suffering from depression score poor grades, but this relationship vanished if their depression got treated. Apart from confidence breaking, depression is a big failure for their academic life. Students with depression symptoms bunk more classes, assessments, and assignments. They drop courses if they find them challenging than non-depressed peers, and they are more likely to drop out of university completely (81). Students suffering from depression can become ruthless, ultimately affecting their educational performance and making them moody (82).

However, it has been stated that the association between anxiety and educational performance is even worse and ambiguous. At the same time, some comprehensive research has noted that the greater the anxiousness, the greater the student's performance. On the other hand, few types of research have shown results where there is no apparent relationship between anxiety and poorer academic grades (83). Ironically, few studies have proposed that a higher anxiety level may improve academic performance (84, 85). Current research by Khan et al. (86) on the undergraduate medical students stated that even though the high occurrence of huge depression between the students, the students GPA is unharmed. Therefore, based on given differences in various research findings, this research is supposed to find a more specific and clear answer to the shared relationship between students' depression levels and academic performance. Based on the given arguments, the researcher formulates the following hypothesis:

H3: Students' depression level has a significant negative effect on their academic performance.

## METHODOLOGY

### Target Population and Sampling Procedure

The target audience of this study contains all male and female students studying in the public, private, or semi-government higher education institutions located in Rawalpindi/Islamabad. The researchers collected data from undergraduate and postgraduate students from the management sciences, engineering, and computer science departments. The sampling technique which has been used is the non-probability sampling technique. A questionnaire was given to the students, and they were requested to fill it and give their opinion independently. The questionnaire is based on five points Likert scale.

However, stress and depression are the most common issue among the students, which affects their learning outcomes adversely. A non-probability sampling technique gathered the data from February 2020 to May 2020. The total questionnaires distributed among students were 220, and 186 responses were useful. Of which 119 respondents were females, 66 males, and 1 preferred not to disclose. See **Table 1** for detailed demographic information of respondents.

### Measurement Scales

We have divided this instrument into two portions. In the first section, there is demographic information of respondents. The



**TABLE 1 |** Respondent's demographic profile.

Particulars	Description	Values	Percentage
Total received responses	Public	36	19.35%
	Private	117	62.90%
	Semi-government	33	17.74%
Gender	Male	66	35.48%
	Female	119	63.97%
	Prefer not to disclose	1	0.54%
Age	Less than 20	29	15.59%
	21–30	146	78.49%
	31–40	11	5.91%
Qualification	Undergraduates	116	62.36%
	Postgraduates	70	37.63%
Degree Program	Management sciences	68	36.55%
	Engineering	8	4.30%
	Computer science	21	11.29%
	Others	89	47.84%
Semester	1 <sup>st</sup> year	23	12.36%
	2 <sup>nd</sup> year	40	21.50%
	3 <sup>rd</sup> year	37	19.89%
	4 <sup>th</sup> year	48	25.80%
	More than 4 <sup>th</sup> year	38	20.43%

second section includes 14 items based on family stress, academic stress, students' depression levels, and students' academic performance. Academic and family stress were measured by 3 item scale for each construct, and students' depression level and academic performance were measured by 4 item scale for each separate construct. The five-point Likert scale is used to measure the items, in which one signifies strongly disagree (S.D), second signifies disagree (D.A), third signifies neither agree nor disagree (N), fourth signifies agree (A.G), and the fifth signifies strongly agree (S.A). The questionnaire has been taken from Gold Berg (87), which is modified and used in the given questionnaire.

## DATA ANALYSIS AND RESULTS

The researchers used the SEM technique to determine the correlation between stress, depression, and academic performance. According to Prajogo and Cooper (88), it can remove biased effects triggered by the measurement faults and shape a hierarchy of latent constructs. SPSS v.23 and AMOS v.23 have been used to analyze the collected data. Kaiser-Meyer-Olkin test is used to test the competence of the sample. The value obtained is 0.868, which fulfills the Kaiser et al. (89), a minimum requirement of 0.6. The multicollinearity factor was analyzed through the variance inflation factor (VIF). It shows the value of 3.648 and meets the requirement of Hair et al. (90), which is < 4. It also indicates the absence of multicollinearity. According to Schwarz et al. (91), common method bias (CMB) is quite complex in quantitative studies. Harman's test of a single factor has been used to analyze CMB. The result obtained for the single factor is 38.63%. As stated by Podsakoff et al. (92), if any of the factors gives value < 50% of the total variance, it is adequate and

**TABLE 2 |** Instrument reliability and validity.

Variable	No. of items	Factor loading	Composite <sup>a</sup> reliability	AVE <sup>b</sup>
Academic stress	3	0.818–0.941	0.863	0.698
Family stress	3	0.852–0.897	0.778	0.721
Student's depression level	4	0.776–0.921	0.897	0.685
Student's academic performance	4	0.779–0.918	0.914	0.693

<sup>a</sup>Composite reliability should be > 0.7 (96).

<sup>b</sup>The average variance extracted (AVE) value should also be > 0.5 (96).

**TABLE 3 |** Discriminant validity analysis.

Variable	Acad. Strs	Fam. Strs	Std. Dep. Lev	Std. Acad. Perf
Acad. Strs	0.835			
Fam. Strs	0.543	0.849		
Std. Dep. Lev	0.622	0.583	0.827	
Std. Acad. Perf	0.623	0.629	0.579	0.832

Acad. Strs, Academic Stress; Fam. Strs, Family Stress; Std. Dep. Lev, Student's Depression Level; Std. Acad. Perf, Student's Academic Performance.

does not influence the CMB. Therefore, we can say that there is no issue with CMB. Considering the above results are adequate among the measurement and structural model, we ensure that the data is valued enough to analyze the relation.

## Assessment of the Measurement and Structural Model

The association between the manifest factors and their elements is examined by measuring model and verified by the Confirmatory Factor Analysis (CFA). CFA guarantees legitimacy and the unidimensional of the measurement model (93). Peterson (94) stated that the least required, i.e., 0.8 for the measurement model, fully complies with its Cronbach's alpha value, i.e., 0.802. Therefore, it can confidently be deduced that this measurement model holds satisfactory reliability. As for the psychological legitimacy can be analyzed through factor loading, where the ideal loading is above 0.6 for already established items (95). Also, according to the recommendation of Molina et al. (96), the minimum value of the average variance extracted (AVE) for all results is supposed to be >0.5. **Table 2** gives detail of the variables and their quantity of things, factor loading, merged consistency, and AVE values.

A discriminant validity test was performed to ensure the empirical difference of all constructs. For this, it was proposed by Fornell and Larcker (97) that the variance of the results is supposed to be greater than other constructs. The second indicator of discriminant validity is that the square root values of AVE have a greater correlation between the two indicators. Hair et al. (90) suggested that the correlation between the pair of predictor variables should not be higher than 0.9. **Table 3** shows that discriminant validity recommended by Hair et al. (90) and Fornell and Larcker (97) was proved clearly that both

**TABLE 4 |** Analysis of measurement and structural model.

The goodness of fit measures	CMIN/DF	NFI	GFI	AGFI	CFI	TLI	RMSEA	SRMR
Recommended value	≤3 <sup>a</sup>	≥0.9 <sup>b</sup>	≥0.9 <sup>b</sup>	≥0.9 <sup>b</sup>	≥0.9 <sup>b</sup>	≥0.9 <sup>b</sup>	≤0.08 <sup>c</sup>	≤0.08 <sup>d</sup>
Measurement model	1.898	0.9	0.91	0.914	0.91	0.91	0.049	0.0596
Structural model	1.986	0.91	0.91	0.918	0.92	0.92	0.052	0.0616

<sup>a</sup>(100). <sup>b</sup>(103, 104). <sup>c</sup>(101). <sup>d</sup>(102).

conditions are fulfilled and indicates that the constructs have adequate discriminant validity.

Kaynak (98) described seven indicators that ensure that the measurement model fits correctly. These indicators include standardized root mean squared residual (SRMR), root means a square error of approximation (RMSEA), comparative fit index (CFI), normative fit index (NFI), adjusted goodness of fit index (AGFI), the goodness of fit index (GFI) and chi-square to a degree of freedom ( $\chi^2/DF$ ). Tucker-Lewis's index (TLI) is also included to ensure the measurement and structural model's fitness. In the measurement model, the obtained result shows that the value of  $\chi^2/DF$  is 1.898, which should be lower than 2 suggested by Byrne (99), and this value also meets the requirement of Bagozzi and Yi (100), i.e., <3. The RMSEA has the value 0.049, which fully meets the requirement of 0.08, as stated by Browne and Cudeck (101). Furthermore, the SRMR acquired value is 0.0596, which assemble with the required need of < 0.1 by Hu and Bentler (102). Moreover, according to Bentler and Bonett (103), McDonald and Marsh (104), and Bagozzi and Yi (100), the ideal value is 0.9, and the values obtained from NFI, GFI, AGFI, CFI, and TLI are above the ideal value.

Afterward, the structural model was analyzed and achieved the findings, which give the value of  $\chi^2/DF$  1.986. According to Browne and Cudeck (101), the RMSEA value should not be greater than 0.08, and the obtained value of RMSEA is 0.052, which meets the requirement perfectly. The minimum requirement of Hu and Bentler (102) should be <0.1, for the structural model fully complies with the SRMR value 0.0616. According to a recommendation of McDonald and Marsh (104) and Bagozzi and Yi (100), the ideal value must be up to 0.9, and **Table 4** also shows that the values of NFI, GFI, AGFI, CFI, and TLI, which are above than the ideal value and meets the requirement. The above results show that both the measurement and structural models are ideally satisfied with the requirements and the collected data fits correctly.

## Testing of Hypotheses

The SEM technique is used to examine the hypotheses. Each structural parameter goes along with the hypothesis. The academic stress (Acad. Strs) with the value  $\beta = 0.293$  while the  $p$ -value is 0.003. These outcomes show a significant positive relationship between academic stress (Acad. Strs) and students' depression levels (Std. Dep. Lev). With the  $\beta = 0.358$  and  $p = 0.001$  values, the data analysis discloses that the family stress (Fam. Strs) has a significant positive effect on the

**TABLE 5 |** Examining the hypotheses.

Hypothesis	Constructs	Estimate	Critical ratio	p-value	Decision
H <sub>1</sub>	Acad. Strs → Std. Dev. Lev	0.201	2.021	0.039*	Accepted
H <sub>2</sub>	Fam. Strs → Std. Dep. Lev	0.358	3.997	0.001*	Accepted
H <sub>3</sub>	Std. Dep. Lev → Std. Acad. Perf	-0.319	-3.402	0.001*	Accepted

\*Acad. Strs, Academic Stress; Fam. Strs, Family Stress; Std. Dep. Lev, Students' Depression Level; Std. Acad. Perf, Student's Academic Performance.

\*The value of  $p$  should be  $p^* \leq 0.05$ .

**TABLE 6 |** Description of items, mean, and standard deviation.

Items	Mean	Standard deviation
Mental health has a valuable impact on students' academic learning.	3.26	1.752
Academic pressure leads to stress in students' life.	3.25	1.530
I have difficulty in understanding basic concepts.	2.95	1.272
I have to revise the things again and again to develop an understanding.	3.14	1.352
I have lost interest in academic aspects that used to be important for me.	2.83	1.351
Family issues leads to stress in students' life.	3.37	1.504
Because of family issues I cannot concentrate on my studies.	3.19	1.468
I am not able to sleep properly because of family issues.	3.02	1.424
Depression negatively affects a student's motivation to learn.	3.37	1.405
Unfair treatment by teachers causes academic depression in students.	3.12	1.620
Depression has negatively affected my learning capabilities.	2.99	1.280
Depression has negatively affected my academic grades.	3.19	1.201
Sometimes I don't see value in my life.	2.96	1.398
I feel depressed in the class.	2.91	1.310

students' depression level (Std. Dep. Lev). However, the student's depression level (Std. Dep. Lev) also has a significant negative effect on their academic performance (Std. Acad. Perf) with the values of  $\beta = -0.319$  and  $p = 0.001$ . Therefore, the results supported the following hypotheses H<sub>1</sub>, H<sub>2</sub>, and H<sub>3</sub>. The sub-hypotheses analysis shows that the results are statistically significant and accepted. In **Table 5**, the details of the sub-hypotheses and the principals are explained precisely. Please see **Table 6** to review items with their mean and standard deviation values. Moreover, **Figure 2** represents the structural model.

## DISCUSSION AND CONCLUSION

These findings add to our knowledge of how teenage depression is predicted by academic and familial stress, leading to poor academic performance, and they have practical implications for

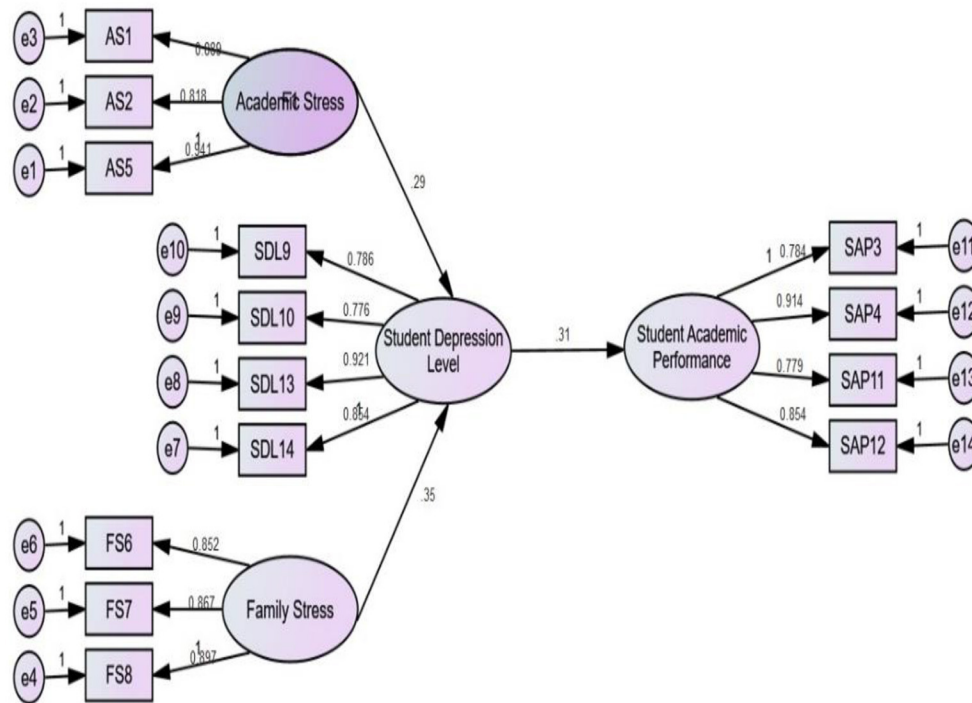


FIGURE 2 | Structural model.

preventative and intervention programs to safeguard adolescents' mental health in the school context. The outcomes imply that extended academic stress positively impacts students' depression levels with a  $\beta$  of 0.293 and a  $p$ -value of 0.003. However, according to Wang et al. (5), a higher level of academic stress is linked to a larger level of school burnout, which leads to a higher degree of depression. Satinsky et al. (105) also claimed that university officials and mental health specialists have expressed worry about depression and anxiety among Ph.D. students, and that his research indicated that depression and anxiety are quite common among Ph.D. students. Deb et al. (106) found the same results and concluded that depression, anxiety, behavioral difficulties, irritability, and other issues are common among students who are under a lot of academic stress. Similarly, Kokou-Kpolou et al. (107) revealed that depressive symptoms are common among university students in France. They also demonstrate that socioeconomic and demographic characteristics have a role.

However, Wang et al. (5) asserted that a higher level of academic stress is associated with a higher level of school burnout, which in return, leads to a higher level of depression. Furthermore, Satinsky et al. (105) also reported that university administrators and mental health clinicians have raised concerns about depression and anxiety and concluded in his research that depression and anxiety are highly prevalent among Ph.D. students. Deb et al. (106) also reported the same results and concluded that Depression, anxiety, behavioral problems, irritability, etc. are few of the many problems reported in

students with high academic stress. Similarly, Kokou-Kpolou et al. (107) confirmed that university students in France have a high prevalence of depressive symptoms. They also confirm that socio-demographic factors and perceived stress play a predictive role in depressive symptoms among university students. As a result, academic stress has spread across all countries, civilizations, and ethnic groups. Academic stress continues to be a serious problem impacting a student's mental health and well-being, according to the findings of this study.

With the  $\beta = 0.358$  and  $p = 0.001$  values, the data analysis discloses that the family stress (Fam. Strs) has a significant positive effect on the students' depression level (Std. Dep. Lev). Aleksic (108) observed similar findings and concluded that many and complicated concerns of personal traits, as well as both home and school contexts, are risk factors for teenage depression. Similarly, Wang et al. (109) indicated that, among the possible risk factors for depression, family relationships need special consideration since elements like parenting styles and family dynamics influence how children grow. Family variables influence the onset, maintenance, and course of juvenile depression, according to another study (110). Depressed adolescents are more likely than normal teenagers to have bad family and parent-child connections.

Conversely, students' depression level has a significantly negative impact on their academic performance with  $\beta$  and  $p$ -values of  $-0.319$  and  $0.001$ . According (111), anxiety and melancholy have a negative influence on a student's academic performance. Adolescents and young adults suffer from

depression, which is a common and dangerous mental illness. It's linked to an increase in family issues, school failure, especially among teenagers, suicide, drug addiction, and absenteeism. While the transition to adulthood is a high-risk period for depression in general (5), young people starting college may face extra social and intellectual challenges that increase their risk of melancholy, anxiety, and stress (112). Students' high rates of depression, anxiety, and stress have serious consequences. Not only may psychological morbidity have a negative impact on a student's academic performance and quality of life, but it may also disturb family and institutional life (107). Therefore, long-term untreated depression, anxiety, or stress can have a negative influence on people's ability to operate and produce, posing a public health risk (113).

## Theoretical Implications

The current study makes various contributions to the existing literature on servant leadership. Firstly, it enriches the limited literature on the role of family and academic stress and their impact on students' depression levels. Although, a few studies have investigated stress and depression and its impact on Students' academic performance (14, 114), however, their background i.e., family and institutions are largely ignored.

Secondly, it explains how the depression level impacts students' academic learning, specifically in the Asian developing countries region. Though a substantial body of empirical research has been produced in the last decade on the relationship between students' depression levels and its impact on their academic achievements, however, the studies conducted in the Pakistani context are scarce (111, 115). Thus, this study adds further evidence to prior studies conducted in different cultural contexts and validates the assumption that family and academic stress are key sources depression and anxiety among students which can lead toward their low academic grades and their overall performance.

This argument is in line with our proposed theory in the current research i.e., cognitive appraisal theory which was presented in 1966 by psychologist Richard Lazarus. Lazarus's theory is called the appraisal theory of stress, or the transactional theory of stress because the way a person appraises the situation affects how they feel about it and consequently it's going to affect his overall quality of life. In line with the theory, it suggests that events are not good or bad, but the way we think about them is positive or negative, and therefore has an impact on our stress levels.

## Practical Implications

According to the findings of this study, high levels of depressive symptoms among college students should be brought to the attention of relevant departments. To prevent college student depression, relevant departments should improve the study and life environment for students, try to reduce the generation of negative life events, provide adequate social support for students, and improve their cognitive and coping capacities to improve their mental qualities.

Stress and depression, on the other hand, may be managed with good therapy, teacher direction, and family support. The outcomes of this study provide an opportunity for academic institutions to address students' psychological well-being and requirements. Emotional well-being support services for students at Pakistan's higher education institutions are lacking in many of these institutions, which place a low priority on the psychological requirements of these students. As a result, initiatives that consistently monitor and enhance kids' mental health are critical. Furthermore, stress-reduction treatments such as biofeedback, yoga, life-skills training, mindfulness meditation, and psychotherapy have been demonstrated to be useful among students. Professionals in the sector would be able to adapt interventions for pupils by understanding the sources from many spheres.

Counseling clinics should be established at colleges to teach students about stress and sadness. Counselors should instill in pupils the importance of positive conduct and decision-making. The administration of the school should work to create a good and safe atmosphere. Furthermore, teachers should assume responsibility for assisting and guiding sad pupils, since this will aid in their learning and performance. Support from family members might also help you get through difficult times.

Furthermore, these findings support the importance of the home environment as a source of depression risk factors among university students, implying that family-based treatments and improvements are critical in reducing depression among university students.

## Limitations and Future Research Implications

The current study has a few limitations. The researcher gathered data from the higher education level of university students studying in Islamabad and Rawalpindi institutions. In the future, researchers are required to widen their region and gather information from other cities of Pakistan, for instance, Lahore, Karachi, etc. Another weakness of the study is that it is cross-sectional in nature. We need to do longitudinal research in the future to authoritatively assert the cause-and-effect link between academic and familial stress and their effects on students' academic performance since cross-sectional studies cannot establish significant cause and effect relationships. Finally, the study's relatively small sample size is a significant weakness. Due to time and budget constraints, it appears that the capacity to perform in-depth research of all firms in Pakistan's pharmaceutical business has been limited. Even though the findings are substantial and meaningful, the small sample size is predicted to limit generalizability and statistical power. This problem can be properly solved by increasing the size of the sample by the researchers, in future researches.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.



## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

All authors contributed to conceptualization, formal analysis, investigation, methodology, writing and editing of the original draft, and read and agreed to the published version of the manuscript.

## REFERENCES

1. Abbas J, Alturki U, Habib M, Aldraiweesh A, Al-Rahmi WM. Factors affecting students in the selection of country for higher education: a comparative analysis of international students in Germany and the UK. *Sustainability*. (2021) 13:1–17. doi: 10.3390/su131810065
2. Aafreen MM, Priya VV, Gayathri R. Effect of stress on academic performance of students in different streams. *Drug Invent Today*. (2018) 10:5.
3. Aamir A, Jan SU, Qadus A, Nassani AA, Haffar M. Impact of knowledge sharing on sustainable performance: mediating role of employee's ambidexterity. *Sustainability*. (2021) 13:12788. doi: 10.3390/su132212788
4. Likisa KD. Challenges and prospects of competency-based education: The case of adama science and technology university alumni students and hawas TVET college, adama, ethiopia. *Competency-Based Educ*. (2018) 1163–9. doi: 10.1002/cbe2.1163
5. Wang C, Wen W, Zhang H, Ni J, Jiang J, Cheng Y, et al. Anxiety, depression, and stress prevalence among college students during the COVID-19 pandemic: a systematic review and meta-analysis. *J Am Coll Health*. (2021) 1–8. doi: 10.1080/07448481.2021.1960849
6. Schimelpfening N. Causes and Risk Factors of Depression. *Verywellmind*. (2020) 18:1–9.
7. Aldieri L, Bruno B, Vinci CP, A. multi-dimensional approach to happiness and innovation. *Appl Econ*. (2021) 53:1300–10. doi: 10.1080/00036846.2020.1828807
8. WHO. Depression. *World Health Organ*. (2021) Available online at: <https://www.who.int/news-room/fact-sheets/detail/depression> (accessed May 2, 2022).
9. Abbas J, Muzaffar A, Mahmood HK, Ramzan MA, Rizvi SS, ul H. Impact of technology on performance of employees (a case study on Allied Bank Ltd, Pakistan). *World Appl Sci J*. (2014) 29:271–6. doi: 10.5829/idosi.wasj.2014.29.02.1897
10. Abbas J, Kumari K, Al-Rahmi WM. Quality management system in higher education institutions and its impact on students' employability with the mediating effect of industry-academia collaboration. *J Econ Adm Sci*. (2021) 12:371–84. doi: 10.1108/JEAS-07-20 21-0135
11. Mahmood HK, Hashmi MS, Shoaib DM, Danish R, Abbas J. Impact of TQM practices on motivation of teachers in secondary schools empirical evidence from Pakistan. *J Basic Appl Sci Res*. (2014) 4:1–8.
12. Akinola M, Kapadia C, Lu JG, Mason MF. Incorporating physiology into creativity research and practice: the effects of bodily stress responses on creativity in organizations. *Acad Manag Perspect*. (2019) 33:163–84. doi: 10.5465/amp.2017.0094
13. Álvarez-Huerta P, Muela A, Larrea I. Student engagement and creative confidence beliefs in higher education. *Think Ski Creat*. (2021) 40:100821. doi: 10.1016/j.tsc.2021.100821

## FUNDING

This work was funded by the 2020 Heilongjiang Province Philosophy and Social Science Research Planning Project on Civic and Political Science in Universities (Grant No. 20SZB01). This work is supported by the Scientific Grant Agency of the Ministry of Education, Science, Research, and Sport of the Slovak Republic and the Slovak Academy Sciences as part of the research project VEGA 1/0797/20: Quantification of Environmental Burden Impacts of the Slovak Regions on Health, Social and Economic System of the Slovak Republic.

## ACKNOWLEDGMENTS

Authors would like to thank all persons who directly or indirectly participated in the completion of this manuscript.

14. Pascoe MC, Hetrick SE, Parker AG. The impact of stress on students in secondary school and higher education. *Int J Adolesc Youth*. (2020) 25:104–12. doi: 10.1080/02673843.2019.1596823
15. Bisson KH. The Effect of anxiety and depression on college students' academic performance: exploring social support as a moderator. *Electron Theses Diss*. (2017) 77:1–7.
16. Ardalan MR. The role of organizational justice in job satisfaction by mediating organizational citizenship behavior and psychological empowerment. *J Manag Educ Organ*. (2021) 10:73–108. doi: 10.52547/meo.10.1.73
17. Lazarus R, Folkman S. *Stress, Appraisal, and Coping*. NY: Springer (1984).
18. Lazarus R. *Psychological Stress and the Coping Process*. NY: McGraw-Hill (1996).
19. Lazarus R. *Emotion and Adaptation*. NY: Oxf Univ Press (1991).
20. Lazarus R. Coping theory and research: past, present, and future. *Psychosom Med*. (1993) 234–47. doi: 10.1097/00006842-199305000-00002
21. Ribeiro Í, Pereira R, Vidal Freire I, Oliveira B, Casotti C, Boery E. Stress and quality of life among university students: a systematic literature review. *Health Prof Educ*. (2017) 4:70–7. doi: 10.1016/j.hpe.2017.03.002
22. Abbas J, Muzaffar A, Shoaib M, Mahmood HK. Do business schools really fulfill industry requirements? an investigation of industrial performance of business graduates. *World Appl Sci J*. (2014) 31:1378–84. doi: 10.5829/idosi.wasj.2014.31.07.424
23. Chawla K, Sachdeva V. Domains of stress and coping strategies used by 1st year medical students. *Natl J Physiol Pharm Pharmacol*. (2018) 8:366–9. doi: 10.5455/njppp.2017.7.1040623102017
24. Yang C, Chen A, Chen Y. College students' stress and health in the COVID-19 pandemic: the role of academic workload, separation from school, and fears of contagion. *PloS ONE*. (2021) 16:e0246676. doi: 10.1371/journal.pone.0246676
25. Popa-Velea O, Pirvan I, Diaconescu LV. The impact of self-efficacy, optimism, resilience and perceived stress on academic performance and its subjective evaluation: a cross-sectional study. *Int J Environ Res Public Health*. (2021) 18:8911. doi: 10.3390/ijerph18178911
26. Abbas J, Sagsan M. Identification of key employability attributes and evaluation of university graduates' performance: Instrument development and validation. *High Educ Ski Work-Based Learn*. (2019) 10:449–66. doi: 10.1108/HESWBL-06-2019-0075
27. Travis J, Kaszycki A, Geden M, Bunde J. Some stress is good stress: the challenge-hindrance framework, academic self-efficacy, and academic outcomes. *J Educ Psychol*. (2020) 112:1632. doi: 10.1037/edu0000478
28. Kaffle B. Parental involvement and its impacts on student performance: a quantitative study in vvas municipality of tanahun. *Artech J Art Social Sci*. (2021) 3:39–48.
29. Atolagbe A, Oparinde O, Umaru H. Parents' occupational background and student performance in public secondary schools in Osogbo Metropolis,



- Osun State, Nigeria. *Afr J InterMultidisciplinary Stud.* (2019) 1:13–24. doi: 10.51415/ajims.v1i1.802
30. Descals-Tomás A, Rocabert-Beut E, Abellán-Roselló L, Gómez-Artiga A, Doménech-Betoret F. Influence of teacher and family support on university student motivation and engagement. *Int J Environ Res Public Health.* (2021) 18:2606. doi: 10.3390/ijerph18052606
  31. Abbas J, Sagsan M. Impact of knowledge management practices on green innovation and corporate sustainable development: a structural analysis. *J Clean Prod.* (2019) 229:611–20. doi: 10.1016/j.jclepro.2019.05.024
  32. Habib M, Abbas J, Noman R. Are human capital, intellectual property rights, and research and development expenditures really important for total factor productivity? An empirical analysis. *Int J Soc Econ.* (2019) 46:756–74. doi: 10.1108/IJSE-09-2018-0472
  33. Abbas J. HEISQUAL: a modern approach to measure service quality in higher education institutions. *Stud Educ Eval.* (2020) 67:100933. doi: 10.1016/j.stueduc.2020.100933
  34. Beiter R, Nash R, McCrady M, Rhoades D, Linscomb M, Clarahan M, Sammut S. The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *J Affect Disord.* (2015) 173:90–6. doi: 10.1016/j.jad.2014.10.054
  35. Hünefeld L, Gerstenberg S, Hüffmeier J. Job satisfaction and mental health of temporary agency workers in Europe: a systematic review and research agenda. *Work Stress.* (2020) 34:82–110. doi: 10.1080/02678373.2019.1567619
  36. Imran M, Abbas J. The Role Of Strategic Orientation In Export Performance Of China Automobile Industry. In: *Handbook of Research on Managerial Practices and Disruptive Innovation in Asia*. Pennsylvania: IGI Global (2020). p. 249–63.
  37. Safdar B, Habib A, Amjad A, Abbas J. Treating students as customers in higher education institutions and its impact on their academic performance. *Int J Acad Res Progress Educ Dev.* (2020) 9:176–91. doi: 10.6007/IJARPED/v9-i4/8458
  38. Lörz M, Netz N, Quast H. Why do students from underprivileged families less often intend to study abroad? *High Educ.* (2016) 72:153–74. doi: 10.1007/s10734-015-9943-1
  39. Brandy JM, Penckofer S, Solari-Twadell PA, Velsor-Friedrich B. Factors predictive of depression in first-year college students. *J Psychosoc Nurs Ment Health Serv.* (2015) 53:38–44. doi: 10.3928/02793695-20150126-03
  40. Pancer SM, Pratt M, Hunsberger B, Alisat S. Bridging troubled waters: helping students make the transition from high school to university. *Guid Couns.* (2004) 19:184–90.
  41. Kumari K, Ali SB, Khan N, un NK, Abbas J. Examining the role of motivation and reward in employees' job performance through mediating effect of job satisfaction: an empirical evidence. *Int J Organ Leadersh.* (2021) 10:401–20. doi: 10.33844/ijol.2021.60606
  42. Topuzoglu A, Binbay T, Ulaş H, Elbi H, Tanik FA, Zagli N, et al. The epidemiology of major depressive disorder and subthreshold depression in Izmir, Turkey: Prevalence, socioeconomic differences, impairment and help-seeking. *J Affect Disord.* (2015) 181:78–86. doi: 10.1016/j.jad.2015.04.017
  43. Yu M, Zhang X, Lu F, Fang L. Depression and risk for diabetes: a meta-analysis. *Can J Diabetes.* (2015) 39:266–72. doi: 10.1016/j.cjcd.2014.11.006
  44. Shakoor F, Fakhar A, Abbas J. Impact of smartphones usage on the learning behaviour and academic performance of students: empirical evidence from Pakistan. *Int J Acad Res Bus Soc Sci.* (2021) 11:862–81. doi: 10.6007/IJARBSS/v11-i2/8902
  45. Mirza AA, Baig M, Beyari GM, Halawani MA, Mirza AA. Depression and anxiety among medical students: a brief overview. *Adv Med Educ Pract.* (2021) 12:393. doi: 10.2147/AMEP.S302897
  46. Chen L, Wang L, Qiu XH, Yang XX, Qiao ZX, Yang YJ, et al. Depression among Chinese university students: prevalence and socio-demographic correlates. *PloS ONE.* (2013) 8:e58379. doi: 10.1371/journal.pone.0058379
  47. Kazmi SJA, Abbas J. Examining the Impact of Industry 4.0 on Labor Market in Pakistan. In: *Handbook of Smart Materials, Technologies, and Devices*. Switzerland: Springer (2021). p. 1–11.
  48. Wahid SS, Ottman K, Hudhud R, Gautam K, Fisher HL, Kieling C, et al. Identifying risk factors and detection strategies for adolescent depression in diverse global settings: A Delphi consensus study. *J Affect Disord.* (2021) 279:66–74. doi: 10.1016/j.jad.2020.09.098
  49. Rocke K, Roopchand X. Predictors for depression and perceived stress among a small island developing state university population. *Psychol Health Med.* (2021) 26:1108–17. doi: 10.1080/13548506.2020.1802049
  50. Abbas J. Service quality in higher education institutions: qualitative evidence from the students' perspectives using maslow's hierarchy of needs. *Int J Qual Serv Sci.* (2020) 12:371–84. doi: 10.1108/IJQSS-02-2020-0016
  51. Fang Y, Forger DB, Frank E, Sen S, Goldstein C. Day-to-day variability in sleep parameters and depression risk: a prospective cohort study of training physicians. *NPJ Digit Med.* (2021) 4:1–9. doi: 10.1038/s41746-021-00400-z
  52. Zheng R, Zhou Y, Fu Y, Xiang Q, Cheng F, Chen H, et al. Prevalence and associated factors of depression and anxiety among nurses during the outbreak of COVID-19 in China: a cross-sectional study. *Int J Nurs Stud.* (2021) 114:103809. doi: 10.1016/j.ijnurstu.2020.103809
  53. Abbas J. Impact of total quality management on corporate sustainability through the mediating effect of knowledge management. *J Clean Prod.* (2020) 244:118806. doi: 10.1016/j.jclepro.2019.118806
  54. Halonen J, Hakko H, Riala K, Riipinen P. Familial risk factors in relation to recurrent depression among former adolescent psychiatric inpatients. *Child Psychiatry Hum Dev.* (2021) 53:1–11. doi: 10.1007/s10578-021-01146-1
  55. Sparks JA, Malspeis S, Hahn J, Wang J, Roberts AL, Kubzansky LD, et al. Depression and subsequent risk for incident rheumatoid arthritis among women. *Arthritis Care Res.* (2021) 73:78–89. doi: 10.1002/acr.24441
  56. Ahsan MU, Nasir M, Abbas J. Examining the causes of plastic bags usages and public perception about its effects on the natural environment. *Int J Acad Res Bus Soc Sci.* (2020) 10:80–96. doi: 10.6007/IJARBSS/v10-i10/7919
  57. Abbas J, Dogan E. The impacts of organizational green culture and corporate social responsibility on employees' responsible behaviour towards the society. *Environ Sci Pollut Res.* (2022). 1–11. doi: 10.1007/s11356-022-20072-w
  58. Jules MA, Maynard D-MB, Lowe G, Lipps G, Gibson RC. A psychosocial analysis of depression, anxiety and student engagement: effects of parenting practices. *Clin Child Psychol Psychiatry.* (2021) 26:110–20. doi: 10.1177/1359104520972447
  59. Parker G, Tavella G. Distinguishing burnout from clinical depression: a theoretical differentiation template. *J Affect Disord.* (2021) 281:168–73. doi: 10.1016/j.jad.2020.12.022
  60. Mahmood HK, Hussain F, Mahmood M, Kumail R, Abbas J. Impact of e-assessment at middle school students' learning—an empirical study at USA middle school students. *Int J Sci Eng Res.* (2020) 11:1722–36.
  61. Ibrahim L, DiazGranados N, Franco-Chaves J, Brutsche N, Henter ID, Kronstein P, et al. Course of improvement in depressive symptoms to a single intravenous infusion of ketamine vs add-on riluzole: results from a 4-week, double-blind, placebo-controlled study. *Neuropsychopharmacology.* (2012) 37:1526–33. doi: 10.1038/npp.2011.338
  62. Jadon A, Chiu C-C, McDermott L, Cunningham P, Frangou S, Chang C-J, et al. Associations of polyunsaturated fatty acids with residual depression or anxiety in older people with major depression. *J Affect Disord.* (2012) 136:918–25. doi: 10.1016/j.jad.2011.09.007
  63. Abbas J. Impact of total quality management on corporate green performance through the mediating role of corporate social responsibility. *J Clean Prod.* (2020) 242:118458. doi: 10.1016/j.jclepro.2019.118458
  64. Flurry LA, Swimberghe K, Allen J. Exposing the moderating impact of parent-child value congruence on the relationship between adolescents' materialism and subjective well-being. *J Bus Res.* (2021) 128:290–302. doi: 10.1016/j.jbusres.2021.02.005
  65. Coley RY, Boggs JM, Beck A, Simon GE. Predicting outcomes of psychotherapy for depression with electronic health record data. *J Affect Disord Rep.* (2021) 6:100198. doi: 10.1016/j.jadr.2021.100198
  66. Ruchkin V, Isaksson J, Schwab-Stone M, Stickley A. Prevalence and early risk factors for bulimia nervosa symptoms in inner-city youth: gender and ethnicity perspectives. *J Eat Disord.* (2021) 9:1–13. doi: 10.1186/s40337-021-00479-5
  67. Curby TW, Zinsner KM, Gordon RA, Ponce E, Syed G, Peng F. Emotion-focused teaching practices and preschool children's social and learning behaviors. *Emotion.* (2021) 1–16. doi: 10.1037/emo0000988
  68. Fu Q, Abdul Rahman AA, Jiang H, Abbas J, Comite U. Sustainable supply chain and business performance: the impact of strategy, network design,

- information systems, and organizational structure. *Sustainability*. (2022) 14:1080. doi: 10.3390/su14031080
69. Chen J, Liu X, Wang D, Jin Y, He M, Ma Y, et al. Risk factors for depression and anxiety in healthcare workers deployed during the COVID-19 outbreak in China. *Soc Psychiatry Psychiatr Epidemiol*. (2021) 56:47–55. doi: 10.1007/s00127-020-01954-1
  70. Kumari K, Abbas J, Rashid S, Haq MAU. Role of corporate social responsibility in corporate reputation via organizational trust and commitment. *Rev Manag Sci*. (2021) 3:42–63. doi: 10.53909/admin.v3i2.84
  71. Hwang J, Abbas J, Joo K, Choo S-W, Hyun SS. The effects of types of service providers on experience economy, brand attitude, and brand loyalty in the restaurant industry. *Int J Env Res Public Health*. (2022) 19:15. doi: 10.3390/ijerph19063430
  72. Zhou X, Sun X. Family depression profiles among adolescents and their parents: A group-based multitrajectory modeling. *J Fam Psychol*. (2021) 1–42. doi: 10.31219/osf.io/r3mgw
  73. Quince TA, Wood DF, Parker RA, Benson J. Prevalence and persistence of depression among undergraduate medical students: a longitudinal study at one UK medical school. *BMJ Open*. (2012) 2:e001519. doi: 10.1136/bmjopen-2012-001519
  74. Sarokhani D, Delpisheh A, Veisani Y, Sarokhani MT, Manesh RE, Sayehmiri K. Prevalence of depression among university students: a systematic review and meta-analysis study. *Depress Res Treat*. (2013) 2013:1–7. doi: 10.1155/2013/373857
  75. Youssef J, Deane FP. Factors influencing mental-health help-seeking in Arabic-speaking communities in Sydney, Australia. *Ment Health Relig Cult*. (2006) 9:43–66. doi: 10.1080/13674670512331335686
  76. Khan SM, Abbas J. Mindfulness and happiness and their impact on employee creative performance: mediating role of creative process engagement. *Think Ski Creat*. (2022). doi: 10.1016/j.tsc.2022.101027
  77. Nguyen DT, Wright EP, Dedding C, Pham TT, Bunders J. Low self-esteem and its association with anxiety, depression, and suicidal ideation in Vietnamese secondary school students: a cross-sectional study. *Front Psychiatry*. (2019) 10:698. doi: 10.3389/fpsy.2019.00698
  78. Mellal AA, Albluwe T, Al-Ashkar D. The prevalence of depressive symptoms and its socioeconomic determinants among university students in Al Ain, UAE. *Education*. (2014) 159:26–3. doi: 10.3389/fpubh.2020.603357
  79. Xie Z, Liu X, Najam H, Fu Q, Abbas J, Comite U, et al. Achieving financial sustainability through revenue diversification: a green pathway for financial institutions in Asia. *Sustainability*. (2022) 14:1–16. doi: 10.3390/su14063512
  80. Doyumgaç I, Tanhan A, Kiyamaz MS. Understanding the most important facilitators and barriers for online education during COVID-19 through online photovoice methodology. *Int J High Educ*. (2021) 10:166–90. doi: 10.5430/ijhe.v10n1p166
  81. Awadalla S, Davies EB, Glazebrook C. A longitudinal cohort study to explore the relationship between depression, anxiety and academic performance among Emirati university students. *BMC Psychiatry*. (2020) 20:1–10. doi: 10.1186/s12888-020-02854-z
  82. Moyano N, Perez-Yus MC, Herrera-Mercadal P, Navarro-Gil M, Valle S, Montero-Marin J. Burned or engaged teachers? the role of mindfulness, self-efficacy, teacher and students' relationships, and the mediating role of intrapersonal and interpersonal mindfulness. *Curr Psychol*. (2021) 1–14. doi: 10.1007/s12144-021-02433-9
  83. Abror A, Patrisia D, Syahrizal S, Sarianti R, Dastgir S. Self-efficacy, employee engagement, remuneration and employee loyalty in higher education: the role of satisfaction and OCB (2019) 29:5456–70.
  84. Alhussain T, Al-Rahmi WM, Othman MS. Students' perceptions of social networks platforms use in higher education: a qualitative research. *Int J Adv Trends Comput Sci Eng*. (2020) 9:1–15. doi: 10.30534/ijatcse/2020/16932020
  85. Khan H, Abbas J, Kumari K, Najam H. Corporate level politics from managers and employees perspective and its impact on employees' job stress and job performance. *J Econ Adm Sci*. (2022) 1–17. doi: 10.1108/JEAS-12-2021-0246
  86. Ngasa SN, Sama C-B, Dzekem BS, Nforchu KN, Tindong M, Aroke D, et al. Prevalence and factors associated with depression among medical students in Cameroon: a cross-sectional study. *BMC Psychiatry*. (2017) 17:1–7. doi: 10.1186/s12888-017-1382-3
  87. Gold Berg I. *Goldberg's Depression Scale*. (1993). Available online at: <https://www.drloratherapy.com/userfiles/2681667/file/GoldbergsDepressionScale.pdf>. (accessed December, 2021).
  88. Prajogo DI, Cooper B. The effect of people-related TQM practices on job satisfaction: a hierarchical model. *Production Planning and Control*. (2010) 21:26–35. doi: 10.1080/09537280903239383
  89. Kaiser HF, Rice J, Jiffy L, Iv M. *Educational Psychological Measurement*. (1974). Available online at: <https://journals.sagepub.com/doi/10.1177/001316447403400115> (accessed March 27, 2020).
  90. Hair JF, Anderson RE, Black WC. *Multivariate Data Analysis* New Jersey: Pearson (2010).
  91. Schwarz A, Rizzuto T, Carraher-Wolverton C, Roldan JL, Barrera-Barrera R. *Examining the Impact and Detection of the "Urban Legend" of Common Method Bias | ACM SIGMIS Database: the DATABASE for Advances in Information Systems*. (2017). Available online at: <https://dl.acm.org/doi/10.1145/3051473.3051479> (accessed April 1, 2020).
  92. Podsakoff PM, MacKenzie SB, Podsakoff NP. Sources of method bias in social science research and recommendations on how to control it. *Annu Rev Psychol*. (2012) 63:539–69. doi: 10.1146/annurev-psych-120710-100452
  93. Hinkins Timothy R. A Brief Tutorial on the Development of Measures for Use in Survey Questionnaires (1998). Available online at: <https://journals.sagepub.com/doi/10.1177/109442819800100106> (accessed April 1, 2020).
  94. Peterson RA. Meta-analysis of alpha cronbach's coefficient. *J Consum Res*. (1994) 21:381–91. doi: 10.1086/209405
  95. Awang Z. *A Handbook on Structural Equation Modeling Using AMOS*. Malaysia: Universiti Teknologi MARA Press (2012).
  96. Molina LM, Lloréns-Montes J, Ruiz-Moreno A. Relationship between quality management practices and knowledge transfer. *J Oper Manag*. (2007) 25:682–701. doi: 10.1016/j.jom.2006.04.007
  97. Fornell C, Larcker David F. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J Mark Res*. (1981) 18:39–50. doi: 10.2307/3151312
  98. Kaynak H. The relationship between total quality management practices and their effects on firm performance. *J Oper Manag*. (2003) 21:405–35. doi: 10.1016/S0272-6963(03)00004-4
  99. Byrne BM. *A Primer of LISREL: Basic Applications and Programming for Confirmatory Factor Analytic Models*. (New York: Springer Science & Business Media), (1989). p. 226. doi: 10.1007/978-1-4613-8885-2\_1
  100. Bagozzi RR, Yi Y. On the evaluation of structural equation models. *J Acad Mark Sci*. (1988) 16:074–94. doi: 10.1007/BF02723327
  101. Browne MW, Cudeck R. Alternative ways of assessing model fit. *Sociol Methods Res*. (1992) 21:230–58. doi: 10.1177/0049124192021002005
  102. Hu L, Bentler PM. Fit indices in covariance structure modeling: sensitivity to under-parameterized model misspecification. (1998). Available online at: [http://refhub.elsevier.com/S0959-6526\(19\)33328-1/sref37](http://refhub.elsevier.com/S0959-6526(19)33328-1/sref37) (accessed November, 2020).
  103. Bentler PM, Bonett DG. Significance tests and goodness of fit in the analysis of covariance structures. *Psychol Bull*. (1980) 88:588–606. doi: 10.1037/0033-2909.88.3.588
  104. McDonald RP, Marsh HW. Choosing a multivariate model: noncentrality and goodness of fit. *Psychological Bull*. (1990). doi: 10.1037/0033-2909.107.2.247
  105. Satinsky EN, Kimura T, Kiang MV, Abebe R, Cunningham S, Lee H, et al. Systematic review and meta-analysis of depression, anxiety, and suicidal ideation among Ph. D students. *Sci Rep*. (2021) 11:1–12. doi: 10.1038/s41598-021-93687-7
  106. Deb S, Strodl E, Sun H. Academic stress, parental pressure, anxiety and mental health among Indian high school students. *Int J Psychol Behav Sci*. (2015) 5:26–34. doi: 10.6007/IJARBS/v11-i3/8465
  107. Kokou-Kpolou CK, Jumageldinov A, Park S, Nieuviarts N, Noorishad P-G, Cénat JM. Prevalence of depressive symptoms and associated psychosocial risk factors among French University students: the moderating and mediating effects of resilience. *Psychiatr Q*. (2021) 92:443–57. doi: 10.1007/s1126-020-09812-8
  108. Aleksic A, Vukovic M. Connecting personality traits with deviant workplace behavior. *J Media Crit*. (2018) 4:11–34.

109. Wang X, Cai L, Qian J, Peng J. Social support moderates stress effects on depression. *Int J Ment Health Syst.* (2014) 8:1–5. doi: 10.1186/1752-4458-8-41
110. Zhao S, Yiyue G. The effects of mother's education on college student's depression level: the role of family function. *Psychiatry Res.* (2018) 269:108–14. doi: 10.1016/j.psychres.2018.08.030
111. Othman N, Ahmad F, El Morr C, Ritvo P. Perceived impact of contextual determinants on depression, anxiety and stress: a survey with university students. *Int J Ment Health Syst.* (2019) 13:1–9. doi: 10.1186/s13033-019-0275-x
112. Ahorsu DK, Adjaottor ES, Yeboah FA, Opoku Y. Mental health challenges in academia: comparison between students of the various educational levels in Ghana. *J Ment Health.* (2021) 30:292–9. doi: 10.1080/09638237.2020.1739253
113. Hedrick J, Bennett V, Carpenter J, Dercher L, Grandstaff D, Gosch K, et al. descriptive study of adverse childhood experiences and depression, anxiety, and stress among undergraduate nursing students. *J Prof Nurs.* (2021) 37:291–7. doi: 10.1016/j.profnurs.2021.01.007
114. Owczarek JE, Lion KM, Radwan-Oczko M. The impact of stress, anxiety and depression on stomatognathic system of physiotherapy and dentistry first-year students. *Brain Behav.* (2020) 10:e01797. doi: 10.1002/brb3.1797
115. Ludwig AB, Burton W, Weingarten J, Milan F, Myers DC, Kligler B. Depression and stress amongst undergraduate medical students. *BMC Med Educ.* (2015) 15:1–5. doi: 10.1186/s12909-015-0425-z

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Deng, Cherian, Khan, Kumari, Sial, Comite, Gavurova and Popp. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Multifarious Linkages Between Personality Traits and Psychological Distress During and After COVID-19 Campus Lockdown: A Psychological Network Analysis

Tzu-Hsuan Liu<sup>1</sup>, Yiwei Xia<sup>2</sup> and Zhihao Ma<sup>3\*</sup>

<sup>1</sup> School of Political Science and Public Administration, Huaqiao University, Quanzhou, China, <sup>2</sup> School of Law, Southwestern University of Finance and Economics, Chengdu, China, <sup>3</sup> Computational Communication Collaboratory, School of Journalism and Communication, Nanjing University, Nanjing, China

## OPEN ACCESS

### Edited by:

Agnes Lai,  
The University of Hong Kong,  
Hong Kong SAR, China

### Reviewed by:

Eleonora Topino,  
Libera Università Maria SS. Assunta  
University, Italy  
Filipa Isabel Ferreira,  
Instituto Universitário da Maia  
(ISMAI), Portugal

### \*Correspondence:

Zhihao Ma  
redclass@163.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

**Received:** 16 November 2021

**Accepted:** 07 June 2022

**Published:** 30 June 2022

### Citation:

Liu T-H, Xia Y and Ma Z (2022)  
Multifarious Linkages Between  
Personality Traits and Psychological  
Distress During and After COVID-19  
Campus Lockdown: A Psychological  
Network Analysis.  
Front. Psychiatry 13:816298.  
doi: 10.3389/fpsy.2022.816298

**Background:** The novel coronavirus disease pandemic is still proliferating and is not expected to end any time soon. Several lockdowns and social distancing measures might be implemented in the future. A growing body of research has explored the effect of personality on individuals' psychological wellbeing during the pandemic. However, most prior studies have not discussed the dynamic and reciprocal transactions between personality and psychological distress in various situations. Therefore, this study aims to explore the internal mechanisms of the ways in which certain personality traits triggered specific symptoms during and after college lockdown, by using network analysis.

**Methods:** Based on survey data from 525 university students in China, the study detected the connection between individual personality and psychological distress through network analysis. Of the participants, 70.1% were female, and 20.9% were male. The mean age of the participants was 19.701 (SD = 1.319) years. We estimated networks via two steps: First, two networks that only contain the Big Five personality traits and the six symptoms of psychological distress during and after the lockdown measure were estimated. Second, we add control variables and re-estimated the networks to check whether the linkages among the Big Five personality traits and the six symptoms of psychological distress observed in the first step were stable. Moreover, we employed strength centrality as the key indicator to present the potential significance of diverse variables within a network.

**Results:** The findings demonstrate that, first, "depress" was the central symptom in the network during the college lockdown, while "efforts" was the central symptom after the lockdown. Second, the symptoms of "restless" and "worthless" significantly declined after the lockdown. Third, we found that there is an internal mechanism through which personality affected certain psychological symptoms during and after lockdowns. Specifically, neuroticism triggered certain symptoms during and after the lockdown, while extraversion and conscientiousness suppressed certain symptoms. Substantial evidence on internal linkages is imperative to develop effective interventions.



**Conclusion:** This study explores the internal mechanisms of the ways in which certain personality traits trigger specific symptoms. Overall, our results provide empirical evidence that personality traits play a key role in how individuals with certain traits respond to college lockdown during a pandemic. The study makes a significant contribution to the literature because it is among the first few studies which explores the effects of personality traits on individual psychological distress using network analysis during the pandemic.

**Keywords:** COVID-19, psychological distress, Big Five personality, lockdown, network analysis

## INTRODUCTION

The novel coronavirus disease (COVID-19) pandemic significantly influenced peoples' daily lives and wellbeing, including physical and psychological wellbeing. For example, research showed that individuals reported more alcohol consumption and poor sleep quality as the pandemic progressed, especially for alcohol consumption and sleep quality (1). Other research found that the pandemic might deteriorate psychological health and exacerbate suicide risk (2, 3). Certain strains of the SARS-CoV-2 virus may continue circulating in pockets of the world population in the future (4). Implementing control measures—such as lockdowns and social distancing—is imperative for controlling the spread of the virus (5). Since the outbreak of COVID-19 in 2019, it has affected university students globally (6); numerous universities closed their campuses and adopted remote teaching *via* online platforms (7). The COVID-19 pandemic has substantially influenced daily lives and wellbeing of college students. For example, a study showed that problematic Internet use (PIU) has become a serious issue among residential college students (8). Another study demonstrated that college students' externalizing problems and attention problems increased after the outbreak of COVID (9). Research related to individual psychological wellbeing found that college students experienced increased acute stress, anxiety, and depressive symptoms during the epidemic (10).

Universities in China employed an innovative closed or semi-closed campus management measure, which derived substantial epidemiological benefits to reduce viral transmission. Almost all universities in China placed teachers and students under blanket campus lockdowns. It is worth noting that not all universities in China implement closed management measure at the same time. It depends on the severity of epidemic and provisional epidemic control policy. Universities in the area with a small outbreak usually adopt closed campus management measure in China. Although students and teachers can return to the campus, some of universities ask teachers to adopt remote teaching to reduce contact. Also, university students are not allowed to leave the campus unless necessary, and off-campus personnel cannot enter the campus without administrative permission. A lack of social interaction, reduced teacher–student contact, and difficult dorm situations that were unfit for learning purposes, involving insufficient data bandwidth, and limited space, directly challenge every student. Although strict precaution management at universities helps to halt the spread of the virus, prior

research that connecting lockdowns to subjective wellbeing suggest that strict measures may negatively affect students' psychological wellbeing (11).

For example, Deng et al. examined the prevalence of psychological disorders in students during the COVID-19 pandemic and found that the pooled prevalence of depressive symptoms, anxiety symptoms, and sleep disturbances was 34, 32, and 33%, respectively (12). By conducting meta-analysis. The researchers observed that the symptoms might resulted from a combination of disrupted academic routines, and isolation of university students. Moreover, Allé and Berntsen has found that psychotic symptoms were higher in individuals with less social interactions, more prolonged self-isolation and smaller living space (13). The study underscored the negative effect of social isolation and living in small spaces on psychological distress during the epidemic. Additionally, Benke et al. suggested that a higher level of restrictions due to lockdown measures, a stronger reduction of social contact, and stronger perceived changes in life were linked to poorer psychological health (14). Furthermore, Brooks et al. highlighted that lengthy lockdown aggravates mental health-related issues (15). Similar results have been reported in several other research (16). These findings underlined that COVID-19 lockdowns were associated with higher levels of psychological symptomatology. Although a growing body of research has explored individuals' psychological wellbeing during the COVID-19 lockdowns, only a few studies discuss the changes in individuals' psychological wellbeing during and after the lockdowns. This paper will elucidate the differences in the effect that individuals' internal mechanisms have on their psychological symptomatology, during and after the lockdown.

A fair body of research has highlighted that the five broad personality traits (Big Five model)—extroversion, neuroticism, conscientiousness, agreeableness, and openness (17)—as the key factors affecting psychological distress. Every trait is made up of multiple facets. For instance, extraversion may reflect an approach temperament and positive emotionality. Neuroticism is the trait disposition to experience moodiness, anxiety, and depression. Agreeableness is the trait disposition to be affable, kind, empathic. Conscientiousness reflects qualities of impulse control and reliability. Openness involves several facets, including curiosity, flexibility, imagination, and willingness to devote oneself in unconventional experiences (17). Research has demonstrated that personality traits were differentially associated with psychopathology and positive mental health outcomes. For instance, emotional stability (reversed neuroticism) was associated with psychopathology, while extraversion and



agreeableness were associated with positive mental health outcomes (18). A few recent studies exploring the effect of personality traits on psychological distress during the COVID-19 pandemic found that certain personality traits are associated with psychological distress. However, the results were inconsistent. For instance, Kroencke et al. conducted a large-scale experience-sampling study and demonstrated that neuroticism had a negative impact on individuals' mental wellbeing during the pandemic (19). Similar findings have been observed in another research (20). Additionally, negative emotional responses may be driven by extraversion because highly extraverted individuals may be significantly dependent on pandemic information, which in turn increases anxiety related to the pandemic (21). A study found that individuals who were introverted experienced less loneliness during the lockdown in France (22). In contrast, Nikčević et al. observed that extraversion and conscientiousness positively influenced psychological wellbeing during the pandemic (23). The inconsistent findings may be due to two reasons: first, such studies did not take different situations into account (e.g., college lockdown or quarantine) (24); second, they did not examine the effect of personality traits on certain symptoms of psychological distress. The reason that the present study explored individual symptoms rather than the whole picture of wellbeing or distress lies in the fact that psychiatric symptoms have been argued to have internal relationships between each other rather than being effects of common association (25). Borsboom suggested the interactions between psychiatric symptoms can be viewed as a network, in which they are nodes and internal interactions between them are linkages between nodes (25, 26). This network approach can be applied to explore the effect of personality trait on certain symptoms of psychological distress.

Also, according to the transactional stress moderation model, personality may influence physiological and psychological responses in response to stressful circumstances, which may in turn lead to damaging physiological, behavioral, and psychological consequences (27). The transactional views of personality show that personality traits, social environments, and symptoms of psychological distress are not always static and affect each other. Based on this theory, distinct personality traits activate or suppress certain psychological symptoms of psychological distress in various situations.

Although some scholars suggested that the end of the COVID-19 pandemic is near, however, COVID-19 may be recurrent disease that the world has to deal with (28). Therefore, recurrent implementation of lockdowns and social distancing measures may be inevitable. Given that behavioral containment and control measures may negatively affect individual psychological wellbeing, it is important to investigate the internal mechanisms through which personality influences individuals' psychological distress in different situations.

A large body of literature explores the effect of personality traits on psychological distress during the pandemic. However, most studies have not considered the possibility of changes in internal linkages between personality traits and psychological wellbeing under different situations. Furthermore, traditional analysis provides limited exploration of the internal linkages

(29). Our study fills this gap by using network analysis, that can provide insights into the effects of personality and psychological distress in various environmental contexts.

Network analysis can provide useful information by graphically mapping the connections between personality and psychological distress; thus, it is possible to assess the specifics of the distress triggered by a certain personality trait in a stressful event (25). Moreover, network analysis helps identify the central symptom and the central trait, which are important predictors of related comorbidities and associations (30, 31). Furthermore, several studies have adopted network analysis to comprehensively disentangle the associations between multiple forms of exposure, such as exposure to traumatic events, and psychological symptoms (32, 33). In addition, network analysis bring benefits to capture nuanced changes of psychological dynamic (34).

Detecting the connection between individual personality and psychological distress through network analysis will helps scholars develop treatment strategies that would most effectively promote enhanced wellbeing in individuals. Although previous research has investigated the impact of personality on psychological distress during the pandemic, the specific triggering effects that personality traits may have on psychological distress remain unexplored. Specifically, whether the mechanism changes after the college lockdown remains unknown.

To identify and support individuals with psychological distress, we emphasized the role of personality traits during and after the closed campus management measure at a university in China. This study aims to explore how the Big Five personality traits influence psychological distress in various environmental contexts.

We explored whether and how this change in responses was affected by personality traits. The Big Five personality traits were chosen to determine internal linkages among personality traits and psychological distress.

## MATERIALS AND METHODS

### Participants and Procedure

The participants were college students recruited from a large university in China. A total of 546 undergraduate students from one college were surveyed. An incentive was offered for participation in the survey in the form of snacks under 1 USD. The survey was done *via* one Chinese online survey system—wenjuanwang (wenjuan.com). The survey was conducted from October 8 to October 30, 2020, while the closed management of the university was implemented from July 1 to October 1, 2020. It is worth noting that some of universities in China implement closed management measure since summer vacation because there are still a great number of students staying at campus. At the time of the survey, the participants were not precisely aware of when the closed management measure would be implemented again; therefore, the current survey can be considered an effective representation of the potential effects of lockdown on individuals' psychological coping mechanisms.

**TABLE 1** | K6 items and corresponding reference names.

Reference names	Items
Nervous	During/After college lockdown, about how often did you feel nervous?
Hopeless	During/After college lockdown, about how often did you feel hopeless?
Restless	During/After college lockdown, about how often did you feel restless or fidgety?
Depress	During/After college lockdown, about how often did you feel so depressed that nothing could cheer you up?
Effort	During/After college lockdown, about how often did you feel that everything was an effort?
Worthless	During/After college lockdown, about how often did you feel worthless?

The survey was conducted on the Big Five personality traits; the participants also rated their levels of psychological distress during and after the implementation of the college lockdown. Twenty-one individuals who refused to participate or did not complete the questionnaire were excluded from the analysis. Finally, 525 individuals were included in the final analysis.

Written informed consent was obtained from all the participants prior to the survey. This study was approved by the research ethics committee of the authors' affiliations.

## Measure

### Big Five Personality Traits

The Big Five Inventory-10 (BFI-10) was employed to measure participants' extraversion, agreeableness, conscientiousness, neuroticism, and openness (35). The BFI-10 has 10 items (two for each trait) with response options on a 5-point Likert scale, where 1 = strongly disagree and 5 = strongly agree. It was identified as a valid inventory to measure personality traits in culturally diverse populations, including the Chinese population (36). The mean scores of two items for each trait, where reversed items were treated in reverse, were used to present individuals' Big Five personality traits.

### Psychological Distress During and After College Lockdown

The Kessler Psychological Distress Short Scale (K6) was used to identify participants' psychological distress (37). The K6 scale consists of six questions regarding feeling "nervous," "hopeless," "restless or fidgety," "so depressed that nothing could cheer you up," "that everything is an effort," and "worthless" during a certain period. Each item presents a psychological distress symptom (Table 1).

The measurements of psychological distress were dependent on the self-report retrospective questionnaire. Following Swedo et al. all participants were asked to rate their psychological distress in two different periods: during the college lockdown and after the lockdown (38). The response options were on a seven-point scale (where 1 = none of the time and 7 = all the time). The mean score of the six items was used to measure psychological

distress, with higher scores indicating more severe psychological distress. The K6 scale used in the current study presents excellent reliability (Cronbach's  $\alpha = 0.908$  for psychological distress during the lockdown, Cronbach's  $\alpha = 0.937$  for psychological distress after lockdown).

### Control Variables

Sex, age, and grade were used as control variables in the current study. Sex was coded as female or male, age was presented by year, and the grade was separated as Grade 1, Grade 2, Grade 3, and Grade 4 according to the university students' information system.

## Statistical Analysis

### Descriptive Statistics

A descriptive analysis was first applied to provide an outline of the sample. Second, a descriptive comparison of psychological distress, including six symptoms, during and after the university lockdown measure, was conducted to observe potential variations in psychological distress in different periods. The paired *t*-test was used for statistical comparison. Third, we conducted the correlation test to reveal the relationships among personality traits and psychological distress during and after college lockdown.

### Network Analysis

In this study, we estimated undirected networks in the form of a mixed graphic model, in which the Big Five personality traits, six symptoms measured by the K6, and control variables were treated as nodes, and edges among nodes can be interpreted as partial correlation coefficients among these variables (39). Since many control variables, such as sex and grade, were categorical, we estimated networks *via* the R package mgm, which was designed to perform network analysis with diverse types of variables (e.g., binary, categorical, and counts) rather than continuous only (40).

Because the network analysis with control variables could make the visualization more complicated, we estimated networks *via* two steps: First, two networks that only contain the Big Five personality traits and the six symptoms of psychological distress during and after the lockdown measure were estimated. Second, we add control variables and re-estimated the networks to check whether the linkages among the Big Five personality traits and the six symptoms of psychological distress observed in the first step were stable. Given that mgm provides the algorithm of regularized generalized regression, we adopted the extended Bayesian information criterion (EBIC) with tuning parameter  $\gamma = 0.5$ , as suggested by a previous simulation study (41).

### Centrality Analysis

We employed strength centrality as the key indicator to present the potential significance of diverse variables within a network (39). Strength centrality is defined as the sum of all the absolute weights of the directly connected edges of a node. Given that the centrality indicators of nodes may be significantly influenced by control variables that are usually highly correlated, the interpretation of nodes' significances within a certain network should exclude those control variables.

**TABLE 2 |** Descriptive statistics ( $N = 525$ ).

	Mean (SD)	N (%)	Min	Max
<b>Big five personality traits</b>				
Extraversion	2.818 (0.887)	-	1	5
Agreeableness	3.509 (0.749)	-	1	5
Conscientiousness	2.751 (0.790)	-	1	5
Neuroticism	3.153 (0.789)	-	1	5
Openness	3.571 (0.855)	-	1	5
<b>Mental illness</b>				
K6 score during lockdown <sup>a</sup>	2.509 (1.241)	-	1	7
K6 score after lockdown <sup>a</sup>	2.461 (1.307)	-	1	7
<b>Control variables</b>				
Sex (1 = female)	-	368 (70.1%)	0	1
Age (years)	19.701 (1.319)	-	15	25
Grade (ref. = Grade 1)	-	-	-	-
Grade 2	-	145 (27.6%)	0	1
Grade 3	-	128 (24.4%)	0	1
Grade 4	-	109 (20.8%)	0	1

<sup>a</sup>The score refers to the average value of six items.

## Robustness Analysis

To assess the accuracy and stability of the edges and the strength centrality obtained from the network analysis, we employed the following steps to perform the robustness analysis. First, we use the bootstrapping approach to estimate the 95% confidence interval to determine the accuracy of the edges. Second, the centrality-stability (CS) coefficient was used to assess the stability of node strength centrality. As suggested by Epskamp et al., the CS coefficient should be above 0.25, revealing adequate stability, and a CS coefficient higher than 0.5 reveals preferable stability (39). We conducted a robustness analysis using the R package bootnet, and all models were bootstrapped 1,000 times.

## RESULTS

### Descriptive Statistics

Table 2 presents the results of descriptive statistics. The sample consisted of 525 college students with a mean age of 19.701 years. Of the participants, 70.1% were female, and the distribution of grade diversity was relatively balanced; the percentage of each grade among the total participants ranged from 20.8 to 27.6%. Both the scores of psychological distress during and after the lockdown measure were at a relatively low level, and the mean score of K6 after lockdown ( $M = 2.461$ ,  $SD = 1.307$ ) was slightly lower than the mean score of K6 during the lockdown ( $M = 2.509$ ,  $SD = 1.241$ ). Additionally, participants reported moderate levels in the five domains of personality traits.

Table 3 shows the descriptive comparison of the K6 score and the scores of the six symptoms during and after the lockdown measure. The mean difference of K6 scores between during and after the lockdown measure was not statistically significant (Diff. = 0.048,  $T = 1.486$ ), while two of the six symptoms, namely “restless” (Diff. = 0.137,  $T = 2.715$ ) and “worthless”

**TABLE 3 |** Mean differences of K6 score and six symptoms' scores between during and after lockdown ( $N = 525$ ).

	During lockdown	After lockdown	Differences	T
K6 score <sup>a</sup>	2.509 (1.241)	2.461 (1.307)	0.048	1.486
Nervous	2.701 (1.445)	2.750 (1.489)	-0.050	-0.979
Hopeless	2.008 (1.286)	2.057 (1.377)	-0.050	-1.130
Restless	2.954 (1.626)	2.817 (1.595)	0.137	2.715**
Depress	2.484 (1.478)	2.423 (1.508)	0.061	1.280
Effort	2.510 (1.498)	2.488 (1.477)	0.023	0.447
Worthless	2.396 (1.635)	2.230 (1.544)	0.166	3.495***

<sup>a</sup>The score refers to the average value of six items.

\*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

(Diff. = 0.166,  $T = 3.495$ ) present a significant decrease after the lockdown measure.

Figure 1 shows the correlation results of the relationships among Big Five Personality Traits, K6 mean score, and all symptoms during and after college lockdown. Detailed correlation coefficients were listed in Supplementary Tables 1, 2.

Both Figures 1A,B reveal that neuroticism was negatively correlated with extraversion, agreeableness, and conscientiousness. Extraversion was positively correlated with conscientiousness and openness.

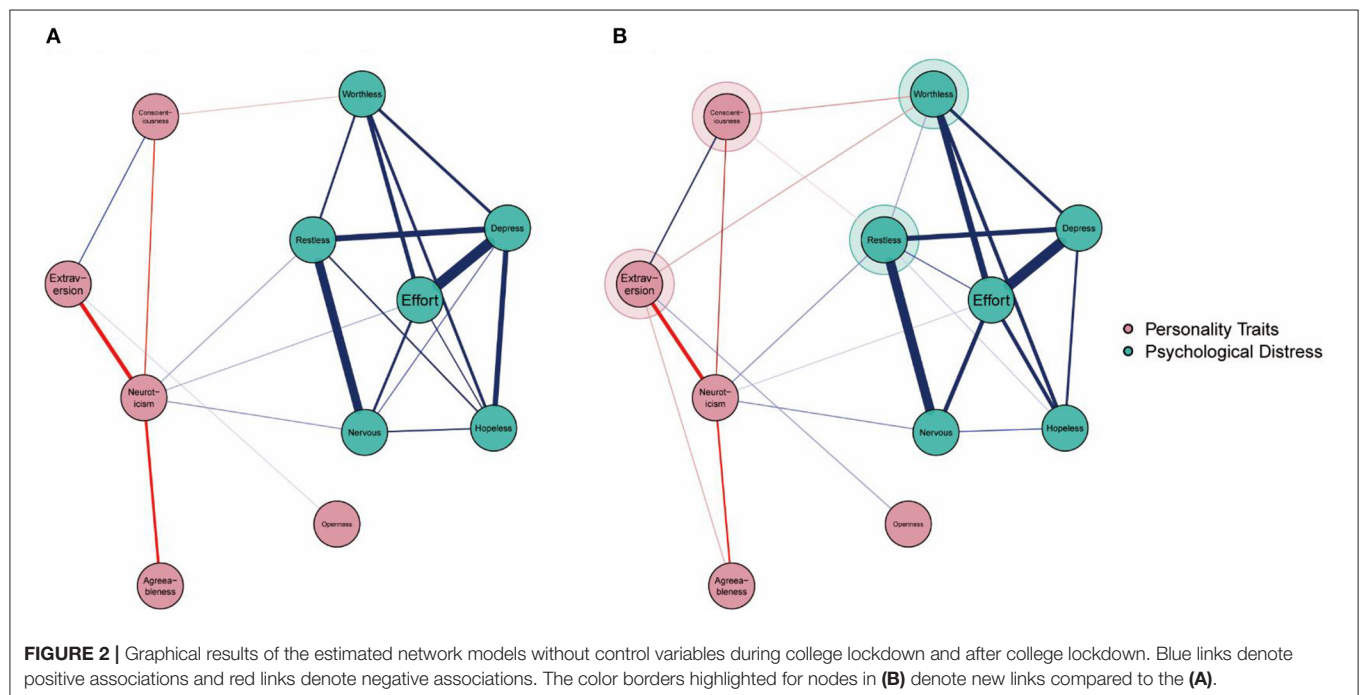
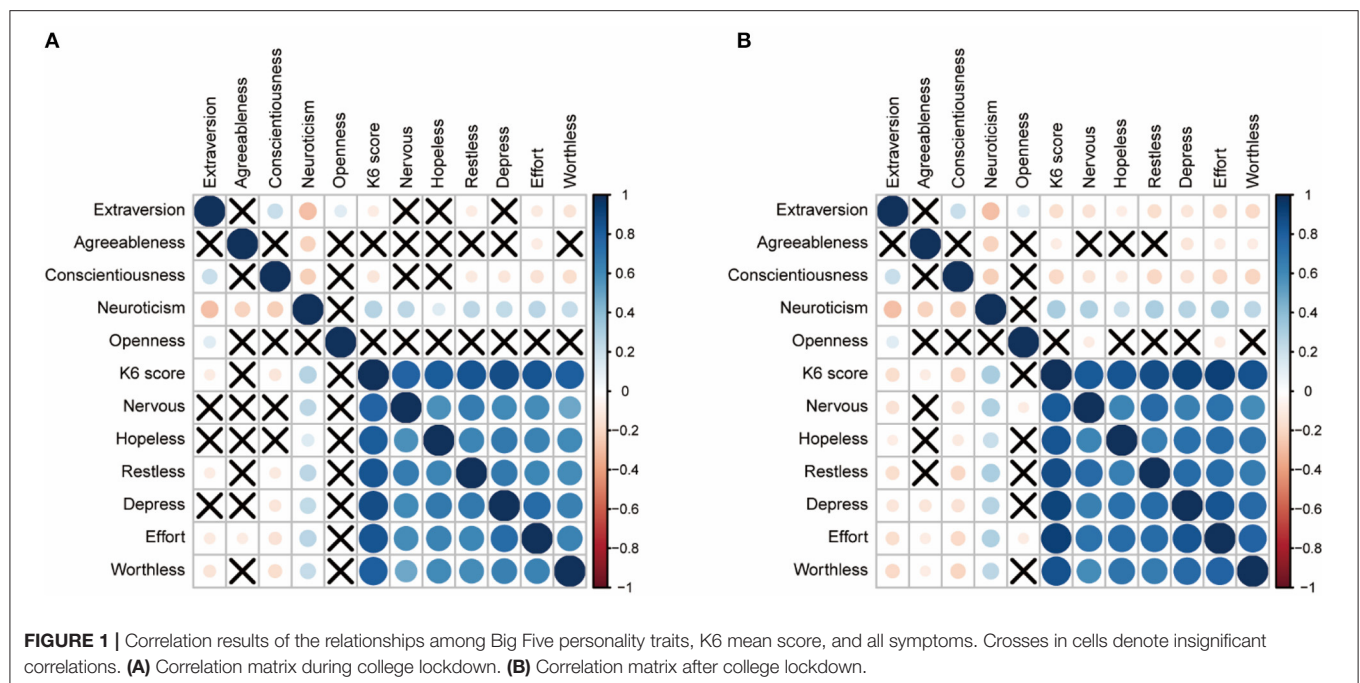
Neuroticism was positively correlated with the K6 mean score and six psychological distress symptoms during and after college lockdown. However, the other four traits' associations with K6 means score and six psychological distress symptoms varied. During college lockdown, extraversion was negatively correlated with K6 mean score and three symptoms (“restless,” “effort,” and “worthless”), conscientiousness was negatively correlated with K6 mean score and four symptoms (“restless,” “depress,” “effort,” and “worthless”), agreeableness only negatively correlated with one symptom (“effort”), openness was insignificantly correlated with any psychological distress symptom and the K6 mean score. After the college lockdown, both extraversion and conscientiousness were negatively correlated with K6 mean score and all psychological distress symptoms, agreeableness was negatively correlated with K6 mean score and three symptoms (“depress,” “effort,” and “worthless”), openness was negatively correlated with two symptoms (“nervous” and “effort”). These results implied that the protective roles of four personality traits may be inhibited during the lockdown period.

## Results of Network Analysis

### The Structure of Networks During Lockdown

The estimated networks of the psychological interaction linkages during lockdown are displayed in Figures 2A, 3A. Detailed edge weights are listed in Supplementary Tables 3, 5, and the bootstrapped accuracy plots are listed in Supplementary Figures 1, 3.

The results in Figure 2A show that all six symptoms of psychological distress were significantly intercorrelated. Moreover, neuroticism was directly positively linked to three symptoms (“nervous,” “restless,” and “efforts”). Additionally,

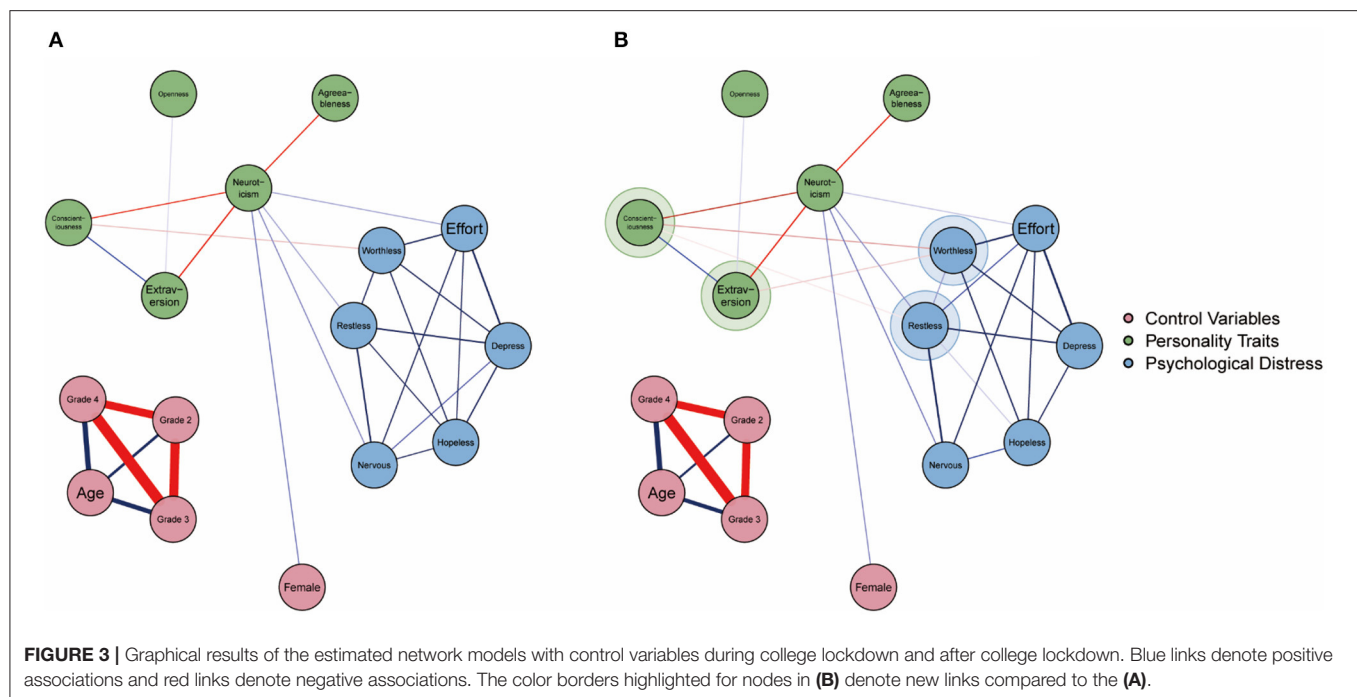


conscientiousness was directly negatively linked to one symptom (“worthless”). The results in **Figure 3A** show that after controlling for age, sex, and grade, the inter-community connections between the Big Five personality traits and psychological distress symptoms were consistent with the results in **Figure 2A**.

### The Structure of Networks After Lockdown

The estimated networks of the psychological interaction linkages after lockdown are displayed in **Figures 2B, 3B**. Detailed edge weights are listed in **Supplementary Tables 4, 6**, and bootstrapped accuracy plots are listed in **Supplementary Figures 2, 4**.





The results in **Figures 2B, 3B** present more sophisticated patterns compared with the results in **Figures 2A, 3A**. First, inter-community connections between the Big Five personality traits and psychological distress symptoms revealed in **Figures 2A, 3A** were stable and consistent with results in **Figures 2B, 3B**. Second, two new inter-community connections were highlighted: the negative linkages between extraversion and “worthless” and conscientiousness and “restless.”

## Centrality Analysis

The robustness of the strength centrality revealed that the networks were very stable (all CS-coefficients were 0.75), and the stability of the network structures *via* the bootstrapping approach is displayed in **Supplementary Figure 5**.

**Figure 4A** shows that “depress” was the most central symptom with a significantly larger strength centrality than other symptoms in the network during the lockdown. Moreover, neuroticism was the most central trait and had a significantly higher strength centrality than other personality traits. After excluding the estimated values of control variables, results in **Figure 4C** were consistent with the above results in **Figure 4A**.

**Figure 4B** shows that “efforts” was the most central symptom and had a significantly larger strength centrality than other symptoms in the network during the lockdown. Neuroticism is the most central trait. The results in **Figure 4D** reveal a consistent pattern after controlling for age, sex, and grade.

## DISCUSSION

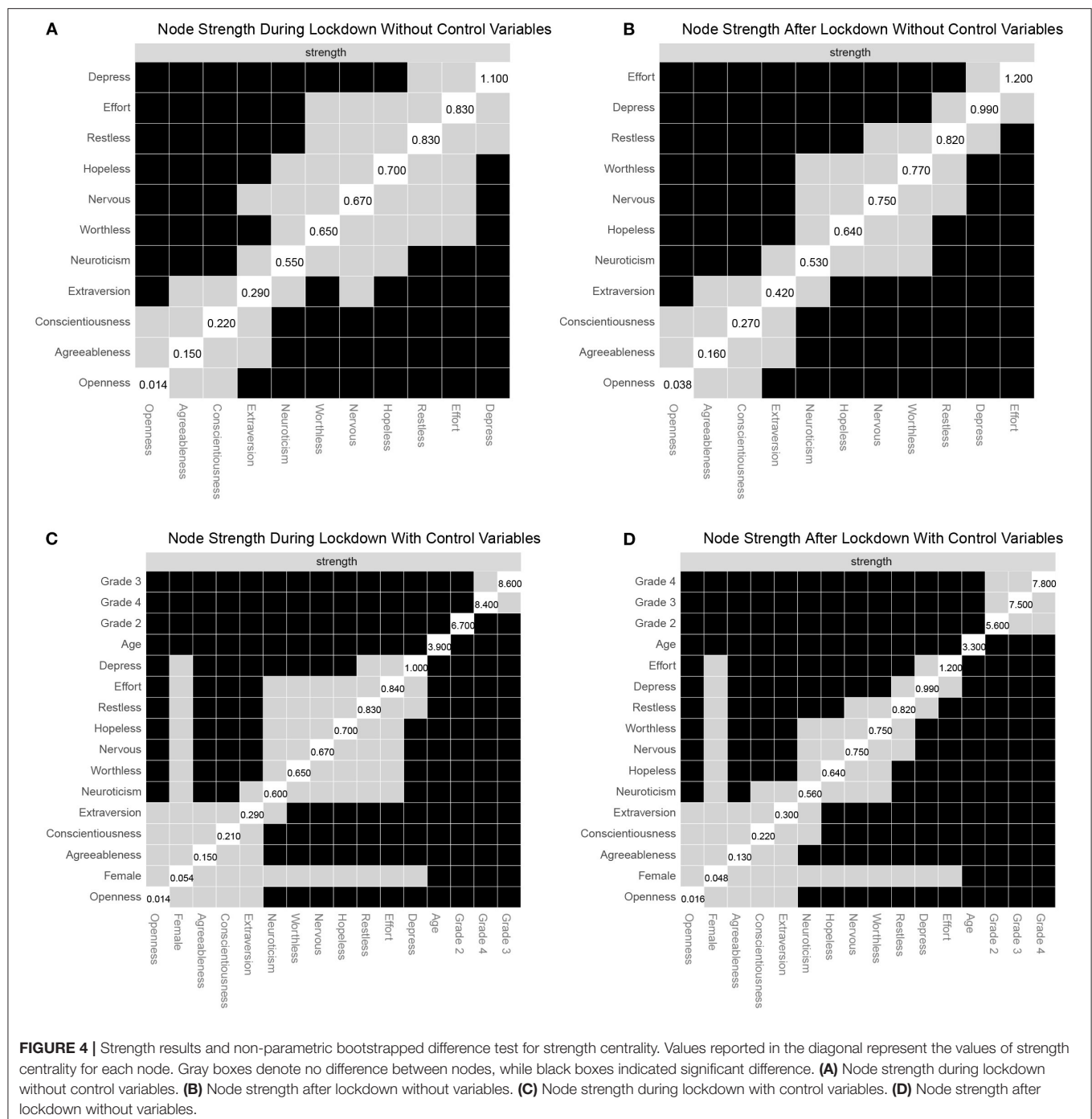
This study primarily aims to provide solid empirical evidence to resolve whether and how the Big Five personality traits predict psychological distress and whether the mechanism varies during

and after lockdowns. Network analysis offers us valuable insights to develop substantial strategies in response to psychological health crises, by examining the pattern of routine activation of personality on psychological distress in high-stakes contexts. To better understand the relationship between personality and psychological health during and after the COVID-19 lockdowns, we focus on which personality traits trigger certain categories of psychological distress during and after the college lockdown periods. Our study is among the first few studies which explores the effects of personality traits on individual psychological distress using network analysis during the pandemic. We have highlighted several significant findings.

Initially, regarding psychological distress, our findings suggested that “depress” was the most central symptom in the network during the college lockdown. This suggests that lockdown adversely might influence the mental health of the population, which is consistent with previous research reporting an increase in the occurrence and frequency depressive symptoms during the lockdown (42). It is noteworthy that “efforts” was the central symptom after the college lockdown. A possible reason is that individuals understand that COVID-19 may remain in circulation in pockets of world population in the future, which perpetuates their sense of danger and uncertainty. Thus, even if they could leave the campus, they still related to “everything being an effort.” Another possible reason may be that the university still has a strict access control system. For example, students should provide health codes to enter the campus. They must also obtain permission from the university to leave the province.

Also, the symptoms of “restless” and “worthless” experienced a significant decline after the lockdown. The results suggest that lockdown measures might negatively affect the mental health of





**FIGURE 4 |** Strength results and non-parametric bootstrapped difference test for strength centrality. Values reported in the diagonal represent the values of strength centrality for each node. Gray boxes denote no difference between nodes, while black boxes indicated significant difference. **(A)** Node strength during lockdown without control variables. **(B)** Node strength after lockdown without variables. **(C)** Node strength during lockdown with control variables. **(D)** Node strength after lockdown without variables.

the population, consistent with previous research reporting an increase in symptoms such as “restless” and “worthless” during the lockdown (43). Lockdowns might be an unsettling experience because of the students’ loss of the freedom to go out, the lack of contact with loved ones in person, feelings of boredom, and uncertainty about the future. Lifting lockdown restrictions might relieve the symptoms of “restless” and “worthless”.

Moreover, personality traits play a crucial role in the ways in which individuals with certain traits respond to

lockdown measures. In fact, previous research has found that extraversion, neuroticism, and conscientiousness are key predictors of psychological wellbeing (19). In the current study, we found that extraversion, neuroticism, and conscientiousness might be responsible for the activation or suppression of some psychological symptoms during and after lockdowns. First, the findings demonstrated that neuroticism was the most central personality trait during and after college lockdown. During and after the lockdown, neuroticism might activate the symptoms of

“nervous,” “restless,” and “efforts.” These findings are consistent with previous evidence, which showed that individuals with higher levels of neuroticism did not adapt well to lockdown, which in turn, might lead to negative impacts on psychological distress during the pandemic (19). Second, conscientiousness might suppress the symptom pertaining to feeling “worthless” during the lockdown, while after the lockdown, it might suppress both symptoms of “worthless” and “restless.” This result is consistent with another study, which suggested that individuals with higher levels of conscientiousness have fewer negative impacts on wellbeing (23). Meanwhile, the symptom of “worthless” might also be suppressed by extraversion after the lockdown. During the lockdown, extraversion might not prevent psychological distress. A possible reason may lie in the fact that individuals high in extraversion may exhibit increased dependence on pandemic information, such as medical information, which in turn facilitates feelings of threat and stress (20). However, after the lockdown, extraverted individuals might have increased contact with other people, which in turn might increase social support. Increase in social support can relieve the symptom of “worthless” (21). These findings are consistent with the transactional model of stress (27). The theory suggests that personality and symptoms of psychological distress are not always static. There might be reciprocal relationships between personality, psychological health, and situational factors (25). The theory supported our findings, which showed that distinct personality traits activate or suppressed certain psychological symptoms.

As for implication, the study suggests that authorities can carry out specific approaches depending on various psychological distress, personality traits, and situations. For instance, neuroticism is the most central symptom during and after lockdowns, and it might trigger symptoms of nervousness, restlessness, and effort. Therefore, universities should target students with high levels of neuroticism and develop targeted interventions, such as mentoring, psychological counseling, and teaching coping skills. Additionally, according to Vos et al.’s study (44), positive personality traits (e.g., optimism, mindfulness, and resilience) the relationship between fear of COVID-19 and psychological distress (45). It is, to our best knowledge, the first study exploring the moderated effect of positive personality traits on the relationship between fear of COVID-19 and psychological distress. Based on the findings of the study, we suggested that the authority can make interventions aimed at improving positive constructs such as optimism, mindfulness, and resilience during the pandemic to promote college students’ psychological health.

## CONCLUSION

This study explores the internal mechanisms of the ways in which certain personality traits trigger specific symptoms. Overall, our results provide empirical evidence that personality traits play a key role in how individuals with certain traits respond to college lockdown during a pandemic. Specifically,

neuroticism triggered psychological distress during and after the lockdown, while extraversion and conscientiousness suppressed psychological distress. A comprehensive understanding of the internal linkages between personality and psychological distress is imperative for developing effective interventions. Furthermore, the current study contributes to the literature by using network analysis and elucidates the effects of personality traits on psychological distress.

Although the study made substantial contributions to the existing literature, two limitations of the study need to be considered. First, the cross-sectional nature of the research does not allow us to generalize the causal relationship between the variables. Moreover, the measurements of psychological distress were dependent on the self-report retrospective questionnaire, which may have resulted in retrospective recall biases. However, according to Middel et al.’s study, retrospective measurement of change in a 12-week interval was not significantly linked to recall bias. The present study was conducted right after the school lockdown (46). It had participants reflect on their previous psychological state during and after the lockdown. The time span was within 12-week intervals, which was not so long that they have serious difficulty recalling how they were during the lockdown. Furthermore, the data of this study were collected from one university in China. Closed-campus management in China is innovative and differs from other universities in other countries. Therefore, it may be difficult to generalize the findings universally. In the future, longitudinal data from multiple universities worldwide should be collected to overcome these limitations.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Research Ethics Committee of School of Political Science and Public Administration at Huaqiao University. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

T-HL wrote the first draft of the study. YX revised the first draft. ZM made the conceptualization and design. All authors approved the final manuscript.

## FUNDING

This study was supported by Major Project of the National Social Science Fund of China (Grant No. 19ZDA324), Project

of Social Science Foundation of Jiangsu Province (Grant No. 21XWC010), the Fundamental Research Funds for the Central Universities (Grant No. 011014370119), and Huaqiao University Start-up Research Fund for High-Quality Professionals (Grant No. 19SKBS214).

## REFERENCES

- French MT, Mortensen K, Timming AR. Changes in self-reported health, alcohol consumption, and sleep quality during the COVID-19 pandemic in the United States. *Appl Econ Lett.* (2022) 29:219–25. doi: 10.1080/13504851.2020.1861197
- Gadermann AC, Thomson KC, Richardson CG, Gagné M, McAuliffe C, Hirani S, et al. Examining the impacts of the COVID-19 pandemic on family mental health in Canada: findings from a national cross-sectional study. *BMJ Open.* (2021) 11:e042871. doi: 10.1136/bmjopen-2020-042871
- Tanaka T, Okamoto S. Increase in suicide following an initial decline during the COVID-19 pandemic in Japan. *Nat Hum Behav.* (2021) 5:229–38. doi: 10.1038/s41562-020-01042-z
- Lavine JS, Bjornstad ON, Antia R. Immunological characteristics govern the transition of COVID-19 to endemicity. *Science.* (2021) 371:741–5. doi: 10.1126/science.abe6522
- Gijzen M, Shields-Zeeman L, Kleinjan M, Kroon H, van der Roest H, Bolier L, et al. The bittersweet effects of COVID-19 on mental health: results of an online survey among a sample of the Dutch population five weeks after relaxation of lockdown restrictions. *Int J Environ Res Public Health.* (2020) 17:9073. doi: 10.3390/ijerph17239073
- Yun J-Y, Kim JW, Myung SJ, Yoon HB, Moon SH, Ryu H, Yim J-J. Impact of COVID-19 on lifestyle, personal attitudes, and mental health among Korean medical students: network analysis of associated patterns. *Front Psychiatry.* (2021) 12:702092. doi: 10.3389/fpsy.2021.702092
- Sundarasan S, Chinna K, Kamaludin K, Nurunnabi M, Baloch GM, Khoshaim HB, et al. Psychological impact of COVID-19 and lockdown among University Students in Malaysia: implications and policy recommendations. *Int J Environ Res Public Health.* (2020) 17:6206. doi: 10.3390/ijerph17176206
- Xia Y, Fan Y, Liu TH, Ma Z. Problematic Internet use among residential college students during the COVID-19 lockdown: a social network analysis approach. *J Behav Addict.* (2021) 10:28. doi: 10.1556/2006.2021.00028
- Copeland WE, McGinnis E, Bai Y, Adams Z, Nardone H, Devadanam V, et al. Impact of COVID-19 pandemic on college student mental health and wellness. *J Am Acad Child Adolesc Psychiatry.* (2021) 60:134–41.e2. doi: 10.1016/j.jaac.2020.08.466
- Li Y, Zhao J, Ma Z, McReynolds LS, Lin D, Chen Z, et al. Mental health among college students during the COVID-19 pandemic in China: a 2-wave longitudinal survey. *J Affect Disord.* (2021) 281:597–604. doi: 10.1016/j.jad.2020.11.109
- Sibley CG, Greaves LM, Satherley N, Wilson MS, Overall NC, Lee CHJ, et al. Effects of the COVID-19 pandemic and nationwide lockdown on trust, attitudes toward government, and well-being. *Am Psychol.* (2020) 75:618–30. doi: 10.1037/amp0000662
- Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, et al. The prevalence of depressive symptoms, anxiety symptoms and sleep disturbance in higher education students during the COVID-19 pandemic: a systematic review and meta-analysis. *Psychiatry Res.* (2021) 2021:113863. doi: 10.1016/j.psychres.2021.113863
- Allé MC, Berntsen D. Self-isolation, psychotic symptoms and cognitive problems during the COVID-19 worldwide outbreak. *Psychiatry Res.* (2021) 302:114015. doi: 10.1016/j.psychres.2021.114015
- Benke C, Autenrieth LK, Asselmann E, Pané-Farré CA. Lockdown, quarantine measures, and social distancing: associations with depression, anxiety and distress at the beginning of the COVID-19 pandemic among adults from Germany. *Psychiatry Res.* (2020) 293:113462. doi: 10.1016/j.psychres.2020.113462
- Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet.* (2020) 395:912–20. doi: 10.1016/S0140-6736(20)30460-8
- Mazza C, Ricci E, Biondi S, Colasanti M, Ferracuti S, Napoli C, et al. Nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *Int J Environ Res Public Health.* (2020) 17:E3165. doi: 10.3390/ijerph17093165
- Carver CS, Connor-Smith J. Personality and coping. *Annu Rev Psychol.* (2010) 61:679–704. doi: 10.1146/annurev.psych.093008.100352
- Lamers SMA, Westerhof GJ, Kovács V, Bohlmeijer ET. Differential relationships in the association of the Big Five personality traits with positive mental health and psychopathology. *J Res Pers.* (2012) 46:517–24. doi: 10.1016/j.jrp.2012.05.012
- Kroencke L, Geukes K, Utesch T, Kuper N, Back MD. Neuroticism and emotional risk during the COVID-19 pandemic. *J Res Pers.* (2020) 89:104038. doi: 10.1016/j.jrp.2020.104038
- Gori A, Topino E, Palazzeschi L, Fabio AD. Which personality traits can mitigate the impact of the pandemic? Assessment of the relationship between personality traits and traumatic events in the COVID-19 pandemic as mediated by defense mechanisms. *PLoS ONE.* (2021) 16:e0251984. doi: 10.1371/journal.pone.0251984
- Kohút M, Kohútová V, Halama P. Big Five predictors of pandemic-related behavior and emotions in the first and second COVID-19 pandemic wave in Slovakia. *Pers Individ Dif.* (2021) 180:110934. doi: 10.1016/j.paid.2021.110934
- Michinov E, Michinov N. Stay at home! When personality profiles influence mental health and creativity during the COVID-19 lockdown. *Curr Psychol.* (2021) 2021:3. doi: 10.1007/s12144-021-01885-3
- Nikčević AV, Marino C, Kolubinski DC, Leach D, Spada MM. Modelling the contribution of the Big Five personality traits, health anxiety, and COVID-19 psychological distress to generalised anxiety and depressive symptoms during the COVID-19 pandemic. *J Affect Disord.* (2021) 279:578–84. doi: 10.1016/j.jad.2020.10.053
- Bedford-Petersen C, Saucier G. Identifying contrasting themes that orchestrate personality expression across situations. *Pers Individ Dif.* (2021) 171:110495. doi: 10.1016/j.paid.2020.110495
- Borsboom D. A network theory of mental disorders. *World Psychiatry.* (2017) 16:20375. doi: 10.1002/wps.20375
- Bogaerts S, van Woerkom M, Erbaş Y, De Caluwé E, Garofalo C, Frowijn I, et al. Associations between resilience, psychological well-being, work-related stress and covid-19 fear in forensic healthcare workers using a network analysis. *Front Psychiatry.* (2021) 12:678895. doi: 10.3389/fpsy.2021.678895
- Lazarus RS, Folkman S. Transactional theory and research on emotions and coping. *Eur J Pers.* (1987) 1:141–69. doi: 10.1002/per.2410010304
- Murray CJL. COVID-19 will continue but the end of the pandemic is near. *Lancet.* (2022) 399:417–9. doi: 10.1016/S0140-6736(22)00100-3
- Zhao N, Li W, Zhang S-F, Yang BX, Sha S, Cheung T, et al. Network analysis of depressive symptoms among residents of Wuhan in the later stage of the COVID-19 pandemic. *Front Psychiatry.* (2021) 12:735973. doi: 10.3389/fpsy.2021.735973
- Gijzen MWM, Rasing SPA, Creemers DHM, Smit F, Engels RCME, De Beurs D. Suicide ideation as a symptom of adolescent depression. A network analysis. *J Affect Disord.* (2021) 278:68–77. doi: 10.1016/j.jad.2020.09.029
- Elliott H, Jones PJ, Schmidt U. Central symptoms predict posttreatment outcomes and clinical impairment in anorexia nervosa: a network analysis. *Clin Psychol Sci.* (2020) 8:139–54. doi: 10.1177/2167702619865958

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2022.816298/full#supplementary-material>

32. Liu N, Ma Z. Psychiatric reactions among the non-exposed population who viewed disaster-related short videos: evidence from the 2021 Henan floods. *J Psychiatr Res.* (2022) 150:21–33. doi: 10.1016/j.jpsychires.2022.03.036
33. Ferreira F, Castro D, Araújo AS, Fonseca AR, Ferreira TB. Exposure to traumatic events and development of psychotic symptoms in a prison population: a network analysis approach. *Psychiatry Res.* (2020) 286:112894. doi: 10.1016/j.psychres.2020.112894
34. Epskamp S, Waldorp LJ, Möttus R, Borsboom D. The Gaussian graphical model in cross-sectional and time-series data. *Multivar Behav Res.* (2018) 53:1. doi: 10.1080/00273171.2018.1454823
35. Rammstedt B, John OP. Measuring personality in one minute or less: a 10-item short version of the Big Five Inventory in English and German. *J Res Pers.* (2007) 41:203–12. doi: 10.1016/j.jrp.2006.02.001
36. Carciofo R, Yang J, Song N, Du F, Zhang K. Psychometric evaluation of Chinese-language 44-item and 10-item Big Five personality inventories, including correlations with chronotype, mindfulness and mind wandering. *PLoS ONE.* (2016) 11:e0149963. doi: 10.1371/journal.pone.0149963
37. Kessler RC, Green JG, Gruber MJ, Sampson NA, Bromet E, Cuitan M, et al. Screening for serious mental illness in the general population with the K6 screening scale: results from the WHO World Mental Health (WMH) survey initiative. *Int J Methods Psychiatr Res.* (2010) 19(Suppl.1):4–22. doi: 10.1002/mpr.310
38. Swedo EA, Beauregard JL, de Fijter S, Werhan L, Norris K, Montgomery MP, et al. Associations between social media and suicidal behaviors during a youth suicide cluster in Ohio. *J Adolesc Health.* (2021) 68:308–16. doi: 10.1016/j.jadohealth.2020.05.049
39. Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: a tutorial paper. *Behav Res.* (2018) 50:195–212. doi: 10.3758/s13428-017-0862-1
40. Haslbeck J, Waldorp L. MGM: estimating time-varying mixed graphical models in high-dimensional data. *J Stat Softw.* (2020) 93:i08. doi: 10.18637/jss.v093.i08
41. Isvoranu AM, Epskamp S. Continuous and ordered categorical data in network psychometrics: which estimation method to choose? deriving guidelines for applied researchers. *PsyArXiv.* (2021) 2021:mbycn. doi: 10.31234/osf.io/mbycn
42. Sigdel A, Bista A, Bhattarai N, Pun BC, Giri G, Marqusee H, et al. Depression, anxiety and depression-anxiety comorbidity amid COVID-19 pandemic: an online survey conducted during lockdown in Nepal. *medRxiv.* (2020) 2020:20086926. doi: 10.1101/2020.04.30.20086926
43. Alshareef R, Al Zahrani A, Alzaharani A, Ghandoura L. Impact of the COVID-19 lockdown on diabetes patients in Jeddah, Saudi Arabia. *Diabetes Metab Syndr.* (2020) 14:1583–7. doi: 10.1016/j.dsx.2020.07.051
44. Vos LMW, Habibović M, Nyklíček I, Smeets T, Mertens G. Optimism, mindfulness, and resilience as potential protective factors for the mental health consequences of fear of the coronavirus. *Psychiatry Res.* (2021) 300, 113927. doi: 10.1016/j.psychres.2021.113927
45. Vos L, Habibović M, Nyklíček I, Smeets T, Mertens G. Optimism, mindfulness, and resilience as potential protective factors for the mental health consequences of fear of the coronavirus. *PsyArXiv.* (2020) 2020:eqx4y. doi: 10.31234/osf.io/eqx4y
46. Middel B, Goudriaan H, Greef M, Stewart R, Sonderen E, van Bouma J, et al. Recall bias did not affect perceived magnitude of change in health-related functional status. *J Clin Epidemiol.* (2006) 59:503–11. doi: 10.1016/j.jclinepi.2005.08.018

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Liu, Xia and Ma. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# The Impact of Family Functioning on College Students' Loneliness: Chain-Mediating Effects of Core Self-Evaluation and Problematic Mobile Phone Use

Ling Qian<sup>1\*</sup>, Die Wang<sup>2</sup>, Min Jiang<sup>2</sup>, Wei Wu<sup>2</sup> and Congying Ni<sup>1</sup>

<sup>1</sup> School of Business, Jinhua Polytechnic, Jinhua, China, <sup>2</sup> College of Teacher Education, Zhejiang Normal University, Jinhua, China

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Carla Nasti,  
University of Campania Luigi Vanvitelli,  
Italy

F. Javier Del Río Olvera,  
University of Cádiz, Spain

### \*Correspondence:

Ling Qian  
feelalive007@126.com

### Specialty section:

This article was submitted to  
Health Psychology,  
a section of the journal  
Frontiers in Psychology

**Received:** 08 April 2022

**Accepted:** 01 June 2022

**Published:** 06 July 2022

### Citation:

Qian L, Wang D, Jiang M, Wu W  
and Ni C (2022) The Impact of Family  
Functioning on College Students'  
Loneliness: Chain-Mediating Effects  
of Core Self-Evaluation  
and Problematic Mobile Phone Use.  
Front. Psychol. 13:915697.  
doi: 10.3389/fpsyg.2022.915697

**Purpose:** To examine the influence of family functioning on college students' loneliness and the mediating effects of core self-evaluation and problematic mobile phone use.

**Methods:** Family Function Scale, Core Self-evaluation Scale, Problem Mobile Phone Use Scale, and Loneliness Scale were used to investigate 8,524 college students.

**Results:** (1) Family functioning positively predicted core self-evaluation ( $\beta = 0.43$ ,  $p < 0.001$ ) and negatively predicted loneliness ( $\beta = -0.21$ ,  $p < 0.001$ ); (2) Core self-evaluation negatively predicted problematic mobile phone use and loneliness ( $\beta = -0.34$ ,  $p < 0.001$ ;  $\beta = -0.50$ ,  $p < 0.001$ ); (3) Problematic mobile phone use significantly positively predicted loneliness ( $\beta = 0.05$ ,  $p < 0.001$ ); (4) Core self-evaluation and problematic mobile phone use showed a significant chain-mediation effect between family functioning and loneliness ( $\beta = -0.01$ ,  $p < 0.001$ ).

**Conclusion:** The results are helpful to comprehend the producing mechanism of loneliness and provide a theoretical basis for the intervention of loneliness.

**Keywords:** family functioning, loneliness, core self-evaluation, problematic mobile phone use, college students

## INTRODUCTION

Loneliness refers to an unpleasant psychological experience when there are differences between the desired social relationship and the actual social relationship network in quality (such as the loss of intimate relationship) or quantity (such as too few friends) (Smoyak, 1984). Long-term loneliness cannot only lead to painful emotions and depression (Zhang et al., 2019), but also lead to suicidal tendencies (Li et al., 2018), anti-social behavior, hostility, and sleep disorders (Li et al., 2016). At the annual meeting of the American Academy of Child and Adolescent Psychiatry in 2020, it was reported that lonely young people were three times more likely to suffer from depression in the future, and the impact of loneliness on mental health might last at least 9 years. Domestic research showed that more than 50% of college students experienced loneliness (Cheng and Zhao, 2017), and loneliness became a common problem among college students (Tang et al., 2014).

Psychological research on loneliness has a history of several decades. From the positive-negative dimension, Moustakas (1961) divided loneliness into existential loneliness and loneliness anxiety.



Existential loneliness is a positive growth experience of self-confrontation, which is less common in lonely people; loneliness anxiety is a negative experience caused by "basic alienation between people" and dominates the lives of lonely people (Russell et al., 1980). From the perspective of social deprivation, Weiss (1987) divided loneliness into emotional loneliness and social loneliness. Emotional loneliness stems from the absence of a private, intimate relationship or attachment, which is a more painful form of isolation; social loneliness stems from the absence of a social connection or sense of belonging to a group, which is a mixture of feelings of rejection or non-acceptance and boredom. This theory has been validated by several researchers in the field of measurement (Russell et al., 1984; Vincenzi and Grabosky, 1987). DiTommaso and Spinner (1993) expanded emotional loneliness to two subtypes: intimate loneliness and familial loneliness. Intimate loneliness refers to the lack of intimate romantic partners, while family loneliness refers to the lack of family members. Starting from the dimension of duration, Young (1982) divides loneliness into three types: transient loneliness, situational loneliness, and chronic loneliness. Transient loneliness refers to some transient, an occasional feeling of loneliness. Situational loneliness is when some specific change occurs that disrupts the original satisfying relationship, such as moving to new a place. Situational loneliness can trigger extremely painful experiences. Chronic loneliness is a condition in which a person has not had a satisfactory social relationship for more than 2 years. When situational loneliness lasts for a long time, it will turn into chronic loneliness. From the perspective of intervention, the greatest attention should be paid to how to prevent situational loneliness from becoming a serious and long-term experience.

In recent years, previous studies have examined the impacts of family cohesion (Yang et al., 2016) family atmosphere (Yang et al., 2013), parent-child relationship (Fan and Wu, 2020) and other family factors on loneliness, but less attention has been paid to the role of family function on loneliness. In addition, most of the existing studies focused on the impact of family on the loneliness of primary and secondary school students (Xing and Chi, 2003; Liu et al., 2018), but few studies focused on the role of family functioning on college students. According to the ecosystem theory, the family is the most direct and lasting micro-system in the source of individual development influence (Pomerantz et al., 2008). Studies have shown that family functioning still has a profound impact on college students (Fang et al., 2006). Family functioning refers to the effectiveness of family rules, family communication, emotional connections, and coping with external events among family members in the family system (Olson, 2000). According to the theory of family function, the normal operation of basic family functions can promote the development of individual mental health and enhance the internal emotional connection of family members (Olson, 2000). Previous studies have found that family functioning is a direct predictor of loneliness (Deng and Zheng, 2013; Wang et al., 2019). Although many studies have shown that family functioning is related to individual loneliness, it is not clear through which mechanism family functioning affects college students' loneliness. Therefore, this study will further

explore the internal mechanism of family function affecting loneliness, and provide reference methods and paths for the intervention of loneliness.

Family functioning not only directly affects loneliness, but also indirectly affects college students' loneliness through core self-evaluation. Core self-evaluation refers to the most basic evaluation of an individual's ability and value, including general self-efficacy, self-esteem, neuroticism, and locus of control (Judge et al., 1997). Some studies suggested that the attitude toward self-internalized by individuals in childhood would continue into adulthood (He, 2015), and individuals with better family function had positive self-concept (Tian, 2012). Evaluation theory holds that emotion is a form of subconscious evaluation of objects, individuals or events by their perceived values, needs or commitments (Lazarus and Folkman, 1984). Previous studies have shown that core self-evaluation had a significant impact and predictive effect on mental health (Liu and Jiang, 2019). Core self-evaluation positively predicted positive emotions and negatively predicted negative emotions (Li and Sun, 2007). College students with high core self-evaluation were emotionally stable and optimistic (Da, 2002). Negative self-evaluation would lead to more flinch, avoidance and other behaviors (Yang, 2019). It is concluded that individual core self-evaluation is influenced by family functioning and is related to individual loneliness. Based on this, this study proposed that core self-evaluation played a mediating role between family functioning and loneliness (Hypothesis 1).

Family functioning not only indirectly affects loneliness through core self-evaluation, but also indirectly affects loneliness through problematic mobile phone use. Problematic mobile phone use refers to uncontrolled and excessive mobile phone use that adversely affects an individual's daily life (Billieux, 2012). The theory of family function points out that a well-functioning family can effectively promote the mental health of individuals (Olson, 2000). Studies have shown that parenting style and social support had significant impacts on mobile phone dependence behavior, and individuals with insufficient social support in real life were more likely to form mobile phone dependence behavior (Zhao, 2020). Mobile phone addiction would have a negative impact on the individual's physiology, psychology, and behavior (He and Xia, 2021). A meta-analysis conducted by Zhang and Li (2020) on the relationship between loneliness and mobile phone addiction showed that there was a moderate positive correlation between mobile phone addiction and loneliness. Based on the above analysis, this study proposed that problematic mobile phone use played a mediating role between family functioning and loneliness (Hypothesis 2).

In the past four decades, researchers mainly explored the influencing factors of loneliness from the aspects of environment and individual (Wang et al., 2015; Pu, 2020). In addition to the direct effect of family functioning on loneliness, family functioning, as an external factor, may also affect loneliness through individual internal factors and individual behavior. Core self-evaluation (intra-individual characteristic) and problematic mobile phone use (individual behavior) are important factors. According to the cognitive behavioral model of pathological Internet use (Chen et al., 2020), cognitive

symptoms of pathological Internet use can lead to emotional or behavioral symptoms, and individual cognition or thought is the main source of abnormal behavior. Therefore, the problem behavior of problematic mobile phone use mainly resulted from the individual's internal cognition. Studies have shown that adolescents with low core self-evaluation were more likely to become addicted to smartphones (Chen et al., 2020). Core self-evaluation was a negative predictor of Internet addiction (Lu and Zheng, 2011). Family, as the most persistent micro-system in the source of individual development influence, not only affected individual core self-evaluation (Tian, 2012), but also had a negative correlation between family function and mobile phone dependence (Shi et al., 2020). To sum up, family function may affect core self-evaluation, and then affect the use of problematic mobile phones, which eventually has an impact on individual loneliness. Accordingly, we assumed that core self-evaluation and problematic mobile phone use played a chain mediating role between family functioning and loneliness (Hypothesis 3).

Based on the above discussion, this study aimed to examine the impact of family functioning on college students' loneliness, and the sole/chain mediating role of core self-evaluation and problematic mobile phone use. Considering that gender may affect loneliness (Pu, 2020), gender is included in the model as a control variable. Based on the existing theory and empirical evidence, this study proposed the following hypothetical model (see Figure 1).

## MATERIALS AND METHODS

### Participants

Using cluster sampling method, 8,524 students in Zhejiang and Anhui provinces were selected as the subjects, with an average age of  $19.06 \pm 1.03$  years, including 3,577 boys (41.96%), and 4,947 girls (58.04%).

### Procedures

The data collection was led by well-trained psychology graduate students and supervised online by the head teacher of each class. Before starting the formal investigation, written informed consent from the school, the teacher, and the participants was obtained. Participants were informed that they could discontinue

or drop out freely. The researchers clearly emphasized the confidentiality of the study results that any information provided by participants would not be disclosed to anyone.

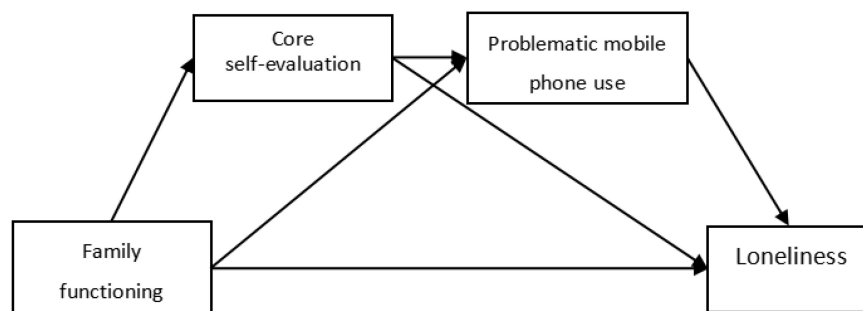
### Measures

The family function scale revised by Zou was used to measure student's family functioning (Cheng and Zou, 2011). The scale is of a single dimension, with a total of 6 items. A 5-point scoring system was used, from "completely inconsistent" to "completely consistent," such as "my family is harmonious," "everyone in the family has made their own contributions to the family." Higher score indicates a better overall family functioning. In this study, the Cronbach's  $\alpha$  of the family functioning questionnaire was 0.96.

The core self-evaluation scale revised by Du was used to measure student's core self-evaluation (Du et al., 2012). The scale is of a single dimension with 10 items, of which 2, 3, 5, 7, 8, and 10 are reverse scoring questions. A 5-point scale was used, with 1 indicating "strongly disagree" and 5 indicating "strongly agree." The higher the score, the higher the core self-evaluation level of the students. The Cronbach's  $\alpha$  of the scale was 0.63. Confirmatory factor analysis results demonstrated that a single-factor model fit the data satisfactorily for core self-evaluation:  $\chi^2/df = 23.16$ , CFI = 0.99, TLI = 0.98, RMSEA = 0.05, SRMR = 0.03, with item loadings ranging from 0.70 to 0.86.

Problematic mobile phone use was measured with the Chinese version of the Mobile Phone Problematic Use Scale (Wei et al., 2019). The scale consists of 5 aspects and 10 items. Each item is 5-point scored, from 1 (not at all) to 5 (in full accord). The higher the score, the higher the degree of problematic use of mobile phones. The Cronbach's  $\alpha$  of the scale was 0.86.

Loneliness was tested with the loneliness questionnaire revised by Zou (2003), which consists of 21 items in total. The questionnaire had four dimensions: pure loneliness, perception of one's own social ability, evaluation of the current peer relationship and perception of the unsatisfied degree of important relationships. The questionnaire was scored on a 5-point scale, with 1 indicating "not at all" and 5 indicating "complete." Except that the high score of perceived social competence represented positive evaluation, the high scores of the other three dimensions represented negative evaluation. The perceived dimension of social competence was scored reversely and then added to the



**FIGURE 1 |** Hypothetical model paths of family functioning, core self-evaluation, problematic mobile phone use, and loneliness.

scores of the other three dimensions, and the average score was taken as the total average score of loneliness. The Cronbach's  $\alpha$  of the scale was 0.87.

## DATA ANALYSIS

After data recovery, all invalid questionnaires (e.g., questionnaires that exceeded 20% missing values) were excluded, SPSS 25.0 and Mplus8.0 were used for statistical analysis.

## RESULTS

### Common Method Deviation

Unrotated principal component factor analysis was performed on the items included in all variables using the Harman one-way test. The results showed that there were 8 factors with the eigenvalue greater than 1, and the variation explanation rate of the first factor was 33.79%, which was lower than the critical standard of 40% (Zhou and Long, 2004). It could be considered that there was no serious common method bias in this study.

### Descriptive Statistics and Correlation Matrix of Each Variable

The results of correlation analysis (as shown in Table 1) showed that family functioning was positively correlated with self-evaluation and gender, and negatively correlated with problematic mobile phone use and loneliness. Self-evaluation was negatively correlated with problematic mobile phone

**TABLE 1 |** Correlation analysis of family functioning, self-evaluation, problematic mobile phone use, and loneliness.

	<i>M ± SD</i>	1	2	3	4	5
1 Family functioning	3.91 ± 0.79	1				
2 Self-evaluation	3.36 ± 0.60	0.43**	1			
3 Problematic mobile phone use	2.84 ± 0.64	-0.14**	-0.33**	1		
4 Loneliness	2.37 ± 0.64	-0.43**	-0.61**	0.24**	1	
5 Gender		0.04**	-0.05**	0.02	-0.07**	1

\*\* $p < 0.01$ .

use, loneliness and gender. Problematic mobile phone use was positively correlated with loneliness, but not significantly correlated with gender. Loneliness was significantly negatively correlated with gender.

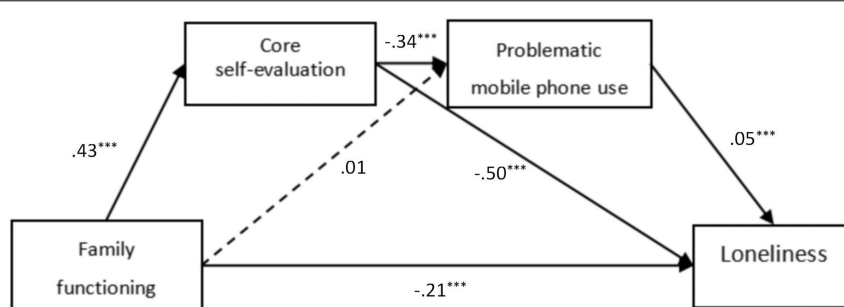
### Test of Chain Mediation Effect

With family functioning as the independent variable, core self-evaluation and problematic use of mobile phones as the mediating variables, loneliness as the dependent variable, and gender as the control variable, the mediation model was tested (see Figure 2). [CFI = 0.99, TLI = 0.97, RMSEA (90% CI) = 0.05, SRMR = 0.02], the model fit was good. The results of path analysis showed that family functioning positively predicted core self-evaluation ( $\beta = 0.43$ ,  $p < 0.001$ ). Family functioning negatively predicted loneliness ( $\beta = -0.21$ ,  $p < 0.001$ ), and core self-evaluation negatively predicted problematic mobile phone use and loneliness ( $\beta = -0.34$ ,  $p < 0.001$ ;  $\beta = -0.50$ ,  $p < 0.001$ ). Problematic mobile phone use positively predicted loneliness ( $\beta = 0.05$ ,  $p < 0.001$ ). Core self-evaluation and problematic mobile phone use played a chain mediating role between family functioning and loneliness.

The confidence interval of the mediating effect was estimated by the bias-corrected non-parametric percentile bootstrap method. The results are shown in Table 2. The mediating effect value of core self-evaluation between family functioning and loneliness was  $-0.22$ , and the 95% confidence interval was  $[-0.189, -0.167]$ . The mediating effect of core self-evaluation was significant. The mediating effect of problematic mobile phone use between family functioning and loneliness was  $0.01$ , and the 95% confidence interval was  $[-0.001, 0.002]$ . The mediating effect of problematic mobile phone use was not significant. Family functioning had an impact on core self-evaluation, and then on core self-evaluation affected mobile phone problem use, which finally affected loneliness. That is, core self-evaluation and problematic mobile phone use showed a chain mediating effect between family functioning and loneliness, and the mediation effect value is  $-0.01$ . The effective dose was 3%.

## DISCUSSION

In this study, college students from well-functioning families experienced less loneliness, which is consistent with previous



**FIGURE 2 |** Chain mediation model. \*\*\* $p < 0.001$ .

**TABLE 2 |** Significance test of mediation effect and value of mediation effect.

Path	Effect value	Effect size	95% confidence interval	
			Lower limit	Upper limit
Family functioning → loneliness	−0.21***	60%	−0.452	−0.414
Family functioning → core Self-evaluation → loneliness	−0.22***	63%	−0.189	−0.167
Family functioning → problematic mobile phone use → loneliness	0.01	3%	−0.001	0.002
Family functioning → core Self-evaluation → problematic Mobile phone use → loneliness	−0.01***	3%	−0.008	−0.003

\*\*\* $p < 0.001$ .

studies (Johnson et al., 2001; Fujimori et al., 2017). Although the focus of interpersonal relationship among college students has shifted to peers, the family environment is still at the core of the personal social support system, and the family is still the main source of financial support and spiritual support for college students (Jiang, 2002). On the one hand, material satisfaction can relieve the realistic pressure of college students to a certain extent, such as the ability to buy high-quality services and vent negative emotions in entertainment consumption; on the other hand, college students cannot only get close emotional connection between relatives in a good family functioning environment, but also get social support from family when interpersonal relationships are frustrated. In addition, college students apply effective interpersonal communication skills acquired in a good family functioning environment to social interaction, form intimate interpersonal relationships, improve the quality of interpersonal communication (Hu et al., 2008), and further strengthen the individual's social support system. Therefore, family, as the spiritual harbor of college students, plays an essential role in interpersonal relationships and reduces the level of loneliness.

This study found that family functioning positively predicted core self-evaluation, and core self-evaluation negatively predicted loneliness. That is, the core self-evaluation of college students played a mediating role between family functioning and loneliness. Previous studies have shown that attachment status was closely related to individual self-evaluation (Tang and Li, 2013). Good attachment relationship can promote effective communication and emotional connection between family members, thus promoting the formation of positive core self-evaluation of college students. Individuals get good self-evaluation in the family, including self-esteem, general self-efficacy and so on, which is conducive to improving the enthusiasm of individual life and learning, actively establishing interpersonal relationships, and tending to solve problems in the face of interpersonal conflicts, rather than escaping or silent treatment, thus experiencing less loneliness. Being in the situation of family dysfunction, such as the more psychological abuse and neglect an individual suffered in childhood, the easier the students form self-evaluation such as fear of rejection and lack of self-confidence, the more withdrawal and emotional inhibition they will show when establishing intimate relationships in adulthood (Yang, 2019). Therefore, the establishment of a good family functioning environment can make family members feel love and warmth, establish the concept that they are needed

by others and deserved to be loved. Under the circumstance, individuals may obtain the concept of their own high sense of value, form a good self-evaluation, and then build a high-quality interpersonal network, which helps to reduce the experience of loneliness.

This study also found that family functioning positively predicted core self-evaluation and negatively predicted problematic mobile phone use, which subsequently had an impact on loneliness. This result supports the path model of mobile phone dependence, which is caused by cognitive dissonance or the need for relationship maintenance due to insecure attachment (Billieux, 2012). Family is the most primitive and core source of self-evaluation. Poor family functioning leads to low self-evaluation. Individuals with low self-evaluation tend to adopt covert, evasive and passive behaviors to maintain relationships, such as using mobile phones to meet individual emotional needs.

In this study, it is confirmed that problematic mobile phone use positively predicted loneliness, which supports the social compensation model of social media use. As the model points out that when individuals cannot get a sense of belonging in real life and lack the ability to use social resources, they will be more inclined to get help through mobile phones, networks and other tools (Park, 2003). However, the effect of using mobile phones for a long time to eliminate loneliness is not ideal, and it may cause a deeper sense of loneliness (Li, 2013; Liu et al., 2019). The possible reason is that using mobile phones for a long time not only compresses the real interpersonal emotional interaction time in reality. As a result of the deterioration of individual's real social skills, it is easy to feel more social alienation and lack of interpersonal belonging in the real world, so loneliness will increase accordingly. At the same time, individuals tend to create a perfect interaction between themselves and others on the Internet, which results in the closure and loss of the real self and aggravates the loneliness of individuals.

The results of this study showed that family functioning had no significant effect on loneliness through problematic mobile phone use, which is inconsistent with hypothesis 2. The possible reason is that most of the research objects of the current problematic use of mobile phones are middle school students. For college students, in the case of high frequency use of mobile phones in their study, work and life, good family functioning may have a more inclusive and open attitude toward the behavior of using mobile phones. Therefore, family functioning



could not have an impact on loneliness through problematic mobile phone use.

## IMPLICATIONS AND LIMITATIONS

The results of the study confirmed that family functioning could improve individual core self-evaluation, reduce problematic use of mobile phones, thereby reducing the individual experience of loneliness. To some extent, this study makes up for the deficiency of the existing research on the family functioning of college students, and further explores the internal psychological and behavioral mechanism for the formation of loneliness, which also provides theoretical support for the intervention path to reduce the loneliness experience of college students.

This study still has the following limitations. First, the subjects are all Chinese college students, and the sample representativeness is slightly insufficient, so we can further study the subjects in different cultural backgrounds in the future. Second, the study employed the self-report method, and the survey results may have social approval effects, so we can use objective research methods such as behavior observation to collect data in the future.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

This study was reviewed by the Ethics Committee of Zhejiang Normal University. The patients/participants provided

their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

DW was responsible for guiding the structure of the article. MJ was responsible for data analysis. WW and CN were responsible for English revision. All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

## FUNDING

The study described in this report was funded by the Scientific Research Project of Education Department in Zhejiang Province (Y202148077) and Project of China Higher Education Association (21FDYB18). The content was solely the responsibility of the authors and did not necessarily represent the official views of Scientific Research Project of Education Department in Zhejiang Province and project of China Higher Education Association. We were appreciative of the students and teachers who participated in our study and the people who assisted in data collection.

## ACKNOWLEDGMENTS

We thank the team from the Family and Child Development Laboratory of Zhejiang Normal University for their guidance and help.

## REFERENCES

- Billieux, J. (2012). Problematic use of the mobile phone: a literature review and a pathways model. *Curr. Psychiatr. Rev.* 8, 299–307. doi: 10.2174/157340012803520522
- Chen, X., Lin, Y., and Liu, Q. X. (2020). Technoference and adolescent smartphone addiction: the effect of core self-evaluations and need satisfaction perceived online. *J. Psychol. Sci.* 43, 355–362.
- Cheng, M. M., and Zhao, B. H. (2017). Relationship between social support and loneliness among college students: a mediating effect of the sense of life meaning. *J. West Anhui Univers.* 33, 145–148.
- Cheng, Y. J., and Zou, H. (2011). Discriminatory perception is more noteworthy than poverty: their effect on poor and non-poor children's behavior. *Chin. J. Special Educ.* 65–70.
- Da, H. M. (2002). Relationship of upbringing given by parents to self-confidence, self-esteem, self-efficacy and mental health of their children. *Chin. Health Educ.* 18, 13–16.
- Deng, L. F., and Zheng, R. C. (2013). Relationships among family functioning, emotional expression and loneliness in college students. *Stud. Psychol. Behav.* 11, 223–228.
- Du, J. Z., Zhang, X., and Zhao, Y. (2012). Reliability, validation and construct confirmatory of core self-evaluations scale. *Psychol. Res.* 5, 54–60.
- Ditommaso, E., and Spinner, B. (1993). The development and initial validation of the social and emotional loneliness scale for adults (selsa). *Personal. Individ. Differ.* 14, 127–134. doi: 10.1016/0191-8869(93)90182-3
- Fan, Z. Y., and Wu, Y. (2020). Relationship between parent-child relationship, loneliness and depression among the left-behind rural children: gratitude as a mediator and a moderator. *Psychol. Dev. Educ.* 36, 734–742.
- Fang, X. Y., Dai, L. Q., Fang, C., and Deng, L. Y. (2006). The relationship between parent-adolescent communication problems and adolescents' social adjustments. *Psychol. Dev. Educ.* 22, 47–52.
- Fujimori, A., Hayashi, H., Fujiwara, Y., and Matsusaka, T. (2017). Influences of attachment style, family functions and gender differences on loneliness in Japanese university students. *Psychology* 8, 654–662. doi: 10.4236/psych.2017.84042
- He, D. M. (2015). *The Impact of Childhood Psychological Maltreatment on Self-esteem and Inferiority of College Students*. Ph.D. thesis. Heilongjiang, China: Harbin Normal University. .
- He, W., and Xia, Y. (2021). Research on the relationship between mobile phone addiction and psychological needs and mobile phone use among college students. *J. Southwest Normal Univers.* 46, 105–111.
- Hu, Z. X., Xu, W. S., and Luo, A. L. (2008). Research on the Relationship between Family Function and Social Network Quality of College Students. *Chin. Youth Res.* 80–84.



- Jiang, Y. (2002). *A Study on the Career Development of College Students*. Doctoral dissertation. Beijing: Beijing Institute of Technology.
- Johnson, H. D., Lavoie, J. C., and Mahoney, M. (2001). Avoidance in late adolescence interparental conflict and family cohesion: predictors of loneliness, social anxiety, and social. *J. Adolesc. Res.* 16, 304–318. doi: 10.1177/0743558401163004
- Judge, T. A., Locke, E. A., and Durham, C. C. (1997). The dispositional causes of job satisfaction: a core evaluations approach. *Res. Organ. Behav.* 19, 151–188.
- Lazarus, R. S., and Folkman, S. (1984). *Stress, Appraisal and Coping*. New York: Springer.
- Li, C. L., and Sun, Q. M. (2007). "A study on the relationship between core self-evaluation and subjective well-being of college students," in *Proceedings of the 11th National Conference on Psychology*, Kaifeng, China.
- Li, L., Mei, S. L., Niu, Z. M., and Song, Y. T. (2016). Loneliness and sleep quality in university students: mediator of smartphone addiction and moderator of gender. *Chin. J. Clin. Psychol.* 24, 345–348.
- Li, Y., Zhu, R. R., He, W., Pan, L., and Li, Z. M. (2018). Mediating effect of rumination on relationship between loneliness and suicidal ideation in college students. *Chin. J. Mental Health* 32, 873–876.
- Li, Y. W. (2013). *The Relation Research on Peer Attachment and Loneliness Basic on the Internet/Mobile-Phone Addiction of Adolescents*. Hubei, China: Central China Normal University. Ph.D. thesis.
- Liu, D., Baumeister, R. F., Yang, C. C., and Hu, B. (2019). Digital communication media use and psychological well-being: a meta-analysis. *J. Comput.-Mediat. Commun.* 24, 259–273. doi: 10.1093/jcmc/zmz013
- Liu, Q. F., Yuan, X. J., Hu, H. Y., Zhang, Q., and He, Y. (2018). Relationship between migrant children family functioning and lone mediating effect of parent-child relationship. *Chin. J. Health Psychol.* 26, 437–440.
- Liu, T., and Jiang, F. F. (2019). A survey on the relationship between core self-evaluations and mental health level for college students with financial difficulties. *J. Yueyang Vocat. Tech. Coll.* 34, 49–53.
- Lu, H., and Zheng, Z. H. (2011). Relation between college students' Internet addiction, subjective well-being and core self-evaluation. *Chin. J. School Health* 32, 951–952.
- Moustakas, C. E. (1961). *Loneliness*. New York, NY: Prentice Hall.
- Olson, D. H. (2000). Circumplex model of marital and family systems. *J. Fam. Ther.* 22, 144–167. doi: 10.1111/1467-6427.00144
- Park, W. K. (2003). The mobile phone addiction among Korean college students. *Kor. Soc. J. Commun. Stud.* 47, 250–281.
- Russell, D., Peplau, L. A., and Cutrona, C. E. (1980). The revised UCLA loneliness scale: concurrent and discriminant validity evidence. *J. Personal. Soc. Psychol.* 39, 472–480. doi: 10.1037/0022-3514.39.3.472
- Russell, D., Cutrona, C. E., Rose, J., and Yurko, K. (1984). Social and emotional loneliness: an examination of Weiss's typology of loneliness. *J. Personal. Soc. Psychol.* 46, 1313–1321. doi: 10.1037/0022-3514.46.6.1313
- Smoyak, S. A. (1984). Loneliness: a sourcebook of current theory, research and therapy. *J. Psychosoc. Nurs. Ment. Health Serv.* 22, 40–41. doi: 10.3928/0279-3695-19840601-09
- Pomerantz, E. M., Ng, F. Y., and Wang, Q. (2008). Culture, parenting, and motivation: the case of East Asia and the United States. *Soc. Psychol. Perspect.* 15, 209–240. doi: 10.1016/S0749-7423(08)15007-5
- Pu, S. S. (2020). *The Influence of College Students' Sense of Power on their Sense of Loneliness*. Ph.D. thesis. Chongqing, China: Southwest University.
- Shi, M. W., Cai, F., Li, Q., and Luo, G. B. (2020). The impact of family functioning on college students' psychological well-being: multiple mediating effects of mobile phone dependence and peer trust. *Chin. Soc. Psychol. Rev.* 01, 51–60.
- Tang, H. B., and Li, X. L. (2013). A study on the relationship among peer attachment, core self-evaluation and depression of Gong-du students. *Soc. Psychol. Sci.* 4.
- Tang, H. Y., Qiu, X., Chen, A., and Wang, Z. J. (2014). The influence of college students' perfectionism on loneliness: the mediating effect of self-esteem. *Chin. J. Health Psychol.* 22, 1577–1579.
- Tian, Y. (2012). *Research on the Relationship Between Parent-Child Attachment, Family Function and Self-Concept Formation of College Students*. Ph.D. thesis. Sichuan, China: Sichuan Normal University.
- Vincenzi, H., and Grabosky, F. (1987). Measuring the emotional/social aspects of loneliness and isolation. *J. Soc. Behav. Personal.* 2, 257–270.
- Weiss, R. S. (1987). Reflections on the present state of loneliness research. *J. Soc. Behav. Personal.* 2, 1–16.
- Wang, D. F., Jiang, W., Chen, C. P., Liu, S. Q., Gao, P. C., Liu, J. Q., et al. (2019). The relationship between subjective family economic status, interpersonal adaptation, family function and mobile phone addiction of college students. *Chin. J. School Health* 40, 1425–1427.
- Wang, M. Z., Fu, C., and Zhou, Z. K. (2015). Research on the relations among big five personality, attachment relationship and adolescents' loneliness. *Psychol. Explor.* 35, 436–441.
- Wei, H. A., Rdl, A., Tpop, C., Rui, Z. D., Sj, A., and Xs, A. (2019). The mediating and moderating roles of social anxiety and relatedness need satisfaction on the relationship between shyness and problematic mobile phone use among adolescents. *Comput. Hum. Behav.* 93, 301–308. doi: 10.1016/j.chb.2018.12.020
- Xing, Z. Q., and Chi, L. P. (2003). The relationship between family functioning and children's loneliness: the role of mediation. *Acta Psychol. Sin.* 35, 216–221.
- Yang, L., Tong, J., Miu, S. J., and Zhao, X. D. (2013). Influences of family atmosphere on loneliness: the mediation of self-consistency. *Chin. J. Health Psychol.* 21, 1725–1729.
- Yang, Q., Yi, L. L., and Song, W. (2016). Relation of loneliness to family cohesion and school belonging in left-behind children. *Chin. J. Ment. Health* 30, 197–201.
- Yang, Q. P. (2019). *Effects of Early Abuse and Neglect on Self-Esteem and Intimacy Fear of College Students and their Intervention*. Ph.D. thesis. Shanghai, China: Shanghai Normal University.
- Young, J. E. (1982). "Loneliness, depression and cognitive therapy: Theory and application," in *Loneliness: A Sourcebook of Current Theory, Research and Therapy*, eds L. A. Peplau and D. Perlman (New York: Wiley-Interscience).
- Zhang, C. Y., Yu, M., and Wang, J. P. (2019). Adolescent loneliness and depressive symptoms: the Mediating role of response style and moderator of gender. *J. Psychol. Sci.* 42, 1470–1477.
- Zhang, Y. L., and Li, S. (2020). The relationship between loneliness and mobile phone addiction: a meta-analysis. *Adv. Psychol. Sci.* 28, 1836–1852. doi: 10.3724/SP.J.1042.2020.01836
- Zhao, M. K. (2020). *Relationship Between Childhood Neglect and Mobile Phone Dependence Behavior of College Students: Mediated Regulation Model*. Ph.D. thesis. Henan, China: Henan University.
- Zhou, H., and Long, L. R. (2004). Statistical remedies for common method biases. *Adv. Psychol. Sci.* 12, 942–950.
- Zou, H. (2003). *Adolescent Peer Relationships: Developmental Characteristics, Functions and Influencing Factors*. Beijing: Beijing Normal University Press, 73–98.

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Qian, Wang, Jiang, Wu and Ni. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# An Authentic Inner Compass and Need Satisfaction as Wellbeing Resources in Bedouin Teaching Students During the COVID-19

Rinat Cohen<sup>1,2</sup> and Ortal Slobodin<sup>3\*</sup>

<sup>1</sup> Baruch Ivcher School of Psychology, Interdisciplinary Center (IDC), Herzliya, Israel, <sup>2</sup> Department of Education, Achva Academic College, Arugot, Israel, <sup>3</sup> The Department of Education, Ben-Gurion University, Beer-Sheva, Israel

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Rafael Gargurevich,  
Pontifical Catholic University of  
Peru, Peru  
Marcia Bent Henry,  
Ochsner Health System, United States

### \*Correspondence:

Ortal Slobodin  
ortal.slobodin@gmail.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

Received: 07 February 2022

Accepted: 31 May 2022

Published: 07 July 2022

### Citation:

Cohen R and Slobodin O (2022) An  
Authentic Inner Compass and Need  
Satisfaction as Wellbeing Resources in  
Bedouin Teaching Students During the  
COVID-19.  
Front. Psychiatry 13:870764.  
doi: 10.3389/fpsy.2022.870764

A growing body of literature suggests that students from underserved backgrounds are more vulnerable to the adverse economic, emotional, and academic effects of the current COVID-19 pandemic. While this vulnerability was attributed to multiple structural and socio-cultural barriers, little attention has been paid to the role of psychological resources in preserving wellbeing in times of crisis and change. Guided by the Self-Determination Theory (SDT), the current study examined the role of the authentic inner compass (AIC) and need-satisfaction in predicting the wellbeing of Bedouin students attending teachers' higher education institutes in the south of Israel during the COVID-19. Participants were 84 Bedouin teaching students (84.1% female) who completed online questionnaires addressing the sense of AIC, need-based experiences, psychological distress, and positive affect. Consistent with the propositions of the SDT, we found that a strong and clear sense of AIC, as well as high need satisfaction and low need frustration, were associated with lower distress and higher positive effect in Bedouin teaching students. We have also found that need satisfaction moderated the effect of the AIC on students' wellbeing so that AIC better predicted lower distress and higher positive effect when students' levels of need satisfaction were higher. Our findings lend further support to the importance of the AIC and need satisfaction to optimal functioning even in collectivist cultural contexts that do not prioritize values of autonomy. The current study provides insight into the interplay between AIC and need-based experience by describing the conditions under which AIC may be beneficial for wellbeing in times of crisis.

**Keywords:** authentic inner compass, Bedouin, COVID-19, higher education, Self-Determination Theory

## INTRODUCTION

The emergence of Corona Virus disease (COVID-19) has forced educational institutions to close their gates and move from traditional face-to-face learning to distance education almost overnight. While this rapid transition has been accompanied by pedagogical, technological, and emotional difficulties for most students (1, 2), these challenges were exacerbated for those from underserved populations (3, 4). Previous studies conducted before and during the COVID-19 have shown that students from underserved backgrounds (e.g., such as culturally and linguistically minority students, students with low socioeconomic status, students living in rural areas, and first-generation

to higher education students) encountered multiple structural and socio-cultural challenges related to distance learning. These difficulties included the lack of access to technological resources (5), limited time and space (6), disconnection from faculty members and peers (7), lack of culturally relevant pedagogies (8, 9), and difficulties in adjusting to self-directed learning (10).

In light of the disproportional adverse impact of the COVID-19 on the educational and psychological outcomes of students from underserved populations (11), recent studies began to examine potential resources that might buffer these harmful effects (12, 13).

Guided by the Self Determination Theory (SDT), the current study focused on the authentic inner compass (AIC) (14) and need satisfaction as two potential psychological resources that may contribute to the wellbeing of Bedouin students attending teachers' higher education institutes in the South of Israel during the COVID-19.

The term "authentic inner compass" refers to inner guiding schemas that inform us on what is truly important for us and help us direct our behaviors and future decision-making. Given that both AIC and need satisfaction were associated with adolescents' and young adults' self-esteem, mental health, and adaptive coping (15–18), we examined how having a sense of an AIC and need-based experiences (satisfaction or frustration) are related to Bedouin minority students' psychological distress and positive affect during the COVID-19. Furthermore, we examined whether students' need-based experiences moderate the association between their sense of AIC and the levels of psychological distress and positive affect.

Understanding the role of AIC and need-satisfaction in minority students' wellbeing may be of high empirical and practical significance to policymakers, academic institutes, faculty members, and teaching students themselves.

## Need-Based Experiences and Their Associations With Students' Wellbeing

The SDT is a general motivation theory that posits that people are inherently prone toward psychological growth and integration, and thus toward learning, mastery, and connection with others (19, 20). SDT argues that for healthy development to unfold individuals require support for three basic psychological needs (21), namely those for autonomy (the feeling of being the origin of one's own behaviors), competence (feeling of achieving desired outcomes), and relatedness (the feeling of being understood and cared for by others). According to the SDT, the experience of need satisfaction serves as an internal resource of motivation and provides energy for exploration and growth (20) across cultures (22, 23) and life circumstances (24, 25).

Studies conducted among school and higher education students have shown that the satisfaction of the three basic psychological needs was associated with beneficial health, emotional and education outcomes, such as agentic engagement (26), autonomous motivation (27), prosocial behavior (28), and life skills development (29). In contrast, the frustration of the three basic psychological needs was associated with maladaptive outcomes, including lower students' engagement (30), decreased

autonomous motivation (31), lower prosocial behavior (28), and higher academic drop-out rates (32). These conclusions appear to hold irrespective of whether researchers used a total score of need satisfaction encompassing the three psychological needs [e.g., (33, 34)], or on distinct measures of the three needs [e.g., (35, 36)].

While most studies within the SDT framework involved children and adolescents, understanding need satisfaction may be particularly important in the higher education context, given the self-determined nature of this education (especially during distance learning). Indeed, Gillet et al. (37) who studied changes in need satisfaction in the course of the first university semester found that students with moderate and increasing levels of need satisfaction reported higher levels of positive affect and effort, while students with low and decreasing levels of need satisfaction reported lower levels of positive affect, effort, and achievement, and higher levels of negative affect.

In times of crisis and change, need satisfaction may act as a resilience factor, attenuating the adverse impacts of the situation on individuals' wellbeing (38). Weinstein and Ryan [(39), p. 12] proposed that need satisfaction "buffer in times of stress, reducing both initial appraisals of stress and encouraging adaptive coping after stress-related events occur." Thus, in the current study, we assumed that students' experience of need satisfaction would promote feelings of wellbeing and growth during the COVID-19 pandemic. In contrast, we assumed that students with high levels of need frustration would experience the COVID-19 as more challenging and difficult to cope with, and thus would exhibit higher distress.

## The Authentic Inner Compass as a Wellbeing Resource

An important aspect of the need for autonomy that is likely to become particularly significant in adolescence and emerging adulthood [e.g., (15, 16)], is a sense of having an AIC. Rooted mainly in SDT (20), and partly on Mill's (40) notion of liberty, Assor (14) proposed that the striving to self-organize and self-direct in ways that allow self-actualization and sense of volition is a core feature of the need for autonomy. When such guiding schemas exist, we feel that we have values, life aspirations, interests, and goals that function like an "authentic inner compass," that informs us on what is truly important for us and help us direct our behaviors and future decision making. When we do not have such action- and decision-guiding inner compass, we are likely to feel confused and not capable of self-endorsed and volitional, self-direction, because we do not know what actions to choose (15, 16). Having a sense of AIC may be particularly important during late adolescence and emerging adulthood, when many central life decisions and identity commitments are made, particularly in societies offering a wide range of choices (17).

Past research on the AIC construct has shown that the experience of having an AIC was associated with a wide range of need satisfaction outcomes including vitality, low levels of depression, sense of meaning, life satisfaction, happiness, autonomous motivation to learn, resistance to

negative pressure, tolerance for ambiguity, absence of attachment avoidance, clear and autonomous future plans and higher self-esteem (15, 16, 41–44). Although the AIC is likely to be of special importance in many post-modern, information-flooded, and moral relativistic societies, previous studies have demonstrated that the experience of having an AIC might be related to wellbeing also in hierarchical-collectivist cultures that traditionally do not emphasize authenticity and personal autonomy, such as Chinese and Bedouin (17, 44). For example, studies with Chinese showed that having a sense of AIC was related to growth promoting qualities such as self-congruence, intrinsic life-goals, and tolerance for ambiguity (41, 44) as well as with indicators of wellbeing, such as vitality, and self-esteem (17).

### Why Need-Based Experiences May Serve as Moderating Factors in the Association Between AIC and Students' Wellbeing?

While past research consistently shows that AIC contributes to many adaptive outcomes, the factors that promote or hinder the ability to translate this sense of self-directedness into wellbeing and coping remained unclear. According to the SDT, need satisfaction is crucial to the development and maintenance of high-quality motivation and optimal functioning (19, 45). Hence, evaluating need satisfaction as a moderator in the AIC-wellbeing relationship could offer a better understanding of the psychological experiences that can promote students' adaptation.

Perceptions of autonomy, competence, and relatedness are fueled by socio-contextual factors in students' life. Previous studies within the SDT framework traditionally investigated basic need satisfaction as a mechanism (mediator) in the relationship between teachers' or parents' behavior and students' outcomes (26, 46). Yet, perceptions of autonomy, competence, and relatedness can be viewed as essential psychological factors that facilitate individuals' ability to use their AIC as a personal resource in stressful situations. Indeed, a few recent studies illustrated that need-based experiences played a moderating role in predicting wellbeing and distress. For example, Boudrias et al. (47) showed that need satisfaction moderated the relationship between job demands and turnover intention among nurses. Specifically, the study found that nurses who experience feelings of autonomy in their workplace were better equipped to deal with situations of role ambiguity and role conflict. In a similar vein, Kranabetter and Niessen (48) found that the satisfaction of the need for relatedness moderated the relationship between work appraisals and employees' depressive symptoms. They argued that employees who felt connected and secured found it easier to successfully integrate their work roles into their selves. In this case, appreciation, as behavior that addresses personal values as a genuine reward, might evoke positive emotions, thereby limiting depressive symptoms.

Together, these studies highlight the importance of investigating need-based experiences as factors promoting or hindering students' ability to translate the sense of AIC into wellbeing and functioning. Examining the moderating role of need experiences may be particularly important in times of crisis

and change because emergencies, especially those eliminating social relationships, are inherently need suppressing (49, 50).

Thus, in the present study, we sought to extend the application of the AIC by considering need-based experiences as moderators of the AIC-wellbeing relationship. We argue that when need satisfaction is high, a sense of AIC would be experienced as a genuine resource for a behavior that is highly self-relevant and valued. It is in such a case that having a strong sense of AIC may particularly unfold its impact on positive emotions, making depressive and anxious symptoms less likely. However, having a sense of AIC may not be that beneficial for students' wellbeing when they feel unable to translate their personal goals into real-world behavior and achievements. For example, having a sense of AIC affects wellbeing more positively if a student feels free to make volitional choices regarding his or her life in general and in the academic context particularly, rather than when he or she feels incompetent, pressured, or controlled. When students perceive themselves as agents and consider their enactments more interesting, joyful, and meaningful (satisfaction of the need for autonomy), if the institute provides opportunities to develop skills and attain valued outcomes by mastering challenging tasks (satisfaction of the need of competence), and when students have a sense of belongingness and secure (satisfaction of the need for relatedness), then the association between having clear educational aspirations and plans would be associated with higher levels of wellbeing and functioning. In contrast, when students lack interest and choice in their studies (frustration of the need for autonomy), when they feel ineffective, bored, or over-challenged (frustration of the need for competence), or when they feel lonely and disconnected from faculty members and peers (frustration of the need for relatedness), having a clear identity and self-directed goals may not be enough to protect their wellbeing, particularly in times of crisis and change.

### Bedouin Students in the Israeli Higher Education System

The Bedouins are a unique subset of Israel's Arab population who number ~270,000 (about 13% of the total Israeli Arab population and 3% of Israel's entire population) (51). Bedouin families tend to be authoritarian, hierarchical, and oriented toward the tribal group. Fathers are the head of the family, and women, although educated, are expected to defer to husbands and fathers and to remain socially confined to the familial/tribal circles (52, 53). As a minority within a minority, the Bedouins have the lowest education level, below-average income per family, and the highest unemployment rates (54). Approximately half of the Bedouin community in the Negev lives in unrecognized settlements, most not connected to water or electricity and situated far from the main roads. Polygamy, although illegal in Israel, is prevalent among 30% of Bedouin women and is associated with increased levels of physical and psychological distress (55).

The number of Bedouin students enrolled in undergraduate programs in Israeli institutions has doubled over the last decade. However, these students still have lower enrollment rates, lower achievements, and higher dropout rates than their



Jewish peers (56). These disparities were attributed to multiple barriers, including inadequate high-school preparation, language challenges, and financial difficulties (57). The Israeli Knesset (58) reported that about one-third of 17-year-old Negev Bedouins did not attend school in the 2015–2016 academic year, and only 32% of 18-year-old Bedouin received matriculation certificates. Accordingly, only about one-third of Bedouin candidates met entry requirements for universities, as opposed to 68 percent of the general population.

Similar to other students from disadvantaged backgrounds (3), Bedouin high education students faced many structural and cultural challenges as a result of the sudden shift to distance learning. A recent study focusing on Bedouin high education students found that 90% of the interviewed students ( $N = 257$ ) experienced extreme difficulties in adjusting to distance learning during the COVID-19 pandemic and that more than half estimated their chances of dropping out to be moderate to high (59). A study that compared Bedouin and Jewish teaching students' experiences of the shift to distance learning during the COVID-19 has shown that Bedouin students' learning was hindered not only by the lack of digital resources but also by gender-based traditional values and roles (60). For example, while Jewish female students, who were often single and without children, found synchronous online-learning methods (real-time live lessons delivered through video conferencing platform) to be effective, Bedouin female students found them ineffective due to multiple domestic tasks and limited computers. Similarly, Manevitch-Malul et al. (61), who focused on the distance learning experiences of Israeli university students found that for many Bedouin students, the shift to distance learning increased the already existing feelings of disconnection and alienation from faculty members and peers and undermined their role as "students." Moreover, Bedouin university students faced increased conflicts between their educational demands and family obligations, especially when their families could not understand or accept their need to continue studying even while staying at home.

## The Current Study

Previous studies on minority students have consistently pointed to ethnic and racial differences in higher education enrollment and performance (62, 63). These disparities were exacerbated by the current COVID-19 pandemic which exposed minority groups worldwide to increased levels of health, financial, social, and educational stressors (64–66).

Given the evidence on the difficulties of students from the underserved backgrounds during the COVID-19 and the shift to distance learning (67), the main purpose of the current study was to examine whether and how a sense of AIC and need-based experiences are associated with psychological wellbeing and distress in Bedouin teaching students. We were also interested in examining whether a sense of AIC interacts with students' level of need satisfaction and need frustration in predicting psychological distress and positive affect. We expected that the positive association between AIC and positive affect would be enhanced by high levels of need satisfaction and attenuated by high levels of need frustration. In contrast, we expected that

the negative association between AIC and psychological distress would be further exacerbated by high levels of need frustration and attenuated by high levels of need satisfaction.

The study was guided by two main hypotheses:

H1: Bedouin students' sense of AIC and need satisfaction will be positively associated with positive affect and negatively associated with psychological distress. In contrast, need frustration will be negatively associated with positive affect and positively associated with psychological distress.

H2a: The association between students' AIC and their level of psychological distress will be moderated by need-based experiences. Specifically, the negative association between AIC and psychological distress would be stronger for students with higher levels of need frustration than for students with lower levels of need frustration. In contrast, the association between AIC and psychological distress would be weaker for students with higher levels of need satisfaction than for students with lower levels of need satisfaction.

H2b: The association between students' AIC and positive affect will be moderated by need-based experiences. Specifically, the positive association between AIC and positive affect would be stronger for students with higher levels of need satisfaction than for students with lower levels of need satisfaction. In contrast, the association between AIC and positive affect would be stronger for students with lower levels of need frustration than for students with higher levels of need frustration.

## METHODS

### Participants and Procedure

According to the Central Bureau of Statistics (56), there are 2,981 Bedouin students studying for a bachelor's degree in all Israeli higher education institutes (1.5% of the total student population in Israel). About half of the Bedouin students (53.2%) are studying education or teaching.

The current study included 84 Bedouin teaching students (84.1% female), studying in one of three higher education institutes that provide teaching training in the South of Israel (one university and two academic colleges). According to representative staff of these three institutes, the total number of Bedouin teaching students is estimated to be around 400 and 500 in a given time point. The vast majority of Bedouin teaching students learn in an academic college for education, which specializes in training pre-service teachers and includes a high proportion of Bedouin students (55%). Given this estimation, our sample size represents 17–20% of the total population of interest.

Participants' age ranged between 20 and 48 (Mean = 32.91, SD = 7.13). Most participants (69.5%) were parents with a mean number of 3.41 children per family (SD = 2.31). The background variables are presented in **Table 1**.

Data were collected between May and July 2021, while most Israeli academic institutes used distance learning methods. Participants were invited to participate in an online survey *via* Qualtrics. The survey was distributed through social media groups of Bedouin teaching students. Students were informed



**TABLE 1** | Participants' background variables ( $N = 84$ ).

	<b>N</b>	<b>Percentage</b>
<b>Gender</b>		
Male	13	15.9
Female	69	84.1
<b>Marital status</b>		
Single	21	25.6
Married	61	74.4
<b>Children</b>		
Yes	57	69.5
No	25	30.5
<b>Religious affiliation</b>		
Traditional	29	35.8
Religious	53	64.2
	<b>M (SD)</b>	<b>Range</b>
Number of children	3.41 (2.31)	0–13
Age	32.91 (7.13)	20–48

that their answers would remain anonymous and confidential. Participation was voluntary without remuneration. The research was approved by the institutional ethics committee.

## Measures

**Background variables** included students' age, gender, marital status, number of children, and level of religiosity.

**Need satisfaction and frustration** were assessed by the Basic Psychological Needs Scale (BPNS) (68). Participants filled out the full 24-item version that has 12 items tapping needs satisfaction, and 12 items tapping needs frustration. All items were rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Each 12-item scale has four items tapping autonomy, four items tapping competence, and four items tapping relatedness. For each participant, the total needs satisfaction and the total need frustration scores were calculated by taking the means of the 12 needs satisfaction scores, and the 12 need frustration scores, respectively. The BPNS has proven good validity, internal consistency, and temporal stability for each of the three factors (68). For example, structural equation modeling showed that autonomy, competence, and relatedness need satisfaction positively predicted active commuting to and from school (69). Previous studies supported the validity and reliability of the BPNS across contexts and cultures (70, 71), with internal consistency ranging between 0.64 and 0.89. Studies that used the scale was in students, beginning teachers, and pre-service teachers from the Bedouin society reported internal consistencies of 0.73–0.78 (72–74). In the current study, Cronbach alpha coefficient for need satisfaction was 0.91 and for need frustration 0.82.

**A sense of an authentic inner compass** was assessed by the Authentic Inner Compass Scale (41). The scale consists of 11 items on a 5-point Likert-type scale ranging from 1 (not at all) to 5 (to a very large extent), including “I

have goals that are personally important to me and I fully identify with,” and “I have values that truly reflect the kind of person I want to be.” The items were averaged to produce a total AIC score. Studies that examined the incremental and discriminant validity of the AIC scale showed that the AIC has weaker correlations with indicators of exploration and purpose-searching than with identification with commitment or identified purpose, supporting the distinctiveness of the behavioral self-realization and AIC concepts (15, 17). The AIC scale has also good criterion validity, showing strong positive correlations with freedom, volition, vitality, and negative correlation with depression (17).

A study that examined the validity of the scale in Bedouin adolescents reported an internal consistency of 0.63 (15). In this study, Cronbach's alpha coefficient was 0.92.

**Psychological distress** was measured by Depression, Anxiety, and Stress Scales (DASS-21) (75). This widely used scale addresses three groups of symptoms: depression, anxiety, and stress, with seven items for each group. Participants responded on a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Previous studies supported the validity and reliability of the DASS-21 in a variety of cultural contexts (76, 77). In a non-clinical sample of American adults, Sinclair et al. (78) reported on good internal consistency (0.91, 0.80, and 0.84 for Depression, Anxiety, and Stress scales, respectively) and scale-level correlations (between 0.68 and 0.73). A recent study that used the DAAS-21 in Arab adults in Israel reported internal consistencies of 0.91, 0.87, and 0.90 for the Depression, Anxiety, and Stress scales, respectively (79). In the current study, the Cronbach's alpha coefficient for depression scale was 0.87, the anxiety scale was 0.90 and the stress scale was 0.86. The Cronbach's alpha coefficient for the total scale was 0.95.

**Positive affect** was assessed by the Positive and Negative Affect Schedule (PANAS) (80). The 10 items in the positive affect scale reflect the extent to which a person feels active, enthusiastic, and alert. High positive affect is a state of high energy, concentration, and experiencing pleasure, whereas low positive affect is characterized by sadness and lethargy (80). Respondents are asked to rate the extent to which they have experienced each particular emotion within the past week, with reference to a 5-point Likert-type scale ranging from 1 (very slightly) to 5 (extremely). The high extreme of each dimension indicates a strong experience of affect, while the low end represents a weak experience of affect (81). The positive affect scale has good internal consistency, with Cronbach's alpha  $\geq 0.84$  across multiple time frames. The scale also demonstrates good convergent and discriminant validity (82). The scale was used in various cultural setting, showing good psychometric properties (83, 84). A study that examined the cross-cultural adaptation of the negative affect scale in Bedouin children reported an internal consistency of 0.77 (85). In Agbaria (86, 87) who studied Arab adolescents in Israel, internal consistencies of  $\alpha = 0.80$  for the positive affect scale and 0.79 for the negative scale were found. In the current study, the Cronbach's alpha coefficient for the positive affect scale was 0.82.

## Confirmatory Factor Analysis

To provide validity information on the internal structure of the employed measurements in the current sample, we conducted a confirmatory factor analysis (Appendix 1). This analysis examined the convergence of the items into factors. The measurement model was composed of 15 manifested items pertaining to the five study variables: need satisfaction, need frustration, authentic inner compass, positive affect, and psychological distress. All the latent variables were assessed by three parcels of items. Variables items were randomized into one of the three parcels. We used parcels to create a reasonable ratio of observed indicators with respect to the sample size (88, 89). For the DAAS-21 scale, factorial construct validity was conducted using the three-factor model, including depression, anxiety and stress. The results indicated an adequate fit to the data,  $\chi^2_{(80)} = 115.51$ ,  $p = 0.006$ , CFI = 0.96, RMSEA = 0.07. Parcel loadings onto their respective factors were all strong and statistically significant, ranging from 0.40 to 0.98, which validated the measurement model.

## Data Analyses

To test H1, bivariate Pearson correlations between study variables were calculated. To assess H2, conditional process modeling was used to test the moderating effect of need-based experiences on the association between AIC and students' wellbeing, as outlined by Hayes (90), using the PROCESS macro. We used an alpha level of 0.05 for all statistical tests. Data analyses were carried out on SPSS Windows 26.0.

Power calculations using G\* POWER calculator (91) revealed that for multiple regression with five predictors, alpha of 0.05 and effect size of 0.95, a minimum of 73 participants was required.

## RESULTS

Table 2 presents the correlations between the participants' background variables and the study variables. Age was negatively associated with psychological distress. No other significant associations were identified.

Means, standard deviations, and correlations between the study variables are presented in Table 3. In line with H1,

the results of the correlation matrix showed that AIC was positively associated with need satisfaction and positive affect. In contrast, AIC was negatively associated with need frustration and psychological distress.

## The Interaction Effect of AIC and Need-Based Experiences on Students' Psychological Distress

As seen in Table 4, results showed that AIC and need satisfaction had main effects on psychological distress ( $B = -0.11$ ,  $SE = 0.05$ ,  $p = 0.02$  and  $B = -0.41$ ,  $SE = 0.13$ ,  $p = 0.001$ , respectively). Consistent with hypothesis H2a, the product term of the interaction between AIC and need satisfaction was significant ( $B = -0.11$ ,  $SE = 0.05$ ,  $p = 0.002$ ), indicating that need satisfaction moderated the link between AIC and psychological distress. Simple slope analyses of the interaction effect showed that the relationship between AIC and psychological distress was significant under moderate ( $B = -0.11$ ,  $SE = 0.05$ ,  $t = -2.23$ ,  $p = 0.02$ ) or high ( $B = -0.20$ ,  $SE = 0.06$ ,  $t = -3.31$ ,  $p = 0.001$ ) levels of need satisfaction. That is, when students' levels of need satisfaction were moderate or high, a stronger sense of AIC predicted lower psychological distress. However, under low levels of need satisfaction, the link between AIC and psychological distress was not significant ( $B = -0.02$ ,  $SE = 0.06$ ,  $t = -0.42$ ,  $p = 0.67$ ). Figure 1 displays the interaction plot for the association between AIC and psychological distress under the condition of low ( $-1$  SD), medium (0 SD), and high ( $+1$  SD) need satisfaction.

Testing the role of need frustration in the relationship between AIC and students' level of psychological distress showed that AIC and need frustration had main effects on psychological distress ( $B = -0.17$ ,  $SE = 0.04$ ,  $p = 0.001$ , and  $B = 0.42$ ,  $SE = 0.11$ ,  $p = 0.001$ , respectively). Consistent with hypothesis H2a, the product term of the interaction between AIC and need frustration was significant ( $B = 0.13$ ,  $SE = 0.05$ ,  $p = 0.01$ ), indicating that need frustration moderated the link between AIC and psychological distress. Simple slopes analyses indicated that AIC was significantly associated with psychological distress under low ( $B = -0.26$ ,  $SE = 0.06$ ,  $t = -4.43$ ,  $p < 0.001$ ) and moderate ( $B = -0.17$ ,  $SE = 0.04$ ,  $t = -3.93$ ,  $p = 0.001$ ) levels of need frustration but not under high levels of need frustration ( $B = -0.07$ ,  $SE = 0.05$ ,  $t = -1.47$ ,  $p = 0.14$ ). Accordingly, when

**TABLE 2 |** Correlations between socio-demographic and study variables.

	Need satisfaction	Need frustration	AIC	Positive affect	Psychological distress
Gender	0.13	0.05	0.21	-0.04	-0.04
Having children	-0.01	-0.03	-0.01	-0.06	0.07
Religion	0.09	0.26	-0.01	-0.08	0.16
Marital status	-0.01	0.08	-0.09	-0.07	0.10
Age	0.17	-0.22	0.13	0.17	-0.39**
Number of children	-0.06	-0.06	-0.001	-0.01	-0.21

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

This table presents the correlations between participants' background variables and the study variables. Age was negatively associated with psychological distress. No other significant associations were identified.

**TABLE 3 |** Descriptive statistics and correlations between study variables.

	M (SD)	1	2	3	4	5
1. Needs satisfaction	3.69 (0.74)	1				
2. Needs frustration	2.54 (0.68)	-0.14	1			
3. AIC	5.22 (1.14)	0.64**	-0.46**	1		
4. Positive affect	3.46 (0.70)	0.47**	-0.47**	0.71**	1	
5. Psychological distress	2.06 (0.76)	-0.43**	0.54**	-0.60**	-0.44**	1

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

AIC, Authentic inner compass.

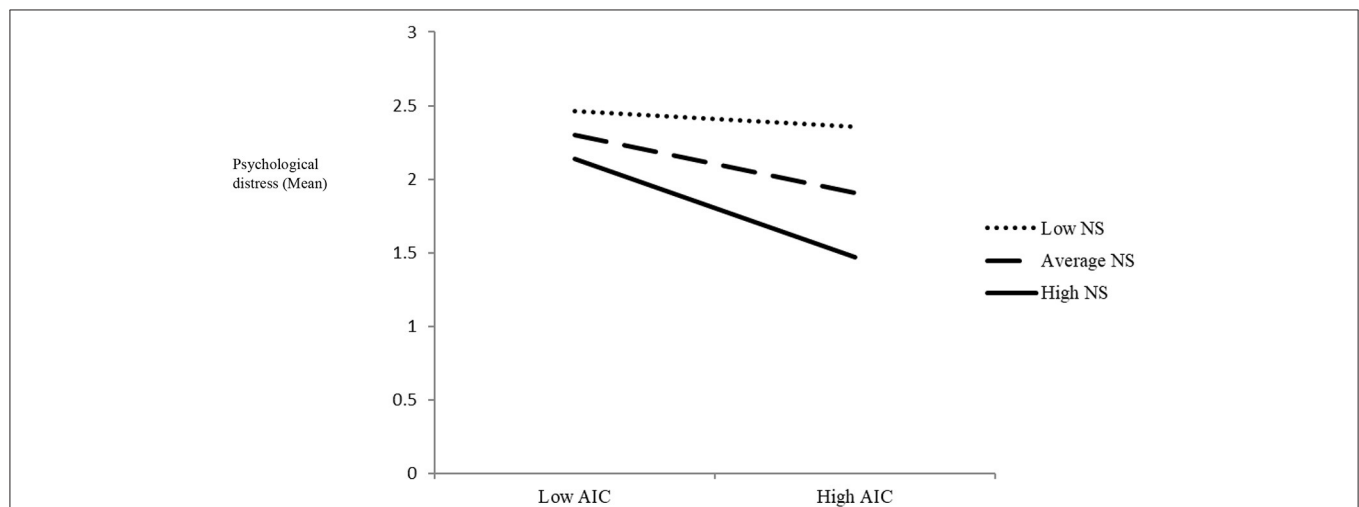
This table shows that AIC was positively associated with need satisfaction and positive affect. In contrast, AIC was negatively associated with need frustration and psychological distress.

**TABLE 4 |** Regression analyses predicting Bedouin students' psychological distress and positive affect.

	Psychological distress					Positive affect				
	$\beta$	B	SE	t	p	$\beta$	B	SE	t	p
AIC	−0.26	−0.11	0.05	−2.23	0.02	0.55	0.22	0.05	4.62	0.001
Need satisfaction	−0.40	−0.41	0.13	−3.24	0.001	0.17	0.17	0.12	1.32	0.19
AIC* need satisfaction	−0.19	−0.11	0.05	−2.22	0.02	0.19	0.09	0.04	2.03	0.04
AIC	−0.38	−0.17	0.04	−3.93	0.001	0.53	0.21	0.04	5.19	0.001
Need frustration	0.39	0.42	0.10	3.87	0.001	−0.28	−0.29	0.10	−2.72	0.01
AIC* need frustration	0.21	0.13	0.05	2.54	0.01	0.02	0.01	0.05	0.29	0.77

AIC, Authentic inner compass.

This table shows that need satisfaction moderated the link between AIC and psychological distress as well as the link between AIC and positive affect. Need frustration moderated the link between AIC and psychological distress.



**FIGURE 1 |** Interaction effect between AIC and need satisfaction (NS) on psychological distress. This figure displays the interaction plot for the association between AIC and psychological distress under the condition of low (−1 SD), medium (0 SD), and high (+1 SD) need satisfaction. As seen, when students' levels of need satisfaction were moderate or high, a stronger sense of AIC predicted lower psychological distress.

students experienced low or moderate levels of need frustration, a stronger sense of AIC predicted lower levels of psychological distress. **Figure 2** displays the interaction plot for the association between AIC and psychological distress under low, moderate, and high levels of need frustration.

## The Interaction Effect of AIC and Need-Experiences on Students' Positive Affect

As seen in **Table 4**, AIC had a main effect on students' positive affect ( $B = 0.22$ ,  $SE = 0.05$ ,  $p = 0.001$ ), while need satisfaction did not significantly predict the level of positive affect ( $B = 0.16$ ,  $SE = 0.12$ ,  $p = 0.19$ ). Consistent with hypothesis H2b, the product term of interaction between AIC and need satisfaction was significant ( $B = 0.10$ ,  $SE = 0.04$ ,  $p = 0.04$ ), indicating that need satisfaction moderated the link between AIC and positive affect. Simple slopes analyses indicated that the association between AIC and positive affect became stronger as the level of need satisfaction increased (low level of need satisfaction;  $B = 0.15$ ,  $SE = 0.06$ ,

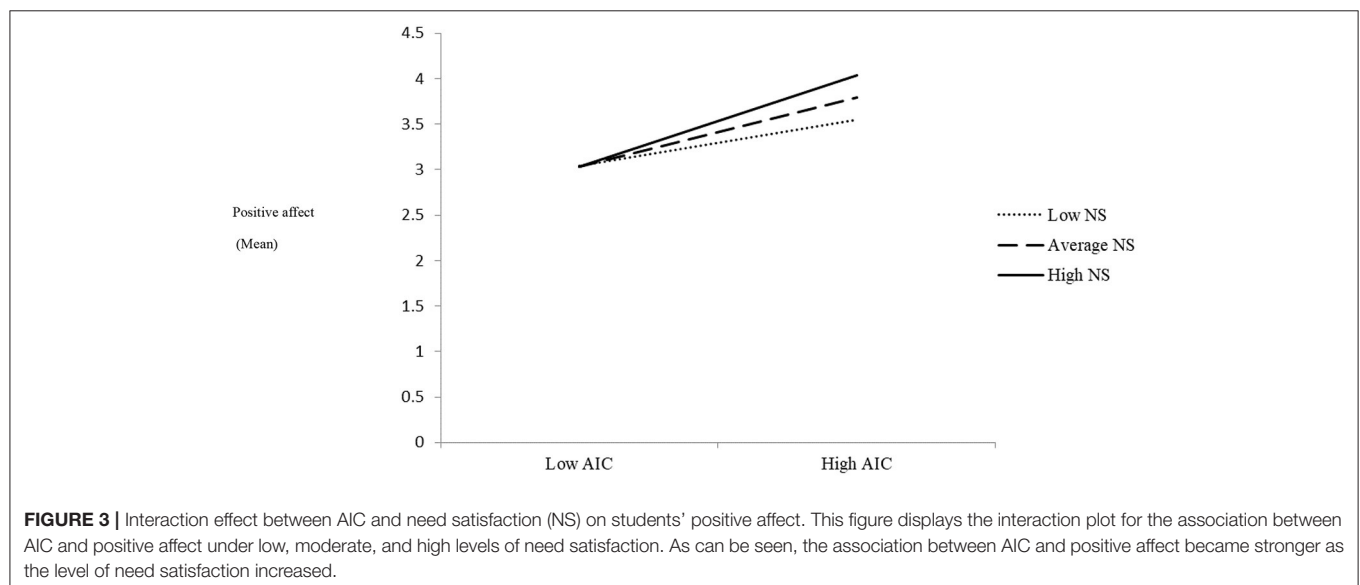
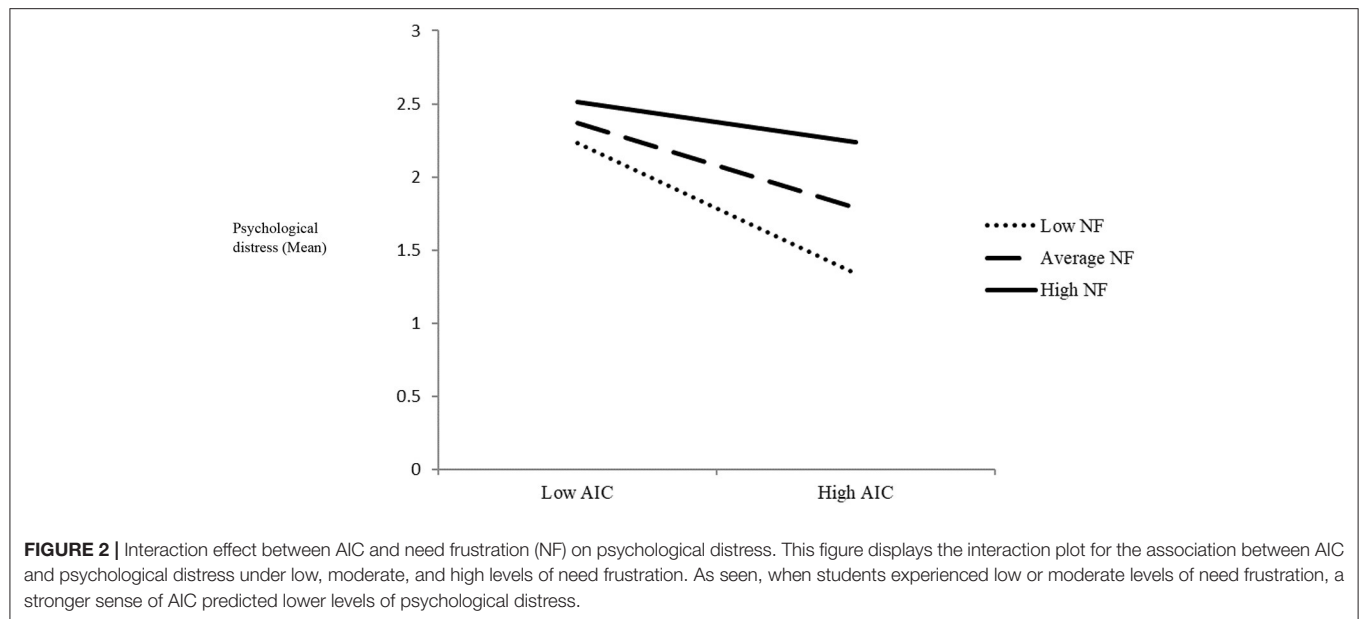
$t = 2.35$ ,  $p = 0.02$ , moderate level;  $B = 0.22$ ,  $SE = 0.04$ ,  $t = 4.62$ ,  $p < 0.001$ , and high level:  $B = 0.30$ ,  $SE = 0.06$ ,  $t = 5.21$ ,  $p < 0.001$ ).

**Figure 3** displays the interaction plot for the association between AIC and positive affect under low, moderate, and high levels of need satisfaction.

Testing the role of need frustration in the relationship between AIC and students' level of positive affect showed that AIC and need frustration had main effects on students' levels of positive affect ( $B = 0.21$ ,  $SE = 0.04$ ,  $p = 0.001$  and  $B = -0.29$ ,  $SE = 0.10$ ,  $p = 0.008$ ). However, the interaction effect between AIC and need frustration was not significant ( $B = 0.01$ ,  $SE = 0.05$ ,  $p = 0.77$ ).

## DISCUSSION

Our study aimed to investigate the roles of the AIC and need satisfaction in predicting the wellbeing of ethnic minority higher education students during the COVID-19. We applied the theoretical framework of SDT to explain how psychological distress (depression, anxiety,



and stress) and positive affect could be predicted by AIC, need-based experiences (satisfaction or frustration), and their interaction.

Consistent with our hypotheses, we found that a strong and clear sense of AIC, as well as high need satisfaction and low need frustration, were associated with lower levels of distress and higher levels of positive affect among Bedouin teaching students. We have also found that need-based experiences moderated the link between AIC and Bedouin teaching students' psychological distress and positive affect. We also found that need frustration moderated the link between AIC and psychological distress.

Overall, our findings suggest that both AIC and need satisfaction may serve as motivating and energizing resources

for minority students in times of crisis and change (92, 93). Our results align with the theoretical propositions of the SDT which state that individuals' psychological functioning derives not only from their environment but also from the psychological resources at their disposal (47). Support for the three basic psychological needs may be particularly essential in times of crisis, which are characterized by a continuous depletion of personal, economic, and social resources (94). Studies within the SDT framework suggested that the support of the three basic psychological needs may act as a resilience mechanism and facilitate adaptive coping strategies in times of crisis (38, 95). For example, Cantarero et al. (38) showed that higher levels of need satisfaction were related to adults' higher wellbeing during the COVID-19 outbreak



and that intervention that supports the basic needs decreased perceived stress.

In addition to the positive association between need satisfaction and students' wellbeing, need satisfaction was also related to a stronger sense of AIC. This finding may be attributed to the energizing effects of need satisfaction on identity processes (96). Previous studies suggested that the support of the three basic psychological needs provides adolescents and adults essential resources and energy to explore existing identity options and facilitates greater self-organization and integrated identity development. Conversely, the frustration of psychological needs limits active and critical thinking and results in a fragmented, loosely integrated identity structure (97, 98). It is, therefore, possible that Bedouin students whose basic needs were satisfied had greater ability to intentionally seek out activities and contexts and make choices that are conducive to experiencing meaning and positivity. Probably, the relationship between need satisfaction and AIC is bidirectional, so that having a strong sense of identity, goals, and meaning increases the likelihood that students would experience their environment as need satisfying.

In line with previous studies that demonstrated the key role of the AIC in predicting adolescents' and young adults' self-esteem, mental health, and adaptive coping (15–18, 42), our findings suggest that having authentic values and goals contributes directly to students' wellbeing, as manifested in a higher level of positive affect and lower levels of distress.

Extending previous findings regarding workplace experiences (47, 48), we found that need-based experiences played a moderating role in students' wellbeing. Importantly, we found that the AIC may function as a wellbeing resource primarily in need-satisfying contexts. That is, students were able to enjoy the positive effects of the having an inner guideline only when they experience themselves as autonomous, related, and competent. However, when students' needs are thwarted (e.g., they feel controlled, incompetent in their abilities, or disconnected from campus life, faculty members, and peers) they may not be able to translate their AIC resources into wellbeing outcomes.

The role of the educational and social environments in supporting students' needs may be particularly crucial for Bedouin students, who are affiliated with a collectivist culture. Studies of culturally and linguistically diverse students in higher education emphasized the importance of family, peers, and institutional support in their adjustment, motivation, and performance (99, 100). This support includes aspects of pre-college socialization environments (school and home environment), financial assistance, balancing family and work responsibilities, and campus climates (e.g., racial/ ethnic discrimination) (101–103). Previous studies on minority students' reasons to pursue higher education showed that in addition to individual motivations (e.g., intellectual curiosity, personal interest, career aspirations), these students largely emphasized collective concerns, such as meeting family expectations and preserve community connections (104, 105). Nevertheless, strong connections with one's family and community may also have adverse effects on students' motivation and performance if they conflict with academic

values and obligations (106). For example, Saenz and Ponjuan (107) noted that the tight solidarity in families of Latin origin may lead individuals to sacrifice their own needs for those of the family. Based on a study of 30 low-income Hmong American high school students, Lor (106) argued that poverty can create conditions in which family ties bind students to gender-based expectations and obligations that prevent them from pursuing opportunities for social mobility. These students are aware of their pivotal role in supporting their families and often frame family obligations as a significant barrier when it comes to achieving their own goals. Family obligations affect students in different ways. While males primarily framed cultural and religious obligations as time-consuming obstacles that interfere with their academic and social lives, females, who are expected to provide social and economic support, internalized guilt about being unable to fulfill their obligations in the future.

The collectivist characteristics of the Bedouin society and the traditional role teaching students (mostly female) play in their households may explain why family and community support are so essential for them in achieving their goals. When family and community connections are so strong and students are highly dependent on others, only environments that support students emotionally and financially and allow them to balance family obligations will allow them to follow their own values and benefit from having a clear and strong AIC.

Notably, although both need satisfaction and need frustration significantly moderated the effects of AIC on psychological distress, need frustration did not alter the relationship between AIC on positive affect. This finding may be explained by the SDT's differentiation between the "bright" pathway (where positive outcomes are more strongly related to need satisfaction) and a "dark" pathway (where negative outcomes are more strongly associated with need frustration). According to this dual-process model within SDT, the lower levels of need satisfaction are not identical to the experiences of need frustration, which has a more active and undermining effect on an individual's needs (108, 109). It is thus possible that students' AIC was a strong predictor of students' positive affect, regardless of their level of need frustration.

Our findings add support to the importance of the AIC to wellbeing in traditional, collectivist societies (18). While the Bedouin culture prioritizes the values of tradition, authority, and hierarchy (52, 53) rather than values of personal autonomy and authenticity, it appears that the experience of having an AIC could be considered a wellbeing resource in this group of students. Similarly, previous research with Hong Kong Chinese youth, who is also greatly influenced by socio-cultural expectations based on tradition, hierarchy, and group orientation, found that the experience of AIC was associated with increased levels of vitality and self-esteem (17). Together, these findings underscore the SDT universality claim, which states that the satisfaction of basic needs represents essential nutrients for optimal functioning regardless of cultural differences in how autonomy is valued and prioritized (68).

Our findings should be considered under several limitations. The major limitation of the current study is a self-report bias, that might be even more pronounced in ethnic minority groups (110). The self-report method also involves problems of shared method variance, such that the associations obtained between students' need-based experiences, the sense of AIC, and their wellbeing may become artificially inflated (111). Using reports from multiple sources would be an effective way of overcoming this limitation. Another shortcoming concerns the small study sample and our limited ability to generalize our results. The Bedouin population is considered a hard-to-reach minority group (112). Like other culturally and linguistically diverse groups, multiple socio-cultural factors, including power differences (defined by situations of unequal levels of authority and influence between the researcher and research participants), reluctance to expose private issues, limited access to technology, and physical segregation (113–115), hinder Bedouin's representation in psychological and psychiatric research (116–118). Recruiting participants was also limited by the length of the spring semester during which students must face certain academic, social, and emotional challenges that we wished to investigate.

In addition to the relatively small sample size, the self-selection survey and the lack of knowledge about the website members limited our ability to obtain a random sampling (119). Because the sample consisted of students who voluntarily signed up to participate in research, it is possible that participation was confounded with various academic and psychological outcomes. Therefore, participants may not be representative of the general population of Bedouin teaching students.

Additionally, the gender distribution is biased in favor of female students. While this distribution may be representative of the general population of teaching students (74.7% female according to the 55), it does not allow us to systematically examine gender differences in the studied variables. Moreover, this study was cross-sectional and therefore cannot provide any information about causality. While need-based experiences may affect wellbeing, this link could also be reversed. It is possible, for example, that higher levels of depression and anxiety may elicit feelings of inadequacy, isolation, and pressure, which in turn will lead to more need frustration. Longitudinal designs should be employed in future research to understand the effects of AIC and need-based experiences on students' adaption along the higher-education continuum. Finally, this study investigated only students' experiences of need satisfaction or frustration, overlooking the role of the organization in supporting these needs. We encourage future research to explore how and to what degree different levels of higher education institutes (departments, lecturers, and student services) satisfy students'

needs and how it is associated with students' wellbeing and academic performance.

## CONCLUSIONS

Our results show that need satisfaction and AIC act as key psychological resources in the adaptation of Bedouin teaching students to the emotional, social, and educational challenges imposed by the COVID-19. It, therefore, appears important to find ways to foster such experiences, especially in students of underserved backgrounds.

One promising venue is to adopt specific behaviors that can nurture students' needs for relatedness, competence, and autonomy. For instance, given that distance learning exacerbates Bedouin students' feelings of exclusion and social alienation (61), it would be important to find alternative ways for inclusion. Possible routes to foster experiences of relatedness would be creating working teams, initiating online social activities, and active reaching out by faculty members. Educational practices and interventions aimed at cultivating a sense of AIC and need satisfaction should consider culture-related values, norms, and expectations, including gender roles, social perceptions of mental health problems, cultural idioms of distress, and culture-specific ideas of autonomy and freedom (120, 121).

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Ethics Committee, Interdisciplinary Center (IDC) Herzliya, Israel. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

RC was responsible for the conception of the study, the design, collecting data, and the statistical analyses. RC and OS contributed equally to the conceptualization, interpretations, and writing of the manuscript. Both authors contributed to the article and approved the submitted version.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2022.870764/full#supplementary-material>

## REFERENCES

1. Di Pietro G, Biagi F, Costa P, Karpiński Z, Mazza J. *The Likely Impact of COVID-19 on Education: Reflections Based on the Existing Literature and*
2. Mseleku Z. A literature review of E-learning E-teaching in the era of COVID-19 pandemic. *Int J Innov Sci Res Technol*. (2020) 5:588–97.

*International Datasets*. Luxembourg: Publications Office of the European Union (2020).

3. Browning MH, Larson LR, Sharaievska I, Rigolon A, McClairlin O, Mullenbach L, et al. Psychological impacts from COVID-19 among university students: risk factors across seven states in the United States. *PLoS ONE*. (2021) 16:e0245327. doi: 10.1371/journal.pone.0245327
4. Hoyt LT, Cohen AK, Dull B, Maker Castro E, Yazdani N. Constant stress has become the new normal: stress anxiety inequalities among U.S. college students in the time of COVID-19. *J Adolesc Health*. (2021) 68:270–6. doi: 10.1016/j.jadohealth.2020.10.030
5. Van Deursen AJAM, van Dijk JAGM. The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media Soc*. (2019) 21:354–75. doi: 10.1177/1461444818797082
6. Bunn M, Bennett A, Burke PJ. In the anytime: flexible time structures, student experience and temporal equity in higher education. *Time Soc*. (2019) 28:1409–28. doi: 10.1177/0961463X18787649
7. Becher A. *Inequity in Distance Learning During the COVID-19: Higher Education Students' Perspectives*. (2021). Available online at: [דפוס חוסר יד - אילת בכר: 24.11.2021](https://www.youtube.com/watch?v=24.11.2021) [מגפת הקורונה](https://www.youtube.com/watch?v=24.11.2021) - Bing video (in Hebrew).
8. Hannon J, D'Netto B. Cultural diversity online: student engagement with learning technologies. *Int J Educ Manag*. (2007) 21:418–32. doi: 10.1108/09513540710760192
9. Tapanes MA, Smith GG, White JA. Cultural diversity in online learning: a study of the perceived effects of dissonance in levels of individualism/collectivism and tolerance of ambiguity. *Internet High Educ*. (2009) 12:26–34. doi: 10.1016/j.iheduc.2008.12.001
10. Turkila M, Lommi H. Student participation in online content-related discussion and its relation to students' background knowledge. *Educ Sci*. (2020) 10:106. doi: 10.3390/educsci10040106
11. Tadase S, Muluye W. The impact of COVID-19 pandemic on education system in developing countries: a review. *Open J Soc Sci*. (2020) 8:159–70. doi: 10.4236/jss.2020.810011
12. Enriquez LE, Morales AE, Rodriguez VE, Chavarria K, Ro A. Mental health COVID-19 pandemic stressors among Latina/o/x college students with varying self parental immigration status. *J Racial Ethn Health Disparities*. (2022). doi: 10.1007/s40615-021-01218-x
13. Fruehwirth JC, Biswas S, Perreira KM. The COVID-19 pandemic and mental health of first-year college students: examining the effect of COVID-19 stressors using longitudinal data. *PLoS ONE*. (2021) 16:e0247999. doi: 10.1371/journal.pone.0247999
14. Assor A. The striving to develop an authentic inner compass as a key component of adolescents' need for autonomy: parental antecedents and effects on identity, well-being, and resilience. In: Soenens B, Vansteenkiste M, Van Petegem S, editors. *Autonomy in Adolescent Development: Toward Conceptual Clarity*. London: Psychology Press (2018). p. 119–44.
15. Assor A, Benita M, Yitshaki N, Geifman Y, Maree W. Sense of authentic inner compass as a moral resource across cultures: possible implications for resisting negative peer-pressure for parenting. *J Moral Educ*. (2020) 49:346–64. doi: 10.1080/03057240.2020.1727423
16. Assor A, Soenens B, Yitshaki N, Ezra O, Geifman Y, Olshtein G. Towards a wider conception of autonomy support in adolescence: the contribution of reflective inner-compass facilitation to the formation of an authentic inner compass and well-being. *Motiv Emot*. (2020) 44:159–74. doi: 10.1007/s11031-019-09809-2
17. Assor A, Benita M, Shi Y, Goren R, Yitshaki N, Wang Q. The authentic inner compass as a well-being resource: predictive effects on vitality, and relations with self-esteem, depression and behavioral self-realization. *J Happiness Stud*. (2021) 22:3435–55. doi: 10.1007/s10902-021-00373-6
18. Assor A, Cohen R, Ezra O, Yu S. Feeling free and having an authentic inner compass as important aspects of the need for autonomy in emerging adults' interactions with their mothers. *Front Psychol*. (2021) 12:635118. doi: 10.3389/fpsyg.2021.635118
19. Deci EL, Ryan RM. The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychol Inq*. (2000) 11:227–68. doi: 10.1207/S15327965PLI1104\_01
20. Ryan RM, Deci EL. *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*. New York, NY: Guilford Publishing (2017).
21. Ryan RM, Ryan WS, Di Domenico SI, Deci EL. The nature the conditions of human autonomy flourishing: self-determination theory basic psychological needs. In: Ryan RM, editor. *The Oxford Handbook of Human Motivation*. 2nd ed. New York, NY: Oxford University Press (2019). p. 89–110.
22. Church AT, Katigbak MS, Locke KD, Zhang H, Shen J, de Jesús Vargas-Flores J, et al. Need satisfaction and well-being: testing self-determination theory in eight cultures. *J Cross Cult Psychol*. (2013) 44:507–34. doi: 10.1177/0022022112466590
23. Lynch MF, Salikhova NR, Ereemeeva AV. Basic needs in other cultures: using qualitative methods to study key issues in self-determination theory research. *J Higher School Econ*. (2020) 17:134–44. doi: 10.17323/1813-8918-2020-1-134-144
24. Henning G, Stenling A, Tafvelin S, Hansson I, Kivi M, Johansson B, et al. Preretirement work motivation and subsequent retirement adjustment: a self-determination theory perspective. *Work Aging Retire*. (2019) 5:189–203. doi: 10.1093/workar/way017
25. Zaman M, Vo-Thanh T, Hasan R, Babu MM. Mobile channel as a strategic distribution channel in times of crisis: a self-determination theory perspective. *J Strategic Market*. (2021). doi: 10.1080/0965254X.2021.1959629
26. Cohen R, Moed A, Shoshani A, Roth G, Kanat-Maymon Y. Teachers' conditional regard and students' need satisfaction and agentic engagement: a multilevel motivation mediation model. *J Youth Adolesc*. (2020) 49:790–803. doi: 10.1007/s10964-019-01114-y
27. Standage M, Gillison F. Students' motivational responses toward school physical education and their relationship to general self-esteem and health-related quality of life. *Psychol Sport Exerc*. (2007) 8:704–21. doi: 10.1016/j.psychsport.2006.12.004
28. Cheon SH, Reeve J, Ntoumanis N. A needs-supportive intervention to help PE teachers enhance students' prosocial behavior and diminish antisocial behavior. *J Sport Exerc Psychol*. (2018) 35:74–88. doi: 10.1016/j.psychsport.2017.11.010
29. Cronin L, Marchant D, Allen J, Mulvenna C, Cullen D, Williams G, et al. Students' perceptions of autonomy-supportive versus controlling teaching basic need satisfaction versus frustration in relation to life skills development in PE. *Psychol Sport Exerc*. (2019) 4:79–89. doi: 10.1016/j.psychsport.2019.05.003
30. Meyer JD, Soenens B, Vansteenkiste M, Aelterman N, Petegem SV, Haerens L. Do students with different motives for physical education respond differently to autonomy-supportive and controlling teaching? *Psychol Sport Exerc*. (2016) 22:72–82. doi: 10.1016/j.psychsport.2015.06.001
31. Haerens M, Vansteenkiste A, De Meester J, Delrue I, Tallir G, Vande Broek W, et al. Different combinations of perceived autonomy support and control: identifying the most optimal motivating style. *Phys Educ Sport Pedagogy*. (2018) 23:16–36. doi: 10.1080/17408989.2017.1346070
32. Ricard NC, Pelletier LG. Dropping out of high school: the role of parent and teacher self-determination support, reciprocal friendships and academic motivation. *Contemp Educ Psychol*. (2016) 44:32–40. doi: 10.1016/j.cedpsych.2015.12.003
33. Cheon SH, Reeve J, Song YG. A teacher-focused intervention to decrease PE students' amotivation by increasing need satisfaction and decreasing need frustration. *J Sport Exerc Psychol*. (2016) 38:217–35. doi: 10.1123/jsep.2015-0236
34. Michou A, Mouratidis A, Ersoy E, Ugur H. Social achievement goals, needs satisfaction, and coping among adolescents. *Pers Individ Differ*. (2016) 99:260–5. doi: 10.1016/j.paid.2016.05.028
35. Johnston MM, Finney SJ. Measuring basic needs satisfaction: evaluating previous research and conducting new psychometric evaluations of the basic needs satisfaction in general scale. *Contem Educ Psychol*. (2010) 35:280–96. doi: 10.1016/j.cedpsych.2010.04.003
36. Niemiec CP, Ryan RM, Deci EL. The path taken: consequences of attaining intrinsic and extrinsic aspirations in post-college life. *J Res Pers*. (2009) 73:291–306. doi: 10.1016/j.jrp.2008.09.001
37. Gillet N, Morin AJS, Huyghebaert T, Burger L, Maillot A, Poulin A, et al. University students' need satisfaction trajectories: a growth mixture analysis. *Learn Instruct*. (2019) 60:275–85. doi: 10.1016/j.learninstruc.2017.11.003



38. Cantarero K, van Tilburg WA, Smoktunowicz E. Affirming basic psychological need promotes mental well-being during the COVID-19 outbreak. *Soc Psychol Per Sci.* (2020) 12:821–8. doi: 10.31234/osf.io/pyhce
39. Weinstein N, Ryan RM. A self-determination theory approach to understanding stress incursion and responses. *Stress Health.* (2011) 27:4–17. doi: 10.1002/smi.1368
40. Mill JS. *On Liberty*. Luton: Andrews UK (1946/2011).
41. Assor A, Ezra O, Yu S. The striving to have an inner compass as a fundamental aspect of emerging adults' need for autonomy. *Presented at the 14th European Congress of Psychology, Milan, Italy* (2015).
42. Russo-Netzer P, Shoshani A. Authentic inner compass, well-being, and prioritization of positivity and meaning among adolescents. *Per Indiv Differ.* (2020) 167:110248. doi: 10.1016/j.paid.2020.110248
43. Soenens B, Vansteenkiste M, Beyers W, Verstuyf J, Assor A. How to resist the sirens' call? The role of an inner compass in protecting adolescents against problematic peer influences. *Presented at the Self-Determination Theory Conference, Victoria, BC, Canada* (2016).
44. Yu S, Deng Y, Yu H, Liu X. Attachment avoidance moderates the effects of parenting on Chinese adolescents' having an inner compass. *Curr Psychol.* (2018) 40:887–94. doi: 10.1007/s12144-018-0007-4
45. Trépanier S, Forest J, Fernet C, Austin S. On the psychological and motivational processes linking job characteristics to employee functioning: insights from self-determination theory. *Work Stress.* (2015) 29:286–305. doi: 10.1080/02678373.2015.1074957
46. Alp A, Michou A, Corlu MS, Baray G. Need satisfaction as a mediator between classroom goal structures and students' optimal educational experience. *Learn Individ Differ.* (2018) 65:80–9. doi: 10.1016/j.lindif.2018.05.012
47. Boudrias V, Trépanier S, Foucreault A, Peterson C, Fernet C. Investigating the role of psychological need satisfaction as a moderator in the relationship between job demands and turnover intention among nurses. *Employee Rel.* (2020) 42:213–31. doi: 10.1108/ER-10-2018-0277
48. Kranabetter C, Niessen C. Appreciation depressive symptoms: the moderating role of need satisfaction. *J Occup Health Psychol.* (2019) 24:629–40. doi: 10.1037/ocp0000153
49. Cohen O, Geva D, Lahad M, Bolotin A, Leykin D, Goldberg A, et al. Community resilience throughout the lifespan - the potential contribution of healthy elders. *PLoS ONE.* (2016) 11:e0148125. doi: 10.1371/journal.pone.0148125
50. Leykin D, Lahad M, Cohen O, Goldberg A, Aharonson-Daniel L. Conjoint Community Resiliency Assessment Measure-28/10 items (CCRAM28 and CCRAM10): a self-report tool for assessing community resilience. *Am J Comm Psychol.* (2013) 52:313–23. doi: 10.1007/s10464-013-9596-0
51. Rosen B, Waitzberg R, Israeli A, Hartal M, Davidovitch N. Addressing vaccine hesitancy and access barriers to achieve persistent progress in Israel's COVID-19 vaccination program. *Isr J Health Policy Res.* (2021) 10:43. doi: 10.1186/s13584-021-00481-x
52. Abu-Rabia Queder S. The activism of Bedouin women: social and political resistance. *HAGAR.* (2007) 7:67–84.
53. Abu-Rabia-Queder S. Does education necessarily mean enlightenment? The case of Palestinian Bedouin women in Israel. *Anthro Educ Q.* (2008) 39:381–400. doi: 10.1111/j.1548-1492.2008.00029.x
54. Abu-Saad T, Horowitz K, Abu-Saad K. Confronting barriers to the participation of Bedouin-Arab women in Israeli higher education. *Literacy Info Comp Educ J.* (2017) 8:2766–74. doi: 10.20533/licej.2040.2589.2017.0365
55. Daoud D, Braun-Lewensohn O, Eriksson M, Sagy S. Sense of coherence and depressive symptoms among low-income Bedouin women in the Negev Israel. *J Mental Health.* (2014) 23:307–11. doi: 10.3109/09638237.2014.951475
56. Central Bureau of Statistics. *Students in Higher Education.* (2019). Available online at: <https://cbs.gov.il/he/maamad/2019/20-2007/8> תשס"ט במסגרת השכלה גבוהה.
57. El-Meccawi S, Degen AA. Higher education among bedouin of the negev: Tel sheva as a case study. *Nomad People.* (2016) 20:88–107. doi: 10.3197/np.2016.200106
58. Kadari-Ovadia S. Amount of Bedouin Students in Israeli Higher Education Doubled in Decade. *Haaretz* (February 24, 2019). Amount of Bedouin students in Israeli higher education doubled in decade - Israel News - Haaretz.com.
59. Abu-Keshak H, Mendales Y. *The Digital Gap During the COVID-19 and Its Effects on the Arab Society in Israel (in Hebrew)*. MOFET (2021). p. 66. Available online at: <https://macam.ac.il/he/maamad/2021/10-2021/10> ת משבר הקורונה והשפעותיו על החברה הערבית בישראל.
60. Frei-Landau R, Avidov-Ungar O. Educational equity amidst COVID-19: Exploring the online learning challenges of Bedouin and Jewish Female Preservice Teachers in Israel. *Teaching Teacher Educ.* (2022) 111:1–4. doi: 10.1016/j.tate.2021.103623
61. Manevitch- Malul G, Becher A, Pinson H, Slobodin O, Abu-Rabia Queder S. Forms of inequity in flexible education amid the COVID-19 pandemic: Students' perspectives in Israeli higher education. *Presented at the CIES 2022, the 66th Annual Conference of the Comparative and International Education* (2022).
62. Frings D, Gleibs IH, Ridley AM. What moderates the attainment gap? The effects of social identity incompatibility and practical incompatibility on the performance of students who are or are not black, asian or minority ethnic. *Soc Psychol Educ.* (2020) 23:171–88. doi: 10.1007/s12128-019-09531-4
63. Richardson JTE. The under-attainment of ethnic minority students in UK higher education: what we know and what we don't know. *J Further Higher Educ.* (2015) 39:278–91. doi: 10.1080/0309877X.2013.858680
64. Centers for Disease Control and Prevention. *COVID-19.* (2020). Available online at: <https://www.cdc.gov/coronavirus/2019-ncov/index.html>
65. Slobodin O, Cohen O. A culturally-competent approach to emergency management: what lessons can we learn from the COVID-19? *Psychol Trauma.* (2020) 12:470–3. doi: 10.1037/tra0000790
66. Tai DGB, Shah A, Doubeni CA, Sia IG, Wieland ML. The disproportionate impact of COVID-19 on racial and ethnic minorities in the United States. *Clin Infect Dis.* (2021) 72:703–6. doi: 10.1093/cid/ciaa815
67. Diaz A, Fosco W, Baweja R. Racial and ethnic disparity in children attending school during the COVID-19 pandemic. *J Am Acad Child Adolesc Psychiatry.* (2020) 60:S223. doi: 10.1016/j.jaac.2021.09.292
68. Chen B, Vansteenkiste M, Beyers W, Boone L, Deci EL, Duriez B, et al. Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motiv Emot.* (2015) 39:216–36. doi: 10.1007/s11031-014-9450-1
69. Burgeño R, González-Cutre D, Sevil-Serrano J, Herrador-Colmenero M, Segura-Díaz JM, Medina-Casabón J, et al. Validation of the Basic Psychological Need Satisfaction in active commuting to and from School (BPNS-ACS) Scale in Spanish young people. *J Trans Health.* (2020) 16:100825. doi: 10.1016/j.jth.2020.100825
70. Vanhove-Meriaux C, Martinet G, Ferrand C. Adaptation and validation of the French psychological need frustration scale for older adults. *Ageing Int.* (2020) 45:99–117. doi: 10.1007/s12126-019-09346-w
71. Zamarrípa J, Rodríguez-Medellín R, Pérez-García JA, Otero-Saborido FM, Delgado M. Mexican Basic Psychological Need Satisfaction and Frustration Scale in physical education. *Front Psychol.* (2020) 11, 253. doi: 10.3389/fpsyg.2020.00253
72. Kaplan H. Teachers' autonomy support, autonomy suppression and conditional negative regard as predictors of optimal learning experience among high-achieving Bedouin students. *Soc Psychol Educ.* (2018) 21:223–55. doi: 10.1007/s12128-017-9405-y
73. Kaplan H. Suppression of psychological needs among beginning teachers: a self-determination theory perspective on the induction process in Bedouin schools. *Front Psychol.* (2021) 12:621984. doi: 10.3389/fpsyg.2021.621984
74. Kaplan H, Madjar N. The motivational outcomes of psychological need support among pre-service teachers: multicultural and self-determination theory perspectives. *Educ Psychol.* (2017) 2. doi: 10.3389/educ.2017.00042
75. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav Res Ther.* (1995) 33:335–43. doi: 10.1016/0005-7967(94)00075-U
76. Norton PJ. Depression Anxiety and Stress Scales (DASS-21): Psychometric analysis across four racial groups. *Anxiety. Stress. Coping.* (2007) 20:253–65. doi: 10.1080/10615800701309279

77. Osman A, Wong JL, Bagge CL, Freedenthal S, Gutierrez PM, Lozano G. The Depression Anxiety Stress Scales-21 (DASS-21): further examination of dimensions, scale reliability, and correlates. *J Clin Psychol.* (2012) 68:1322–38. doi: 10.1002/jclp.21908
78. Sinclair CJ, Siefert CJ, Slavin-Mulford JM, Stein MB, Renna M, Blais MA. Psychometric evaluation and normative data for the depression, anxiety, and stress scales-21 (DASS-21) in a nonclinical sample of U.S. adults. *Eval Health Prof.* (2012) 35:259–79. doi: 10.1177/0163278711424282
79. Sokar S, Greenbaum CW, Haj-Yahia MM. Exposure to parental violence during childhood later psychological distress among Arab adults in Israel: the role of gender sense of coherence. *J Interpers Violence.* (2022). doi: 10.21428/cb6ab371.041f97dd
80. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS Scales. *J Pers Soc Psychol.* (1988) 47:1063–70. doi: 10.1037/0022-3514.54.6.1063
81. Watson D, Clark LA. Measurement and mismeasurement of mood: recurrent and emergent issues. *J Pers Assess.* (1997) 68:267–96. doi: 10.1207/s15327752jpa6802\_4
82. Tran V. Positive affect negative affect scale (PANAS). In: Gellman MD, Turner JR, editors. *Encyclopedia of Behavioral Medicine*. New York, NY: Springer (2013), p. 1508–9.
83. Joiner TE, Sandin B, Chorot P, Lostao L, Marquina G. Development and factor analytic validation of the SPANAS among women in Spain: (More) cross-cultural convergence in the structure of mood. *J Pers Assess.* (1997) 68:600–15. doi: 10.1207/s15327752jpa6803\_8
84. Thompson ER. Development and validation of an internationally reliable short-form of the positive and negative affect schedule (PANAS). *J Cross-Cult Psychol.* (2007) 38:227–42. doi: 10.1177/0022022106297301
85. Veronese G, Pepe A, Cavazzoni F, Obaid H, Perez J. Agency via life satisfaction as a protective factor from cumulative trauma and emotional distress among Bedouin children in Palestine. *Front Psychol.* (2019) 10:1674. doi: 10.3389/fpsyg.2019.01674
86. Agbaria QA. Depression among Muslim Arab students: the contribution of spiritual, social and cognitive factors. *Psychol Res.* (2014) 4:428–40. doi: 10.17265/2159-5542/2014.06.003
87. Agbaria QA. Religiosity, social support, self-control and happiness as predictors of violence among Arab adolescents in Israel. *Create Educ.* (2014) 5:75–85. doi: 10.4236/ce.2014.52013
88. Bagozzi RP, Edwards JR. A general approach for representing constructs in organizational research. *Org Res Method.* (1998) 1:45–87. doi: 10.1177/109442819800100104
89. Bandalos DL, Finney SJ. Item parceling issues in structural equation modeling. In: Marcoulides GA, Schumacker RE, editors. *New Developments and Techniques in Structural Equation Modeling*. Mahwah: Lawrence-Erlbaum (2001). p. 269–96.
90. Hayes AF. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression Based Approach*. New York, NY: Guilford Press (2013).
91. Faul F, Erdfelder E, Lang AG, Buchner A. G\*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* (2007) 39:175–91. doi: 10.3758/BF03193146
92. Vansteenkiste M, Neyrinck B, Niemiec CP, Soenens B, Witte HD, Broeck AV. On the relations among work value orientations, psychological need satisfaction and job outcomes: a self-determination theory approach. *J Occup Organ Psychol.* (2007) 80:251–77. doi: 10.1348/096317906X111024
93. van Wingerden J, Derks D, Bakker AB. Facilitating interns' performance: the role of job resources, basic need satisfaction and work engagement. *Career Dev Int.* (2018) 23:382–96. doi: 10.1108/CDI-12-2017-0237
94. Hobfoll SE, Schröder KEE, Wells M, Malek M. Communal versus individualistic construction of sense of mastery in facing life challenges. *J Soc Clin Psychol.* (2002) 21:362–99. doi: 10.1521/jscp.21.4.362.22596
95. Šakan D, Žuljević D, Rokvić N. The role of basic psychological needs in well-being during the COVID-19 outbreak: a self-determination theory perspective. *Front Public Health.* (2020) 8:713. doi: 10.3389/fpubh.2020.583181
96. Arden A, Katz I, Slobodin O. Psychological need-based experiences as energizing processes for mothers' identity formation. *J Child Fam Stud.* (2022). doi: 10.1007/s10826-022-02258-5
97. Luyckx K, Vansteenkiste M, Goossens L, Duriez B. Basic need satisfaction and identity formation: bridging self-determination theory and process-oriented identity research. *J Counsel Psychol.* (2009) 56:276–88. doi: 10.1037/a0015349
98. Soenens B, Berzonsky MD, Vansteenkiste M, Beyers W, Goossens L. Identity styles causality orientations: in search of the motivational underpinnings of the identity exploration process. *Eur J Pers.* (2005) 19:427–42. doi: 10.1002/per.551
99. Dennis JM, Phinney JS, Chuateco LI. The role of motivation, parental support, and peer support in the academic success of ethnic minority first-generation college students. *J Coll Stud Dev.* (2005) 46:223–36. doi: 10.1353/csd.2005.0023
100. Hurtado S, Alvarado AR, Guillermo-Wann C. Thinking about race: the salience of racial identity at two- and four-year colleges and the climate for diversity. *J Higher Educ.* (2015) 86:127–55. doi: 10.1353/jhe.2015.0000
101. Isik U, Tahir OE, Meeter M, Heymans MW, Jansma EP, Croiset G, et al. Factors influencing academic motivation of ethnic minority students: A review. *Sage Open.* (2018). doi: 10.1177/2158244018785412
102. Kwon S. Perceived discrimination, family and spousal relationships, and psychological distress among Asian Americans: testing mediation and moderation effects. *Soc Sci J.* (2020) 57:26–38. doi: 10.1016/j.soscij.2019.01.001
103. Slobodin O, Ickson T, Herman L, Vaknin O. Perceived discrimination and motivation to pursue higher education in Ethiopian-origin students: the moderating role of ethnic identity. *Front Psychol.* (2021) 12:647180. doi: 10.3389/fpsyg.2021.647180
104. Knutsen DW. *Motivation to pursue higher education* (Ph D thesis). Russell Sage Foundation, Boston, MA, United States (2011).
105. Phinney JS, Dennis J, Osorio S. Reasons to attend college among ethnically diverse college students. *Cult Divers Ethnic Minority Psychol.* (2006) 12:347–66. doi: 10.1037/1099-9809.12.2.347
106. Lor Y. Ties that bind: family obligations as immediate and anticipatory obstacles. *Race Ethn Educ.* (2019) 22:666–82. doi: 10.1080/13613324.2017.1395327
107. Saenz VB, Ponjuan L. The vanishing Latino male in higher education. *J Hisp Higher Educ.* (2009) 8:54–89. doi: 10.1177/1538192708326995
108. Bartholomew KJ, Ntoumanis N, Ryan RM, Thøgersen-Ntoumani C. Psychological need thwarting in the sport context: assessing the darker side of athletic experience. *J Sport Exerc Psychol.* (2011) 33:75–102. doi: 10.1123/jsep.33.1.75
109. Soenens B, Deci EL, Vansteenkiste M. How parents contribute to children's psychological health: the critical role of psychological need support. In: Wehmeyer L, Little TD, Lopez SJ, Shogren KA, Ryan R, editors. *Development of Self-Determination Through the Life-Course*. New York, NY: Springer (2017). p. 171–87.
110. Rosenman R, Tennekoon V, Hill LG. Measuring bias in self-reported data. *Int J Behav Health Res.* (2011) 2:320–32. doi: 10.1504/IJBHR.2011.043414
111. Liu WC, Chee Keng, Wang J, Ryan RM. (eds.). *Building Autonomous Learners: Perspectives From Research and Practice Using Self-Determination Theory*. Singapore: Springer (2016).
112. Magnani R, Sabin K, Saidel T, Heckathorn D. Review of sampling hard-to-reach and hidden populations for HIV surveillance. *AIDS.* (2005) 19:S67–72. doi: 10.1097/01.aids.0000172879.20628.e1
113. Alvarez R, Vasquez E, Mayorga C, Feaster D, Mittrani V. Increasing minority research participation through community organization outreach. *West J Nurs Res.* (2006) 28:541–60. doi: 10.1177/0193945906287215
114. Hilton CL, Fitzgerald RT, Jackson KM, Maxim RA, Bosworth CC, Shattuck PT, et al. Brief report: under-representation of African Americans in autism genetic research: a rationale for inclusion of subjects representing diverse family structures. *J Autism Dev Disord.* (2010) 40:633–9. doi: 10.1007/s10803-009-0905-2
115. Serfaty DR, Cherniak AD, Strous RD. How are psychotic symptoms and treatment factors affected by religion? A cross-sectional study about religious coping among ultra-Orthodox Jews. *Psychiatry Res.* (2020) 293:113349. doi: 10.1016/j.psychres.2020.113349
116. Arnett JJ. The neglected 95%: why American psychology needs to become less American. *Am Psychol.* (2008) 63:602–14. doi: 10.1037/0003-066X.63.7.602



117. Arnett JJ. The neglected 95%: Why American psychology needs to become less American. In: Kazdin AE, editor. *Methodological Issues and Strategies in Clinical Research*. Washington, DC: American Psychological Association (2016). p. 115–32.
118. Thalmayer AG, Toscanelli C, Arnett JJ. The neglected 95% revisited: is American psychology becoming less American? *Am Psychol*. (2021) 76:116–29. doi: 10.1037/amp0000622
119. Khazaal Y, van Singer M, Chatton A, Achab S, Zullino D, Rothen S, et al. Does self-selection affect samples' representativeness in online surveys? An investigation in online video game research. *J Med Internet Res*. (2014) 16:e164. doi: 10.2196/jmir.2759
120. Bokek-Cohen Y, Ben-Asher S. The Israeli selective myopia and the missing culturally sensitive support for Bedouin IDF war widows. *J Hum Rights Soc Work*. (2018) 3:17–28. doi: 10.1007/s41134-017-0045-0
121. Slobodin O, Ziv-Beiman S. Keeping culture in mind: relational thinking and the Bedouin community. *Psychoanal Dial*. (2021) 31:450–67. doi: 10.1080/10481885.2021.1925284

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Cohen and Slobodin. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# How Does Shyness Affect Chinese College Students' Tendency to Mobile Phone Addiction? Testing the Mediating Roles of Social Anxiety and Self-Control

Xinwei Li<sup>1,2</sup>, Weijian Li<sup>1,2</sup>, Mengxian Liu<sup>3</sup>, Weilong Xiao<sup>1,2\*</sup> and Hui Zhou<sup>4</sup>

<sup>1</sup> College of Teacher Education, Zhejiang Normal University, Jinhua, China, <sup>2</sup> Key Laboratory of Intelligent Education Technology and Application of Zhejiang Province, Zhejiang Normal University, Jinhua, China, <sup>3</sup> School of Electronic Commerce, Zhejiang Business College, Hangzhou, China, <sup>4</sup> Jinhua Advanced Research Institute, Jinhua, China

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Hu Jian,  
Jiangxi University of Finance and  
Economics, China  
Guohua Zhang,  
Wenzhou Medical University, China

### \*Correspondence:

Weilong Xiao  
xwl743@163.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 23 March 2022

**Accepted:** 20 June 2022

**Published:** 13 July 2022

### Citation:

Li X, Li W, Liu M, Xiao W and Zhou H  
(2022) How Does Shyness Affect  
Chinese College Students' Tendency  
to Mobile Phone Addiction? Testing  
the Mediating Roles of Social Anxiety  
and Self-Control.  
*Front. Public Health* 10:902425.  
doi: 10.3389/fpubh.2022.902425

**Background and Aims:** Mobile phone addiction among college students has gained considerable research attention because of its adverse effects on their health and academic performance. However, little is known about the mechanisms underlying the relationship between shyness and mobile phone addiction among college students.

**Methods:** Four questionnaires were used to examine whether mobile phone addiction tendency was predicted by shyness and the mediating roles of social anxiety and self-control among 3,189 Chinese college students. Correlation and mediation analyses were conducted using Hayes PROCESS.

**Results:** The results showed that (1) social anxiety (indirect effect = 0.22, 95% CI = 0.18–0.26) and self-control (indirect effect = 0.23, 95% CI = 0.21–0.25) played a partial mediating role in the relationship between shyness and mobile phone addiction tendency; (2) social anxiety and self-control also mediated the link between shyness and mobile phone addiction tendency sequentially (indirect effect = 0.10, 95% CI = 0.09 to 0.12).

**Conclusion:** These results suggest that mobile phone addiction among shy college students could be eliminated by alleviating social anxiety and strengthening self-control.

**Keywords:** college students, shyness, social anxiety, self-control, mobile phone addiction tendency

## INTRODUCTION

Adolescents and youth are major forces that will make the world better in the future. However, they face serious problems, such as mobile phone addiction. Globally, there is a high incidence of mobile phone addiction among adolescents (1). One survey showed that the prevalence of problematic mobile phone use or addiction is between 10% and 31% in British and Korean adolescents, respectively (2). In China, the prevalence of problematic phone use ranges between 15 and 30% (3). Mobile phone addiction/excessive usage of mobile phones could lead to depression (4), academic difficulties (5), and poor creativity and productivity (6, 7). Therefore, understanding the mechanisms underlying mobile phone addiction may be significant for college students who are trying to quit mobile phone addiction.

Shyness is the tendency to feel nervous, worried, or embarrassed in the presence of others because of the fear of feeling judged by others in interpersonal interactions (8, 9). In previous

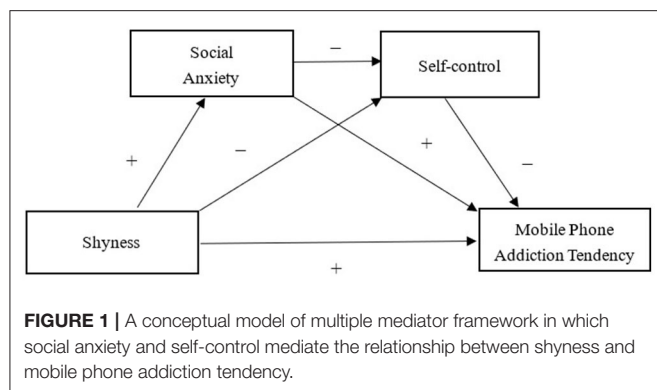
research, there were two types of studies: First, some studies distinguish shyness when an individual's score on the scale exceeds a certain point, and the individual could be considered shy (9). Moreover, other studies explored the relationship between mobile phone addiction and different levels of shyness (8, 10). These studies did not distinguish the standard by which scores should be regarded as shy individuals and suggested that shyness is a property. Further, they stated that higher scores indicated a higher level of shyness. In this study, we selected the second condition. Individuals with shy properties have numerous disadvantages compared to others. They tend to pick up negative emotions (e.g., loneliness and depression) and are more likely to evaluate themselves negatively (11). Furthermore, shy people usually have decreased social interaction and weaker social ties (12), which could lead to difficulties in life and work. All these negative emotions and real-life difficulties caused by shyness could lead to mobile phone addiction (8). Compensatory Internet Use Theory posits that people turn to the internet or smartphones to escape pain when they encounter psychosocial problems in the real world (13). According to this theory, individuals with a shy property are more likely to relieve their negative emotions and satisfy their need for socialization by using the internet and mobile phones, which provide a social networking environment without face-to-face communication (13, 14). Furthermore, some studies have investigated the relationship between shyness and mobile phone addiction and found that shyness is a potential factor in mobile phone addiction (8, 10, 12). For example, Tian et al. found that problematic mobile phone use could be positively predicted by shyness in a sample of 1,621 undergraduate students (10). Based on the theory and results of empirical studies, this study hypothesizes that mobile phone addiction tendency is significantly and positively predicted by shyness.

Social anxiety may mediate the relationship between shyness and mobile phone addiction. Social anxiety is a common human experience characterized by an intense fear of evaluation from others in social situations (15). Everyone has social needs. Shy individuals also have the motivation to interact with others, but they spend much time monitoring their feelings and behaviors during social interactions, worrying about making a bad impression on others; thus, their normal social needs cannot be satisfied (16). These contradictory results may lead to social anxiety (17). To relieve social anxiety, shy individuals indulge in the online world to satisfy their normal social needs. According to the cognitive model of social phobia (18, 19), individuals with social anxiety generally exhibit negative thinking patterns and are more likely to view neutral social cues as negative signs. This may explain why shy people are vulnerable to anxiety in face-to-face social situations. The internet and mobile phones provide socially anxious people with an ideal tool to alleviate anxiety by creating a less intimate circumstance than that of face-to-face interactions and allowing anxious individuals to escape from personal interactions and immediate responses (20). Research has shown that, compared to others, socially anxious people prefer online social interactions and are more vulnerable to mobile phone addiction (21, 22). For instance, Caplan found that problematic mobile phone use positively correlates with social anxiety (21). Based on the theory and empirical evidence,

this study proposes that social anxiety mediates the relationship between shyness and mobile phone addiction.

In addition, the relationship between shyness and mobile phone addiction may be mediated by self-control. Hagger et al. suggest that self-control is an individual's ability to consciously control impulsive behaviors and resist satisfying immediate needs and desires (23). Previous studies have shown that shyness is negatively correlated with self-control (24, 25), and mobile phone addiction can be negatively predicted by self-control (26). Furthermore, Li et al. found that the relationship between loneliness and mobile phone addiction was mediated by self-control. Shyness and loneliness are both negative emotions in nature and should be regarded as predisposing factors to addictive behaviors (26). The reward model of self-control posits that an imbalance between obtaining rewards and exerting effort often leads to decreased self-control (27). On the one hand, individuals with shyness should exert effort to restrain negative emotions in social situations; on the other hand, the outcome of social interaction is often not ideal. The imbalance between the effort they put in and the outcome they received would cause them to have negative emotional problems (28), which leads to decreased self-control. Therefore, this study hypothesized that the relationship between shyness and mobile phone addiction tendency was mediated by self-control.

Furthermore, the relationship between shyness and mobile phone addiction could not only be mediated by social anxiety and self-control but also by them sequentially. As an effective and verified theoretical framework for explaining the development of online addictive behaviors, the Interaction of Person-Affect-Cognition-Execution (I-PACE) model was chosen as the framework for this study. The model explains not only why social anxiety and self-control could mediate the relationship between shyness and mobile phone addiction tendency but also why shyness and mobile phone addiction tendency could be sequentially mediated by social anxiety and self-control. The model posits that addictive behaviors are the result of interactions between predisposing factors, mediators (e.g., affective and cognitive responses), and execution (e.g., coping styles) (29). In this study, shyness was considered a predisposing variable. Social anxiety was included as an affective variable, and self-control was considered a cognitive variable. In this study, shyness was a predisposing variable that could lead to addictive behavior. Social anxiety was considered an affective variable, and self-control was included as a cognitive variable. Specifically, shy individuals have the intention and motivation to communicate with others. However, they spend much time focusing on negative emotions and worrying about making a bad impression on others, leading to social anxiety (17, 30). Self-control can also be affected by social anxiety (8). The limited resources of self-control theory posit that individuals' self-control strength depends on limited resources, and all self-control behaviors (including emotion regulation, mind control, and decision-making) consume the same resources (31). The depletion of self-control resources in some areas leads to a decline in self-control ability (32). One recent study showed that individuals with social anxiety risk poor self-control after social interaction (33). A decline in self-control has been linked to mobile phone addiction (34). Based on the



theory of the I-PACE model and empirical evidence, this study hypothesized that the relationship between shyness and mobile phone addiction tendency could be sequentially mediated by social anxiety and self-control.

## THE PRESENT STUDY

This study aimed to explore the mechanisms underlying the relationship between shyness and mobile phone addiction. Based on these theories and empirical evidence, this study hypothesized that the relationship between shyness and mobile phone addiction could be mediated by social anxiety and self-control in a parallel and sequential manner. The hypothesized model is illustrated in **Figure 1**. The specific assumptions are as follows.

H1: The tendency to mobile phone addiction was significantly and positively predicted by shyness.

H2: Social anxiety mediates the relationship between shyness and mobile phone addiction tendency.

H3: The relationship between shyness and mobile phone addiction is mediated by self-control.

H4: The relationship between shyness and mobile phone addiction tendency is mediated by social anxiety and self-control sequentially.

## MATERIALS AND METHODS

### Procedures and Participants

This study used an internet survey to collect data. Before the survey, all participants were informed that the study was conducted anonymously and that their information would be kept confidential. Informed consent was provided in class. The questionnaire link was then sent to participants through the SO JUMP platform, which was used to collect responses and store data. Finally, all of the data were imported into SPSS for further analyses.

The initial sample consisted of 3,606 college students. However, 417 participants who provided incomplete responses were excluded, resulting in 3,189 valid samples for analysis (response rate: 88%), with 1,994 male (62.5%) and 1,195 (37.5%) female respondents. Among them, 1,980 were from the countryside (62.1%). An important inclusion criterion for

participant selection was that the mobile phone addiction tendency score was  $\geq 1$ . These participants were from eight majors, including pedagogy, economics, and business administration. The sample included 1,350 freshmen, 925 sophomores, 531 juniors, and 383 seniors. Their average age was 19 years ( $SD = 3.70$ ). A total of 1,980 (62.1%) participants were from rural areas, whereas 1,209 (37.9%) were from urban areas. Furthermore, 1,032 (32.4%) participants were from one-child families, whereas 2,157 (67.6%) had siblings. The participants had been using smartphones for an average of 6 years.

## Measures

### Shyness

Shyness was measured using the revised Cheek and Buss Shyness Scale (35). This tool includes two dimensions (i.e., shyness and sociability) and 13 items (e.g., I am often uncomfortable at parties and other social functions). Respondents were asked to rank their agreement using a five-point Likert scale, namely, “1” = “strongly disagree” and “5” = “strongly agree.” Scores on the 13-item scale ranged from 13 (lowest shyness) to 65 (highest shyness). Higher scores reflected higher levels of shyness. In this study, Cronbach’s alpha for the scale was 0.85. The results of CFA showed that  $\chi^2/df = 2.109$ , CFI = 0.999, AGFI = 0.991, TLI = 0.996, RMSEA = 0.019 (90% CI = 0.012, 0.025), indicating good validity.

### Social Anxiety

Social anxiety was measured using the short form of social anxiety revised by Wang et al. (36), which includes only one dimension and consists of six items (e.g., “Ignored when in a group”). All items are scored on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The higher the score, the more severe was the social anxiety. In this study, Cronbach’s alpha for the scale was 0.86. The results of the CFA showed  $\chi^2/df = 2.959$ , CFI = 1.000, AGFI = 0.994, TLI = 0.997, RMSEA = 0.025 (90% CI = 0.000, 0.049), which indicated good validity in this study.

### Self-Control

This study used the Chinese version of the Self-control Scale (SCS) compiled by Tangney et al. (37) to measure self-control. The scale includes 5 dimensions (i.e., impulse control, healthy habits, resisting temptation, focus on work, and limiting play) and 13 items (e.g., “I could resist temptation very well”). Respondents were asked to rank their agreement on a 5-point Likert scale (1 = not at all, 5 = very much), with higher scores indicating a higher level of self-control. In this study, the internal consistency coefficient of the scale was 0.81. The results of the CFA showed that  $\chi^2/df = 2.863$ , CFI = 0.998, AGFI = 0.987, TLI = 0.990, RMSEA = 0.024 (90% CI = 0.015, 0.033), indicating good validity in this study.

### Mobile Phone Addiction Tendency

This study used the MPAAI scale designed by Leung (38) to measure mobile phone addiction tendencies. It includes four factors (i.e., Inability to Control Craving, Feeling Anxious & Lost, Withdrawal/Escape, and Productivity Loss) and consists of 17 items (e.g., “You find it difficult to switch off your mobile phone”), with response options ranging from 1 (not at all) to 5



**TABLE 1 |** Confirmatory factor analysis.

Model	$\chi^2(df)$	$\chi^2/df$	$\Delta\chi^2$	RMSEA	CFI	TLI	SRMR
4-factor model <sup>a</sup>	5260.00 (1056)	4.981		0.035	0.951	0.946	0.042
3-factor model <sup>b</sup>	7828.00 (1059)	7.391	2568.01***	0.045	0.921	0.913	0.051
2-factor model <sup>c</sup>	9178.66 (1061)	8.651	3918.67***	0.049	0.906	0.895	0.056
1-factor model <sup>d</sup>	11796.38 (1062)	11.108	6536.39***	0.056	0.875	0.862	0.064

*N* = 3,189.

<sup>a</sup>Hypothesized 4-factor model.

<sup>b</sup>Combining SC and SA into one factor.

<sup>c</sup>Combining Shy, SC, SA into one factor.

<sup>d</sup>All factors were combined into a single factor. \*\*\**p* < 0.001.

(always). Higher scores indicate a higher level of mobile phone addiction. The internal consistency coefficient of the scale is 0.92. The results of the CFA showed  $\chi^2/df = 3.572$ , CFI = 0.996, AGFI = 0.980, TLI = 0.988, RMSEA = 0.028 (90% CI = 0.024, 0.033), indicating good validity.

## Statistical Analysis

All analyses were conducted using SPSS 21.0. First, we show the results of the descriptive statistics and then calculate the correlation coefficients among these variables. Second, Model 4 (process macro for SPSS) was used to conduct a mediation analysis of social anxiety and self-control in the relationship between shyness and mobile phone addiction. Third, Model 6 (process macro for SPSS) was used to conduct a sequential mediation analysis of social anxiety and self-control in the relationship between shyness and mobile phone addiction.

## Confirmatory Factor Analysis

We used Mplus 8.0 to conduct a confirmatory factor analysis (CFA) of our focal variables to verify discriminant validity. We compared the hypothesized four-factor model to several alternative models. The results of the chi-square difference test indicated that the four-factor model (Shy, SC, SA, and MP) displayed a significantly better model fit ( $\chi^2/df = 4.981$ , RMSEA = 0.035, CFI = 0.951, TLI = 0.946, SRMR = 0.042) than the alternative models (see **Table 1**), suggesting that our measures had desirable discriminant validity. According to Podsakoff et al., the single-factor model displayed the worst fit, indicating no severe common method biases.

## RESULTS

### Common Method Biases

A common variance analysis was applied to the four questionnaires through factor analysis. The chi-square statistic of Bartlett's test of sphericity is significant. After principal component analysis, nine eigenvalues >1 were extracted. The first factor explaining the variance was 31.75%, less than the 40% required by the critical standard (39), indicating that the questionnaires used in this study had no significant common method bias.

### Descriptive Statistics and Correlation Analysis

The descriptive statistics and correlation coefficients among these variables are shown in **Table 2**. The results showed that

**TABLE 2 |** Descriptive statistics and correlation matrix of all variables.

Variables	M	SD	1	2	3	4	5
Age	19.00	3.70	–				
Shyness	2.47	0.64	0.01	–			
Social anxiety	1.94	0.81	–0.02	0.70**	–		
Self-control	3.35	0.65	0.02	–0.47**	–0.52**	–	
MPAT	2.01	0.71	–0.01	0.50**	0.50**	–0.57**	–

*N* = 3,189. MPAT, Mobile Phone Addiction Tendency. \*\**p* < 0.01.

mobile phone addiction tendency was significantly and positively correlated with shyness ( $r = 0.50$ ,  $p < 0.01$ ) and social anxiety ( $r = 0.50$ ,  $p < 0.01$ ), and was significantly and negatively correlated with self-control ( $r = -0.57$ ,  $p < 0.01$ ).

### Mediating Effect of Social Anxiety

After controlling for age and sex, Model 4 (PROCESS macro for SPSS) was used to test H1 and H2. The results were shown in **Table 3** and showed that shyness was positively correlated with social anxiety ( $b = 0.90$ ,  $p < 0.001$ ), and social anxiety was positively related to mobile phone addiction tendency ( $b = 0.25$ ,  $p < 0.001$ ). The residual direct effect was also significant ( $b = 0.34$ ,  $p < 0.001$ ). This result indicates that social anxiety partially mediated the relationship between shyness and mobile phone addiction tendency (indirect effect = 0.22, 95% CI = 0.18–0.26), thereby supporting H2. This model accounted for 39.3% of the variance in mobile phone addiction.

### Mediating Effect of Self-Control

H3 was tested using the PROCESS macro for SPSS (Model 4) after controlling for age and sex. The results were shown in **Table 4** and showed self-control was negatively predicted by shyness ( $b = -0.48$ ,  $p < 0.001$ ), and mobile phone addiction tendency was negatively predicted by self-control ( $b = -0.47$ ,  $p < 0.001$ ). The residual direct effect was also significant ( $b = 0.33$ ,  $p < 0.001$ ). Thus, self-control also played a partial mediating role in the link between shyness and mobile phone addiction tendency (indirect effect = 0.23, 95% CI = 0.21–0.25), supporting H3. This model accounted for 41.1% of the variance in mobile phone addiction.

### Multiple Mediation Model

The results of multiple mediation analysis of social anxiety and self-control were shown in **Table 5**. After controlling for age and sex, Model 6 (PROCESS macro for SPSS) was used to test

**TABLE 3 |** Results of mediation analysis of social anxiety.

	M: SA			Y: MPAT		
	B	SE	95%CI	B	SE	95%CI
X: shyness	0.90***	0.02	0.86, 0.93	0.34***	0.02	0.29, 0.38
M: SA	–	–	–	0.25***	0.02	0.21, 0.28
age	–0.01	0.02	–0.04, 0.04	–0.01	0.00	–0.01, 0.00
gender	–0.01	0.02	–0.04, 0.04	–0.01	0.02	–0.05, 0.04
Constant	–0.17*	0.07	–0.32, –0.03	0.71***	0.08	0.57, 0.86
	$R^2 = 0.49$			$R^2 = 0.29$		
	$F_{(3,185)} = 1036.99***$			$F_{(4,184)} = 480.22***$		

SA, Social Anxiety; MPAT, Mobile Phone Addiction Tendency. \*\*\* $p < 0.001$ .

**TABLE 4 |** Results of mediation analysis of self-control.

	M: SC			Y: MPAT		
	B	SE	95%CI	B	SE	95%CI
X: shyness	–0.48***	0.02	–0.51, –0.45	0.33***	0.02	0.29, 0.37
M: SC	–	–	–	–0.47***	0.02	–0.51, –0.44
age	0.00	0.00	0.00, 0.01	0.00	0.00	–0.01, 0.01
gender	–0.01	0.02	–0.05, 0.03	–0.01	0.02	–0.05, 0.03
Constant	4.54***	0.05	4.44, 4.63	2.77***	0.10	2.58, 2.96
	$R^2 = 0.22$			$R^2 = 0.40$		
	$F_{(3,185)} = 304.02***$			$F_{(4,184)} = 525.50***$		

SC, Self-control; MPAT, Mobile Phone Addiction Tendency. \*\*\* $p < 0.001$ .

the multiple mediation model. The results showed the pathways for “shyness→ social anxiety→ mobile phone addiction tendency” (indirect effect = 0.10, 95% CI = 0.06–0.13). The pathways for “shyness→ self-control→ mobile phone addiction tendency” (indirect effect = 0.08, 95% CI = 0.07–0.10) were significant. These results indicate that social anxiety and self-control mediated the relationship between shyness and mobile phone addiction. The sequential pathway for “shyness→ social anxiety→ self-control→ mobile phone addiction tendency” was significant (indirect effect = 0.10, 95% CI = 0.09–0.12). Furthermore, the residual direct effect was significant ( $b = 0.24$ ,  $p < 0.001$ ). This result indicates that social anxiety and self-control partially mediated the relationship between shyness and mobile phone addiction tendency. This multiple mediation model explained a significant portion of the variation in mobile phone addiction tendencies ( $R^2 = 0.41$ ).

## DISCUSSION

This study found that mobile phone addiction tendency among college students could be positively predicted by shyness, supporting H1. The present finding was consistent with previous studies (10, 11). For example, the research conducted by Tian et al. found that shyness positively influences generalized pathological internet use. One possible explanation is that the internet provides shy people with a communication environment

that satisfies their social needs without the anxiety and discomfort associated with face-to-face communication (8).

This study found that social anxiety partially mediated the relationship between shyness and mobile phone addiction tendency, thereby supporting H2. The present finding was similar to previous studies (2, 40). One explanation for this result could be that shyness makes individuals addicted to mobile phones through social anxiety. Shyness is a form of social withdrawal (41). Social motivation theory divides social withdrawal into three subtypes: shyness, unsociability, and social avoidance (42). Compared to individuals with unsociability and social avoidance, shy individuals have both high social approach motivation and social avoidance motivation, which results in the greatest psychological avoidance conflict among the three social withdrawal subtypes. On the one hand, shy individuals have a strong desire to communicate with others, but on the other hand, they often feel nervous in the face of communication. These contradictory results may lead to social anxiety. Another explanation could be that shy individuals cannot obtain an identity, leading to social anxiety. Adolescence is a critical period for acquiring identity (43). However, shy individuals have difficulties expressing themselves and understanding others, belonging to a group, and being approved by a group. Difficulties in acquiring identity may result in social anxiety. Many studies have shown that shyness is often associated with negative consequences of social adaptation (44). Shy individuals are prone to developing problems, such as low self-esteem and social

**TABLE 5 |** Testing the pathways of the multiple mediation model.

Effect	<i>B</i>	<i>SE</i>	95%CI	
<b>Direct effects</b>				
Shyness→ social anxiety	0.90***	0.02	0.86	0.93
Shyness→ self-control	−0.21***	0.02	−0.26	−0.17
Social anxiety→ self-control	−0.30***	0.02	−0.33	−0.27
Shyness→ mobile phone addiction tendency	0.24***	0.02	0.20	0.29
Social anxiety→ mobile phone addiction tendency	0.12***	0.02	0.08	0.15
Self-control→ mobile phone addiction tendency	−0.43***	0.02	−0.47	−0.40
<b>Indirect effects</b>				
Shyness→ social anxiety→ mobile phone addiction tendency	0.10	0.02	0.06	0.13
Shyness→ self-control→ mobile phone addiction tendency	0.08	0.01	0.07	0.10
Shyness→ social anxiety→ self-control→ mobile phone addiction tendency	0.10	0.01	0.09	0.12

*N* = 3,189. \*\*\**p* < 0.001.

anxiety (45). Shy individuals are more prone to using mobile phones to relieve social anxiety and satisfy normal social needs.

Furthermore, this study found that the relationship between shyness and mobile phone addiction tendency was mediated by self-control, thereby supporting H3. This finding is consistent with that of previous studies (2, 24). For instance, Han et al. found that low self-control mediated the impact of shyness on mobile phone addiction. One possible explanation is that shyness weakens self-control, which, in turn, leads to mobile phone addiction. According to the limited resource model of self-control (46), activities, such as emotional control, may lead to reduced self-control, resulting in problematic behaviors (47). Shy individuals are typically introverted and nervous. They usually adopt chronic and negative coping strategies, such as withdrawal and escapism, which lower self-control levels (48). Research has shown that low self-control levels lead to various behavioral problems and addictions (49, 50), including mobile phone addiction (51). According to theory and empirical evidence, the relationship between shyness and addiction to mobile phones was mediated by self-control.

The main result of this study was that social anxiety and self-control mediated the relationship between shyness and mobile phone addiction. This result was similar to that of previous studies (24, 40), which could be explained by the I-PACE model (29). This result suggests that shy individuals often experience high social anxiety levels that consume cognitive resources, thus impairing self-control (46) and eventually increasing the risk of mobile phone addiction (52). The I-PACE model posits that the occurrence and development of addictive behaviors result from predisposing variables, affective and cognitive responses

to specific stimuli, and executive function (29). In this study, shyness was a predisposing factor for mobile phone addiction (14), impairing individuals' affective and cognitive activities. In this study, individuals with shyness experienced social anxiety because they could not meet their normal social needs (45). Whereas, this negative feeling would consume resources used to control behavior, thus impairing their self-control and eventually leading to mobile phone addiction. The results of the multiple mediation model, therefore, support important explanatory mechanisms in which predisposing factors (e.g., shyness) could impair individuals' affective (social anxiety) and cognitive activity (self-control). The results of this study were conducted under the guidance of the I-PACE model, and the results supported the I-PACE model.

## IMPLICATIONS FOR PRACTICE

This study has both theoretical and practical implications. Theoretically, this study not only enriches related research in this field but also supports the I-PACE model, which posits that addictive behaviors are the consequence of predisposing variables (e.g., shyness), affective (e.g., social anxiety), and cognitive (self-control) responses to specific stimuli and executive functions. Practically, this study analyzed why shyness could affect mobile phone addiction tendencies. On the other hand, this study also provided some ways (i.e., alleviating social anxiety and strengthening self-control) to alleviate mobile phone addiction among shy college students. To help shy college students avoid the negative influence of mobile phone addiction, educators can offer courses on interpersonal communication to teach them how to communicate with others and reduce their social anxiety. Educators can also help shy college students eliminate mobile phone addiction by strengthening self-control. Self-control training can improve self-awareness and self-monitoring (53, 54), which is beneficial for reducing addictive behavior (55, 56).

## LIMITATIONS AND FUTURE DIRECTIONS

Some limitations of this study should be noted. First, it used a cross-sectional design, which limited the exploration of the causal relationship among these variables. Second, we did not perform a good sampling job. We chose convenient sampling, which could lead to systematic errors and make it difficult to generalize our research results. Therefore, future research should focus on participant sampling. Third, although this study investigated the mechanisms underlying the relationship between shyness and mobile phone addiction, we did not consider moderating variables that could mitigate the negative effect of shyness. These limitations should be addressed in future studies.

## CONCLUSION

This study explored the mechanism (i.e., the mediating roles of social anxiety and self-control) underlying the relationship between shyness and mobile phone addiction tendency based

on a sample of 3,189 Chinese college students. The results showed that social anxiety and self-control mediated the effect of shyness on mobile phone addiction tendency in a parallel and sequential manner. These results discuss some implications for helping shy college students overcome mobile phone addiction (e.g., alleviating social anxiety and strengthening self-control).

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Zhejiang Normal University. The patients/participants provided their written informed consent to participate in this study.

## REFERENCES

- López-Fernández O, Ma HS, Freixa-Blanxart M. Spanish adaptation of the "Mobile phone problem use scale" for adolescent population. *Adicciones*. (2012) 24:123–30. doi: 10.20882/adicciones.104
- Liu QQ, Yang XJ, Hu YT, Zhang CY, Nie YG. How and when is family dysfunction associated with adolescent mobile phone addiction? Testing a moderated mediation model. *Child Youth Serv Rev*. (2020) 111:1–9. doi: 10.1016/j.chilyouth.2020.104827
- Ma RZ, Meng HR, Yan LL. Cellphone-specific parenting practices and chinese adolescents' cellphone use and addiction: a national survey. *Stud Psychol Behav*. (2021) 19:265–272.
- Thomée S, Harenstam A, Hagberg M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults-A prospective cohort study. *BMC Public Health*. (2011) 11:66. doi: 10.1186/1471-2458-11-66
- Liu X, Luo Y, Liu ZZ, Yang Y, Liu J, Jia CX. Prolonged mobile phone use is associated with poor academic performance in adolescents. *Cyber Psychol Behav*. (2020) 23:303–11. doi: 10.1089/cyber.2019.0591
- Calvert SL, Valkenburg PM. The influence of television, video games, and the internet on children's creativity. In: *Oxford Handbook of the Development of Imagination*. (2013). doi: 10.1093/oxfordhb/9780195395761.013.0028
- Ztürk M, Sarikaya S. The relationship between the mathematical reasoning skills and video game addiction of Turkish middle schools' students: a serial mediator model. *Think Skills Creat*. (2021) 40:1–11. doi: 10.1016/j.tsc.2021.100843
- Han L, Geng J, Jou M. Relationship between shyness and mobile phone addiction in Chinese young adults: mediating roles of self-control and attachment anxiety. *Comput Hum Behav*. (2017) 76:363–71. doi: 10.1016/j.chb.2017.07.036
- Cheek JM, Buss AH. Shyness and sociability. *J Pers Soc Psychol*. (1981) 41:330–9. doi: 10.1037/0022-3514.41.2.330
- Tian Y, Si YD, Meng WX, Gao FQ. Mediating factors of the association between shyness and generalized pathological internet use in Chinese university students. *Int J Ment Health Ad*. (2018) 17:1–18. doi: 10.1007/s11469-018-9979-4
- Iranmanesh M, Foroughi B, Nikbin D, Hyun SS. Shyness, self-esteem, and loneliness as causes of fa: the moderating effect of low self-control. *Curr Psychol*. (2019) 1:1–12. doi: 10.1007/s12144-019-00465-w
- Roberts LD, Smith LM, Pollock CM. "U ra lot bolder on the net": shyness and Internet use. In: Crozier WR, editor. *Shyness: Development, Consolidation and Change*. New York, NY: Routledge Farmer (2000). p. 121–38.

## AUTHOR CONTRIBUTIONS

Conceptualization: WX and WL. Methodology and writing—original draft preparation: XL. Validation: ML and HZ. Resources: WL. Writing—review and editing: XL and WX. Supervision: ML, WL, and HZ. All authors contributed to the article and approved the submitted version.

## FUNDING

This project was supported by Open Research Fund of College of Teacher Education, Zhejiang Normal University (No. jykf22040) and Party Building and Ideological and Political Education Research Institute, Zhejiang Business College (No. SZY\_SZ202210).

## ACKNOWLEDGMENTS

The authors thank the subjects who participated in the study.

- Kardefelt-Winther D. A conceptual and methodological critique of internet addiction research: towards a model of compensatory internet use. *Comput Hum Behav*. (2014) 31:351–4. doi: 10.1016/j.chb.2013.10.059
- Caplan SE. Problematic Internet use and psychosocial well-being: development of a theory-based cognitive-behavioral measurement instrument. *Comput Hum Behav*. (2002) 18:553–75. doi: 10.1016/S0747-5632(02)00004-3
- Morrison AS, Heimberg RG. Social anxiety and social anxiety disorder. *Annu Rev Clin Psycho*. (2013) 9:249–74. doi: 10.1146/annurev-clinpsy-050212-185631
- Crozier R. Shyness as a dimension of personality. *Br J Soc Clin Psychol*. (1979) 18:121–8. doi: 10.1111/j.2044-8260.1979.tb00314.x
- Blte AW, Miers AC, Bos E, Westenberg PM. Negative social self-cognitions: how shyness may lead to social anxiety. *J Appl Dev Psychol*. (2019) 63:9–15. doi: 10.1016/j.appdev.2019.05.003
- Clark DM, Wells A. A cognitive model of social phobia. In: Heimberg R, Liebowitz M, Hope DA, Schneier FR, editors. *Social Phobia: Diagnosis, Assessment and Treatment*. New York, NY: Guilford Press (1995). p. 69–93.
- Shalom JG, Israeli H, Markovitzky O, Lipsitz JD. Social anxiety and physiological arousal during computer mediated vs. face-to-face communication. *Comput Hum Behav*. (2015) 44:202–8. doi: 10.1016/j.chb.2014.11.056
- Lee YK, Chang CT, Lin Y, Cheng ZH. The dark side of smartphone usage: psychological traits, compulsive behavior and technostress. *Comput Hum Behav*. (2014) 31:373–83. doi: 10.1016/j.chb.2013.10.047
- Caplan SE. Relations among loneliness, social anxiety, and problematic Internet use. *Cyberpsychol Behav Soc Netw*. (2006) 10:234–2. doi: 10.1089/cpb.2006.9963
- Sapacz M, Rockman G, Clark J. Are we addicted to our cell phones? *Comput Hum Behav*. (2016) 57:153–9. doi: 10.1016/j.chb.2015.12.004
- Hagger MS, Wood C, Stiff C, Chatzisarantis NLD. Ego depletion and the strength model of self-control: a meta-analysis. *Psychol Bull*. (2010) 136:495–525. doi: 10.1037/a0019486
- Han L, Dou FF, Zhu SS, Xue WW, Gao FQ. Relationship between shyness and aggression: the mediating role of being bullied and self-control. *Chin J Clin Psychol*. (2016) 24:81–5. doi: 10.16128/j.cnki.1005-3611.2016.01.019
- Xu Y, Zhou Y, Zhao J, Xuan Z, Liu H. The relationship between shyness and aggression in late childhood: the multiple mediation effects of parent-child conflict and self-control. *Pers Individ Differ*. (2021) 182:1–10. doi: 10.1016/j.paid.2021.111058
- Li XW, Feng XC, Xiao WL, Zhou H. Loneliness and mobile phone addiction among Chinese college students: the mediating roles of boredom



- prone to self-control. *Psychol Res Behav Manag.* (2021) 14:687–94. doi: 10.2147/PRBM.S315879
27. Shenhav A, Botvinick MM, Cohen JD. The expected value of control: an integrative theory of anterior cingulate cortex function. *Neuron.* (2013) 79:217–40. doi: 10.1016/j.neuron.2013.07.007
  28. Gao FQ, Xue WW, Han L, Ren YQ, Xu L. Shyness and aggression: multiple mediating of self-esteem stability and paranoid. *Chin J Clin Psycholgy.* (2016) 24:721–3. doi: 10.16128/j.cnki.1005-3611.2016.04.033
  29. Brand M, Young K, Laier C, WoLfling K, Potenza MN. Integrating psychological and neurobiological considerations regarding the development and maintenance of specific internet-use disorders: an interaction of person-affect-cognition-execution (I-PACE) model. *Neurosci Biobehav R.* (2016) 71:252–66. doi: 10.1016/j.neubiorev.2016.08.033
  30. Bruch MA, Rivet KM, Heimberg RG, Hunt A, McIntosh B. Shyness and sociography: additive and interactive relations in predicting interpersonal concerns. *J Pers.* (2010) 67:373–406. doi: 10.1111/1467-6494.00059
  31. Baumeister RF, Tice VDM. The Strength model of self-control. *Curr Dir Psychol Sci.* (2007) 16:351–5. doi: 10.1111/j.1467-8721.2007.00534.x
  32. Kashdan TB, Weeks JW, Savostyanova AA. Whether, how, and when social anxiety shapes positive experiences and events: a self-regulatory framework and treatment implications. *Clin Psychol Rev.* (2011) 31:786–99. doi: 10.1016/j.cpr.2011.03.012
  33. Blackhart GC, Williamson J, Nelson L. Social anxiety in relation to self-control depletion following social interactions. *J Soc Clin Psychol.* (2015) 34:747–73. doi: 10.1521/jscp.2015.34.9.747
  34. Khang H, Kim JK, Kim Y. Self-traits and motivations as antecedents of digital media flow and addiction: the Internet, mobile phones, and video games. *Comput Hum Behav.* (2013) 29:2416–24. doi: 10.1016/j.chb.2013.05.027
  35. Cheek JM. *The Revised Cheek and Buss Shyness Scale.* Wellesley, MA: Wellesley College (1983). doi: 10.1037/t05422-000
  36. Wang XD, Wang XL, Ma H. *Handbook of Mental Health Assessment.* Beijing: Chinese Mental Health Journal Press (1999).
  37. Tangney JP, Baumeister RF, Boone AL. High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *J Pers.* (2004) 72:271–324. doi: 10.1111/j.0022-3506.2004.00263.x
  38. Leung L. Impacts of Net-generation attributes, seductive properties of the Internet, and gratifications-obtained on Internet use. *Telematics Inform.* (2003) 20:107–29. doi: 10.1016/S0736-5853(02)00019-9
  39. Podsakoff PM, Mackenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol.* (2003) 88:879–903. doi: 10.1037/0021-9010.88.5.879
  40. Lenton-Brym AP, Santiago VA, Fredborg BK, Antony MM. Associations between social anxiety, depression, and use of mobile dating applications. *Cyberpsychol Behav Soc Netw.* (2020) 24:1–8. doi: 10.1089/cyber.2019.0561
  41. Crozier R. Shyness and self-esteem in middle childhood. *Br J Educ Psychol.* (2011) 65:85–95. doi: 10.1111/j.2044-8279.1995.tb01133.x
  42. Asendorpf JB. Beyond social withdrawal: shyness, unsociability, and peer avoidance. *Hum Dev.* (1990) 33:250–9. doi: 10.1159/000276522
  43. Oztunc M. Analysis of problematic mobile phone use, feelings of shyness and loneliness in accordance with several variables. *Proc Soc Behav Sci.* (2013) 106:456–66. doi: 10.1016/j.sbspro.2013.12.051
  44. Zimbardo PG. *Shyness: What It Is, What to Do About It.* Da Capo Press (1990).
  45. Henderson L, Gilbert P, Zimbardo P. Shyness, social anxiety, and social phobia. In: *Social Anxiety.* New York, NY: Academic Press (2014). p. 95–115. doi: 10.1016/B978-0-12-394427-6.00004-2
  46. Muraven M, Baumeister RF. Self-regulation and depletion of limited resources: does self-control resemble a muscle? *Psychol Bull.* (2000) 126:247–59. doi: 10.1037/0033-2909.126.2.247
  47. Luczynski KC, Hanley GP. Prevention of problem behavior by teaching functional communication and self-control skills to preschoolers. *J Appl Behav Anal.* (2013) 46:355–68. doi: 10.1002/jaba.44
  48. Han L, Ren Y, Chen Y, Jie Xu, Gao F. The impact of shyness on self-control: the multiple mediating effects of security and coping styles. *Chin J Special Educ.* (2016) 191:63–68.
  49. Dvorak RD, Simons JS, Wray TB. Alcohol use and problem severity: associations with dual systems of self-control. *J Stud Alcohol Drugs.* (2011) 72:678–84. doi: 10.15288/jsad.2011.72.678
  50. Özdemir Y, Kuzucu Y, Ak S. Depression, loneliness and Internet addiction: how important is low self-control? *Comput Hum Behav.* (2014) 34:284–90. doi: 10.1016/j.chb.2014.02.009
  51. Lee YJ, Park JH. The effect of use motives, self-control and social withdrawal on smartphone addiction. *J Digit Conver.* (2014) 12:459–65. doi: 10.14400/JDC.2014.12.8.459
  52. Jeong SH, Kim HJ, Yum JY, Hwang Y. What type of content are smartphone users addicted to? SNS vs. GAMEs. *Comput Hum Behav.* (2016) 54:10–7. doi: 10.1016/j.chb.2015.07.035
  53. Alberts H, Martijn C, Vries N. Fighting self-control failure: overcoming ego depletion by increasing self-awareness. *J Exp Soc Psychol.* (2011) 47:58–62. doi: 10.1016/j.jesp.2010.08.004
  54. Wan EW, Sternthal B. Regulating the effects of depletion through monitoring. *Pers Soc Psychol Bull.* (2008) 34:32–46. doi: 10.1177/0146167207306756
  55. Castine BR, Albein-Urios N, Lozano-Rojas O, Lozano-Rojas JM, Hohwy J, Verdejo-Garcia A. Self-awareness deficits associated with lower treatment motivation in cocaine addiction. *Am J Drug Alcohol Abuse.* (2019) 45:108–14. doi: 10.1080/00952990.2018.1511725
  56. Son M. Influence of self-awareness, other-awareness, and interpersonal relation competence on smartphone and internet addiction in nursing students. *J Korean Acad Psychiatr Ment Health Nurs.* (2018) 27:74–84. doi: 10.12934/jkpmhn.2018.27.1.74

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Li, Li, Liu, Xiao and Zhou. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



# Associations Between Academic Stress, Mental Distress, Academic Self-Disclosure to Parents and School Engagement in Hong Kong

Esther Pui Yung Chyu\* and Ji-Kang Chen

Department of Social Work, The Chinese University of Hong Kong, Hong Kong, Hong Kong SAR, China

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

### Reviewed by:

Kindy Yi Lam,  
Independent Researcher, Hong Kong,  
Hong Kong SAR, China  
Jianjiu Chen,  
Columbia University, United States

### \*Correspondence:

Esther Pui Yung Chyu  
estherchyu@yahoo.com

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

Received: 02 April 2022

Accepted: 13 June 2022

Published: 14 July 2022

### Citation:

Chyu EPY and Chen J-K (2022)  
Associations Between Academic  
Stress, Mental Distress, Academic  
Self-Disclosure to Parents and School  
Engagement in Hong Kong.  
Front. Psychiatry 13:911530.  
doi: 10.3389/fpsy.2022.911530

Numerous studies have indicated that academic stress is associated with various detrimental personal physical and emotional outcomes; however, relatively few studies have explored how academic stress affects adolescents' interactions with their significant others in families and schools, which are two important social systems for school-age adolescents. In addition, there are also few studies examining how academic stress influences adolescents' self-disclosure to parents and school engagement in East Asian districts particularly in Hong Kong, where the level of academic stress among adolescents is high. This study examines how academic stress affects mental distress, academic self-disclosure to parents and school engagement and explores gender differences in the risk for the outcomes of academic stress. One thousand and eight hundred and four students from eight secondary schools in Hong Kong participated in this study. The results indicate that academic stress has a significant association with all three outcomes, but the correlation with school engagement is positive, which is contrary to the findings of most previous studies. The possible reasons for such positive association are discussed. In addition, the model can be applied to both genders, but females are more susceptible to the detrimental outcomes of academic stress by suffering a higher level of mental distress. This study suggests that academic stress should be an important entry point to tackle adolescents' mental distress while interventions should be targeted at females who are experiencing a higher level of mental distress. In addition, in view of the significant associations between academic stress and self-disclosure to parents, as well as between academic stress and school engagement, suggestions are provided to families and schools on how to proactively provide support to those students who are experiencing academic stress.

**Keywords:** academic stress, mental distress, academic self-disclosure to parents, school engagement, Hong Kong

## INTRODUCTION

Academic stress is a growing and alarming threat to young people around the world (1). Research has indicated that adolescents across age groups, genders and cultural contexts are increasingly affected by academic stress (2–4). Empirical findings have also suggested that tremendous academic stress has detrimental impacts on mental wellbeing in young people, including somatic syndromes

(5–7), anxiety (3, 8, 9), depression (3, 8, 9), suicidal attempts (10, 11), and addictive habits (12, 13). However, the sample of most of these studies is college students, while high-school students are seldom included in previous studies to examine how academic stress affects their mental health. Although mental health issues among high-school students are well-documented in Hong Kong (14, 15), we are not sure whether these mental health problems are under the influence of academic stress. With this concern, the current study will examine how academic stress affects the level of mental distress among high-school students. The empirical findings of the present study can not only inform youth counselors about the effective way and entry point for handling mental distress among school-age students but also inform policy makers about the necessity of combating academic stress, as tremendous academic stress may have a great effect on students' mental wellbeing.

In addition, spillover theory and the ecology perspective inform us that emotional experiences in one setting will affect what happens in the other settings (16–18). Academic stress, one of the prominent sources of stress among school-age students, will likely affect adolescents' behavior in family and school settings, which are two primary contexts for personal development. However, there is a lack of findings showing how academic stress impacts school-age adolescents' behavior in school and family. In addition, theories and empirical studies have shown that there is a contrasting relationship between academic stress and school engagement in the Western context (19, 20), little is known how academic stress impacts one's involvement in school in East Asian societies, where the school context is quite different from Western societies in terms of school curriculum, teacher-student ratio, and class size. In sum, the primary goal of the current study is to provide observed evidence on the relationship between academic stress and high school students' mental health, interaction with parents and school engagement. In addition, the effect of gender is also examined to determine which gender is at a greater risk of the effects of academic stress.

## LITERATURE REVIEW

### Academic Stress and Mental Distress

Research findings have indicated that academic stress is strongly associated with poor academic performance and procrastination (21, 22), physical illness (5–7), symptoms of mental distress (3, 8, 9, 23–25), suicidal ideations and attempts (10, 11), and addictive behaviors (12, 13). Among these detrimental outcomes, mental distress has received a great deal of attention from researchers and youth counselors. According to the World Health Organization, an estimated 20% of adolescents worldwide experience mental health problems (26). Empirical studies have indicated that academic stress is strongly associated with mental health issues, irrespective of the geographic locations or courses of study (3, 27, 28). However, the samples in most of these studies were college students or undergraduates who were studying a specific subject, such as medicine, or in a specific form, such as college freshmen (8, 29, 30). In Hong Kong, a few studies have examined how academic stress triggers anxiety in elementary students (31, 32). Surprisingly, adolescents in high schools are

underresearched in previous studies, particularly in Hong Kong. In addition, relatively few studies have investigated how academic stress among adolescents in high schools impacts their mental wellbeing. Adolescence, described as a period of “storm and stress” (33), is a period during which individuals are particularly vulnerable to academic stress (27). Their identity and values are somehow defined by their academic achievement, particularly through the evaluation and comments from their significant others, such as parents and teachers (34, 35). In Chinese culture, families tend to place a strong emphasis on academic excellence and regard academic achievement as one of the few avenues for upward mobility and bring honor to one's family (36, 37). In addition, children are socialized to be hypersensitive to the judgment of others, especially superiors such as parents and teachers. Therefore, in the context of academic stress, Asian students tend to put pressure on themselves to excel academically, and they also strive hard to meet the academic expectations of significant others, such as parents and teachers (38, 39). Hence, when compared to their counterparts in the West, students in Hong Kong are more susceptible to academic stress triggered by high expectation from family and teachers or from themselves who are striving to satisfy their parents' educational aspiration (38, 39). On the other hand, unlike college students who have almost secured a university degree, high school students in Hong Kong are facing an exit certificate examination; they may consider this period a critical juncture or fateful moment in their life, and it is of great importance to define their future (27). Consequently, adolescents in high schools have more opportunities to be exposed to academic stress and are more susceptible to its detrimental effects on their mental health. However, few studies have provided empirical evidence of how academic stress impacts mental distress in adolescents. Based on previous research, this study hypothesizes that students experiencing academic stress are more likely to develop mental distress.

### Academic Stress and Its Spillover Effects to Other Social Systems

The ecological perspective advises that the social systems of adolescents are interconnected (18). The emotional experiences of high school students may inevitably affect and shape their behaviors in other social settings. The process by which experience in one setting influence behavior or experiences in other contexts is often referred to as spillover (16). The concept of spillover has been widely adopted to explain the linkages between work stress and family experience. For example, a man who is experiencing overwhelming work-related stress may exhaust his energy dealing with that stress and be unable to focus or pay attention, which may adversely affect the frequency and quality of his interactions with his family members (16, 17). Although the concept of spillover offers a useful framework to examine the association between work stress and family experiences, it is rarely applied to examine how academic stress impacts the behaviors of high school students in their other social settings. To the best of our knowledge, the current study is one of the first to examine how academic stress affects interaction and engagement in family and school, which are the two primary contexts for their personal development. The findings of this study can not only

provide empirical evidence of whether spillover theory can be applied in academic stress but also enrich theoretical knowledge about the effects of academic stress.

### Academic Self-Disclosure to Parents

Academic self-disclosure to parents refers to the verbal communication of their thoughts, feelings and experiences in academic areas by adolescents to their parents (40, 41). Self-disclosure, denoting one's willingness and actual behavior in communication, is an imperative basis for family interaction (42). In addition, adolescents' academic self-disclosure to parents plays an important role in allowing parents to have the information they need in a timely manner, enabling them to provide support and guidance to their children who are experiencing academic stress (42). In contrast, low level self-disclosure with parents may impede parents from knowing the academic difficulties that their children are facing (40). A question is what leads adolescents to not disclose their academic difficulties to their parents. Objective self-awareness theory explains that a negative mood caused by a discrepancy between the perceived standard and individual performance may foster withdrawal and inhibit disclosure (41). In addition, uncertainty is regarded as an important emotion governing self-disclosure (43). When adolescents feel vulnerable and anxious about the possible response on the part of the listener, the chance of self-disclosure is reduced (43). In other words, academic stress, a negative emotional state of adolescents, may induce hesitation and worry, which may in turn inhibit self-disclosure. In addition, when overwhelming academic stress accumulates to the point of burnout, students may become withdrawn and passive to disclose their academic issues to their significant others, including their parents (2, 44). Although the above theory suggests that academic stress may influence the level of academic self-disclosure to parents, to the best of our knowledge, no study has provided empirical evidence showing whether academic stress affects self-disclosure to parents. Based on the literature, this study hypothesizes that academic stress is negatively associated with adolescents' academic self-disclosure to parents.

### School Engagement

School engagement describes students' participation and involvement in the school setting. Although there are different definitions, researchers generally agree that school engagement is a multidimensional construct that is usually composed of three components (45), (1) cognitive engagement, which refers to students' investment in schoolwork, as well as their thoughtfulness, willingness to learn and willingness to make the necessary effort while studying; (2) emotional engagement, which refers to students' enjoyment of and interest in school-related challenges and their emotional reactions to their teachers and classmates; and (3) behavioral engagement, which refers to students' presence at school and compliance with school discipline rules (45). Studies on school engagement have consistently shown that engagement in high school brings favorable outcomes, including better academic achievement, positive teacher-student relationships, healthy psychological wellbeing, and even long-term positive benefits, such as better job opportunities and greater life satisfaction (46). In contrast,

low engagement in school is associated with school dropout, a lack of motivation to learn and psychological distress (47).

Self-determination theory argues that the satisfaction of three basic psychological needs, i.e., competency, autonomy and relatedness, is essential for maintaining intrinsic motivation, and such motivation can foster participation and engagement in social systems (48, 49). According to this theory and empirical findings, when students perceive a high level of stress in academics, they may experience a sense of failure in meeting academic demands. This may lead to feelings of incompetency, lack of confidence in their own ability to achieve academic success, and inability to connect with peers due to their own psychological distress. Thus, the three basic psychological needs are not satisfied. As a result, intrinsic motivation is inhibited, which may foster disengagement from school (19, 20, 49). The negative association between stress and school engagement was supported by several empirical studies conducted in the Western context (20). Nevertheless, the literature on stress posits that stress can have facilitative effects by motivating the individual to work hard to perform well in stressful situations if the stress level is still within the range in which coping remains possible (19). In other words, stress can have an activating effect, not only an inhibitory influence, on one's behavior and performance. A study has indicated that the more students report activating test anxiety, the greater they are engaged in school by paying more attention and participating more in lessons. In sum, these different empirical studies have contrasting predictions about how academic stress influences one's engagement in school. Most of these studies are conducted in Western societies, where the school system and context may vary substantially from those in East Asian countries with regard to the curriculum, class size and teacher-student ratio (46). Little is known about how academic stress affects school engagement in an East Asian context. Based on the literature, this study hypothesizes that academic stress is negatively associated with school engagement.

### Effect of Gender

According to the literature on stress, gender plays a crucial role in predicting stress and stress escalation. Although most studies have indicated that girls experience a higher level of academic stress (50, 51) and suffer more from the psychopathology associated with academic stress, the results of some studies have suggested that gender does not play a significant role in predicting stress and is not associated with academic stress (1, 52). In addition, some studies have indicated that girls used to have a higher level of school engagement than boys (53), particularly as reflected in behaviors such as punctuality and regularly doing homework, which have traditionally been considered female characteristics (54). However, findings from one study suggested that test anxiety and stress have positive associations with school disengagement in both boys and girls (20). To extend our knowledge of how gender influences the connections between academic stress and its outcomes, a gender comparison was conducted in this study. Such an examination can not only advance our theoretical knowledge but also provide evidence that can be used to identify high-risk groups, facilitating the implementation of targeted prevention programs.



## CURRENT STUDY

### Participants

The data used in this study were collected from secondary 4–6 (grades 10–12) students from eight secondary schools in Hong Kong. Convenience sampling strategies were adopted in this study to obtain the data. Although the sample is not strictly representative, the participating schools have covered different bandings, denoting various academic performances, and across different districts in Hong Kong, implying that the students come from different families with different social economic statuses. A total of 2072 secondary 4–6 students were invited to participate in the research, while 258 students or their parents (12.5%) did not give consent to take part. Finally, a total of 1,814 students successfully participated. Ten questionnaires were excluded because they were returned incomplete. As a result, the final data set consisted of 1,804 entries. Of the sample, 789 (43.8%) were boys, 1,012 (56.2%) were girls, and three did not indicate their gender. The grade-level distribution was as follows: 710 (39.4%) students were in secondary 4 (grade 10), 716 (39.7%) students were in secondary 5 (grade 11) and 378 (20.9%) students were in secondary 6 (grade 12).

### Procedure

To assess the adequacy of the scales and ascertain the reliability and validity of the measurement and to test how far the sample can understand the questions, a pilot test was conducted while a total of 124 secondary 4–6 (grades 10–12) students participating. Exploratory factor analysis using the data collected in the pilot test was conducted. The factor loadings of the individual items for each latent variable were generally adequate except for one item from the scale of academic self-disclosure to parents; thus, the item was deleted after the pilot test.

The researchers have conducted a briefing to class-teachers who then helped to deliver a self-administered anonymous survey in the classroom. The students were informed of the background of the study, and they were encouraged to respond truthfully. The questionnaire included 65 items asking about the participants' demographic information and their personal experiences in the school and the family. The survey took approximately 20 min to complete. Written consent was obtained from both students and their parents or guardians before the survey was administered. They were informed that their participation was entirely voluntary, and they were free to withdraw from the study at any time and for any reason. The questionnaire, the related procedures, the informed consent forms and the compliance with ethical practices were reviewed and supervised by the university with which the authors are affiliated.

### Measures

#### Gender

The students were asked to indicate whether they were male or female.

#### Demographic Information

The students were asked to report their demographic background across ten items, including the year of education, age, parents' highest level of educational attainment, occupational background

of parents, living arrangements of the family, family financial situation and their academic ranking in the class in the last semester.

### Academic Stress

In the East Asian context, academic stress is mostly conceptualized as academic expectation stress, in which expectations come from parents, teachers and students themselves (39, 55). In addition, frequent comparisons and excessive demands are the other two dimensions of academic stress (56, 57) that are suggested in the literature. Hence, based on the literature and findings of previous studies, academic stress in this study is first operationalized with five dimensions, namely, academic expectation stress from parents, academic expectation stress from teachers, academic expectation stress from students themselves, frequent comparisons, and excessive demands. Items measuring these five dimensions were from various validated inventories (57–59) and were compiled as the initial scale of academic stress for this study. However, the result of an exploratory factor analysis indicated that there were four indicators of the variable instead of five. The items measuring “frequent comparisons” were finally incorporated into the indicator of “academic expectation stress from students themselves”, while the indicator of “excessive demands” remained even though its factor loading was slightly low.

Based on the findings of the pilot test, seventeen items were used to assess academic stress. These items asked students about their actual feelings regarding different descriptions. The items were rated on a 5-point Likert scale (“1 = totally disagree” to “5 = totally agree”). This latent variable consisted of four subscales with a total of 17 items. The first three subscales were academic expectations stress from parents (five items, factor loading = 0.71), academic expectations stress from teachers (three items, factor loading = 0.76) and academic expectations stress from the students themselves (six items, factor loading = 0.85). The fourth subscale was excessive demands (three items, factor loading = 0.46). All 17 items were selected from the inventories in research studies in Taiwan (47–49). The following are some sample questions: “I blame myself if I cannot meet my parents' academic expectations” (academic expectations stress from parents), “If I have a poor performance in school, I think my teachers are disappointed in me” (academic expectations stress from teachers), “If I cannot meet my own expectations, I am not good enough” (students' academic expectations stress) and “The assessments and examinations are too much for me, and I feel that they are unbearable” (excessive demands). The score for this scale was calculated by summing these 17 items, with a higher score indicating a higher level of academic stress. The Cronbach's alpha coefficient for these items was 0.919.

### Mental Distress

The items of this latent variable were derived from the Brief Symptom Rating Scale (BSRS). This scale is a Chinese inventory that was developed and validated by Taiwanese psychiatrists and is used as a screening tool to identify common mental health problems (60). The Brief Symptom Rating Scale has 50 items with ten subscales, measuring different mental distress symptoms, namely, somatization, obsession,

interpersonal sensitivity, depression, anxiety, hostility, phobia, paranoid, psychoticism and addiction. As depression, anxiety and somatization are common mental distress symptoms among adolescents, these three subscales were then selected to construct a latent variable of mental distress in this study. The item responses were given on a 5-point Likert scale (“1 = never” to “5 = very severe”). The three subscales are (1) depression (seven items, factor loading = 0.91), including the items “I feel lonely” and “I feel hopeless about the future”; (2) anxiety (seven items, factor loading = 0.95), including the items “I am scared” and “I feel unsettled and I cannot sit calmly”; and (3) somatization (five items, factor loading = 0.77), including the items “I feel that it is hard to breathe” and “I have chest pain.” The score for this scale was calculated by summing these 19 items, with a higher score indicating a higher level of mental distress. The Cronbach’s alpha coefficient for these items was 0.957.

### Academic Self-Disclosure to Parents

This variable was measured with five items that asked students about the extent to which they agreed with statements regarding academic self-disclosure to parents. The inventory was translated from the questionnaire developed by Kerr and Stattin (61). These five items were translated from English to Chinese to maintain a consistent language version of the questionnaire, and a standard back-translation procedure was employed to ensure accuracy. The original scale had six items, one of which was deleted after the pilot test because of its low factor loading. The responses to the items were given on a 5-point Likert scale (“1 = totally disagree” to “5 = totally agree”). The results of an exploratory factor analysis suggested that the scale was unidimensional. To build a robust latent structure for academic self-disclosure to parents, these five items were randomly placed into three parcels. The first parcel (factor loading = 0.93) included two items, i.e., “I can discuss my academic issues with my mother/father without feeling restrained or embarrassed” and “My parents try to understand my concerns and views regarding academics.” The second parcel (factor loading = 0.88) also included two items, i.e., “It is easy for me to express my true feelings about academics to my mother/father” and “My parents are good listeners.” The third parcel (factor loading = 0.84) had one item, i.e., “If I experienced academic difficulties, I would tell my mother/father.”

The score for this scale was calculated by summing these five items, with a higher score indicating a high level of academic self-disclosure to parents. The Cronbach’s alpha coefficient for these items was 0.917.

### School Engagement

This variable was measured with eight items that asked the students about their views and feelings regarding school engagement. The items were selected from an inventory developed in Taiwan (62). The inventory has 29 items measuring the three dimensions of school engagement, i.e., cognitive, affective and behavioral engagement. The criteria for item selection were based on factor loadings and the content of the items to ensure the scale’s reliability and validity. The responses to the items were given on a 5-point Likert scale (“1 = totally not met” to “5 = totally met”). The results of an exploratory factor analysis indicated that there were three factors: (1) cognitive engagement (two items, factor loading = 0.66), including the item “I will try different ways to understand the teacher’s lecture during class,” (2) affective engagement (three items, factor loading = 0.66), including the items “I am proud of my school” and “I feel relaxed when I interact with my teachers”; and (3) behavioral engagement (three items, factor loading = 0.54), including the items “I will actively participate in classroom discussions” and “I will take the initiative to ask questions.” The score for this scale was calculated by summing these eight items, with a higher score indicating a higher level of school engagement. The Cronbach’s alpha coefficient for these items was 0.831.

### Plan of Analysis

Descriptive analyses of the variables in this study were first conducted, followed by latent variable structural equation modeling (SEM) with maximum likelihood estimation using the AMOS program (version 27). Confirmatory factor analysis was first conducted to ensure that the measurement model had a good fit (63). Next, the SEM was tested with the full dataset. Cross-group SEM was applied to examine gender differences in the theoretical model. In this comparative analysis, all the factor loadings and the paths of the same model were constrained to be simultaneously equal across genders. Then, the model was

**TABLE 1 |** Descriptive statistics of the research variables.

**Means and standard deviations for each scale (standard deviations in parenthesis)**

	Overall	Gender	
		Male	Female
1. Academic stress <sup>a</sup>	57.76 (11.19)	55.14 (11.62)	59.80 (10.41)
2. Mental distress <sup>b</sup>	40.87 (16.99)	38.10 (15.56)	43.01 (17.74)
3. Academic self-disclosure to parents <sup>a</sup>	14.83 (4.80)	14.59 (4.75)	15.02 (4.84)
4. School engagement <sup>c</sup>	26.37 (4.88)	26.52 (4.93)	26.27 (4.93)

<sup>a</sup>On a scale: from 1 = “Strongly disagree” to 5 = “Strongly agree”.

<sup>b</sup>On a scale: from 1 = “Never” to 5 = “Very severe”.

<sup>c</sup>On a scale: from 1 = “Totally not met” to 5 = “Totally met”.

**TABLE 2 |** Intercorrelations between variables.

	1	2	3	4
1. Academic stress	–	0.459**	–0.090**	0.197**
2. Mental distress		–	–0.194**	–0.045
3. Academic self-disclosure to parents			–	0.238**
4. School engagement				–

\*\* $p < 0.01$ .

tested by releasing the path constraints to determine whether releasing the equality constraint could significantly improve the fit. The model fit was evaluated using SEM incremental fit indices, including the normed fit index (NFI), comparative fit index (CFI), incremental fit index (IFI) and root mean square error of approximation (RMSEA). Typically, an NFI, CFI and IFI above 0.95 and an RMSEA below 0.06 indicate that the model fits the data well (64–66). A number of demographic variables were added to the model as control variables before conducting the SEM analysis. They were family economic status, father's education level and mother's education level.

## RESULTS

### Descriptive Statistics

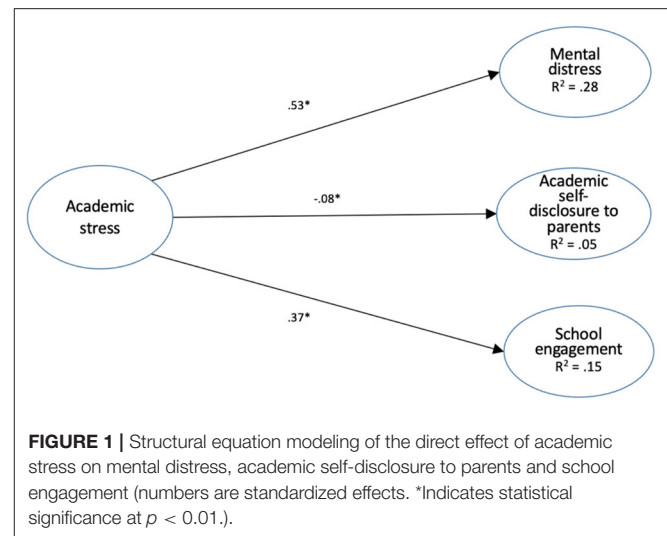
**Table 1** shows the descriptive statistics (means and standard deviations) of the study variables broken down by gender. **Table 2** shows the correlations among the four variables. All the variables are positively associated with each other except two, which are both related to academic self-disclosure to parents (academic stress,  $r = -0.090$ ,  $p < 0.01$ ; mental distress,  $r = -0.194$ ,  $p < 0.01$ ). Another negative but non-significant correlation was found between mental distress and school engagement. The strongest association was found between academic stress and mental distress ( $r = 0.459$ ,  $p < 0.01$ ). Two relatively strong associations were found related to school engagement (academic stress,  $r = 0.197$ ,  $p < 0.01$ ; academic self-disclosure to parents  $r = 0.238$ ,  $p < 0.01$ ).

### Overall Model

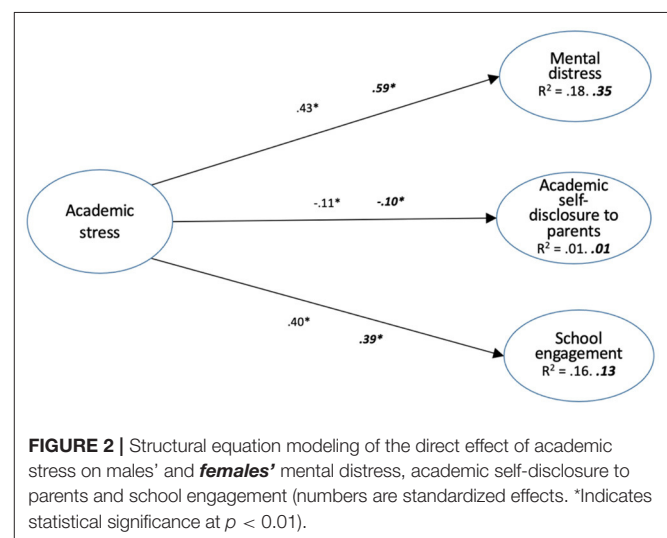
The results of the analysis based on the total sample indicated that the model was a good fit for the data [ $\chi^2_{(104, N=1,804)} = 705.757$ ,  $p < 0.001$ , with NFI = 0.947, CFI = 0.954, IFI = 0.954, and RMSEA = 0.06].

**Figure 1** shows the paths in the overall model. The three paths to the three endogenous variables were all significant: the path from academic stress to mental distress ( $\beta = 0.53$ ,  $p < 0.001$ ), the path from academic stress to academic self-disclosure to parents ( $\beta = -0.08$ ,  $p < 0.001$ ), and the path from academic stress to school engagement ( $\beta = 0.37$ ,  $p < 0.001$ ).

Overall, the variable of academic stress accounted for 28, 5, and 15% of the explained variances in the dependent variables of mental distress ( $R^2 = 0.28$ ), academic self-disclosure ( $R^2 = 0.05$ ) and school engagement ( $R^2 = 0.15$ ), respectively.



**FIGURE 1 |** Structural equation modeling of the direct effect of academic stress on mental distress, academic self-disclosure to parents and school engagement (numbers are standardized effects. \*Indicates statistical significance at  $p < 0.01$ ).



**FIGURE 2 |** Structural equation modeling of the direct effect of academic stress on males' and females' mental distress, academic self-disclosure to parents and school engagement (numbers are standardized effects. \*Indicates statistical significance at  $p < 0.01$ ).

### Gender Comparison

In this analysis, the paths in the same model were constrained to be simultaneously equal in the male and female subgroups. The analysis showed that there was a good fit to the data [ $\chi^2_{(121, N: \text{males} = 789, \text{females} = 1,012)} = 719.951$ ,  $p < 0.001$ , with NFI = 0.940, IFI = 0.950, CFI = 0.950, and RMSEA = 0.052].

Next, the model was tested to determine whether releasing the equality constraints on the paths could significantly improve the fit. After releasing path constraints one at a time, it was determined that releasing the constraint between academic stress and mental distress yielded a better fit. The result for the final model with one constraint released was as follows:  $\chi^2_{(120, N: \text{males} = 789, \text{females} = 1,012)} = 705.026$ ,  $p < 0.001$ , with NFI = 0.942, IFI = 0.951, CFI = 0.951, and RMSEA = 0.052. **Figure 2** presents the results of this analysis.

Gender differences emerged in the path between academic stress and mental distress. The association between academic stress and mental distress is stronger among females ( $\beta = 0.59$ )

than among males ( $\beta = 0.43$ ). Finally, the overall model explained 35% of the variance in mental distress among females ( $R^2 = 0.35$ ) and 18% of the variance among males ( $R^2 = 0.18$ ). These results mean that the overall model explains mental distress better for females than for males.

## DISCUSSION

This study examined how academic stress affects mental distress, academic self-disclosure to parents and school engagement among high school adolescents in Hong Kong. A comparison by gender was also performed to determine whether the theoretical model fit both genders.

As hypothesized, the results of the present study indicate that the association between academic stress and mental distress is positive and significant. This finding is consistent with previous empirical studies that suggested that students who experience academic stress are more likely to suffer from various symptoms of mental distress (3, 8, 9, 23). In view of the strong correlation ( $r = 0.46$ ) between academic stress and mental distress in this study, academic stress should indeed be considered a risk factor for mental health problems in adolescents in Hong Kong. In addition, academic stress being measured in this study is referred to as stress triggered by the academic expectations of parents, teachers and adolescent themselves. To satisfy their parents' educational aspiration, teachers' academic demands, and their own scholastic desire, high-school students strive for excellence and success in academic performance, which may push them to the edge of mental distress, especially those examinations that they are facing are crucial to determine their path after high school.

In line with our hypothesis, the results of this study suggest that there is a negative and significant association ( $r = 0.09$ ) between academic stress and academic self-disclosure to parents. Specifically, a higher level of academic stress means that students are unlikely to disclose their academic situation to their parents (40). This finding supports the present theoretical framework and its integration with spillover theory and objective self-awareness theory. When high school students experience academic stress, their distress may spill over to the family system and affect communication with their parents with a decrease in self-disclosure to parents (16). This blockage of communication will prevent parents from being informed of the academic situation and the difficulties experienced by their children in a timely manner (42). These findings also provide empirical data to support the ideas suggested by objective self-awareness theory, that once students are aware of their own situation or performance, they will likely develop a negative mood when they see the discrepancy between their performance and the standard; this, in turn, will inhibit their self-disclosure, especially when they are not sure of their parents' responses (41, 67). Moreover, non-disclosure will mean that parents remain ignorant of the academic situation their child is in, making it difficult for them to provide support and assistance in a timely manner.

In contrast to our hypothesis, the results of this study indicate that academic stress is positively associated with school engagement, i.e., the higher the level of academic stress is, the more adolescents are engaged in school. This result is contrary

to most past empirical studies that concluded that there was a negative association between stress and school engagement (19, 20, 46, 68). Although stress, particularly excessive stress, has detrimental impacts on the health and functioning of individuals, it may also have facilitative effects by motivating the individual to work hard or perform well in stressful situations if the stress level is still within the coping range (69, 70). Stress related to examinations or academic issues may motivate students to further engage in school by paying more attention to their learning, putting extra effort into their schoolwork, or increasing their participation in lessons to overcome challenges. In other words, academic stress may be associated with greater school engagement if students have the desire and determination to master their academic challenges.

In addition, school engagement is usually considered a multidimensional construct that has three common components, i.e., cognitive, affective and behavioral engagement (71). However, some school personnel adopt typology to classify students based on their different types of engagement (72), including (1) engagement, (2) strategic compliance, (3) ritual compliance, (4) retreatism and (5) rebellion (72). This typology is based on the nature of and motivation behind school engagement. Based on this classification system and the three different components of school engagement, Conner suggested that there are seven categories, namely, purposeful, full, rational, busy, pleasurable, mental and recreational engagement (73). The findings indicated that most students, even those experiencing stress during high school, display busy engagement, i.e., they consistently work hard and put in effort; however, they rarely enjoy their work (73). This type of engagement is mainly driven by the belief that engagement in school is necessary and beneficial to academic success. In the present study, the positive association between academic stress and school engagement may reflect the fact that the students display this type of school engagement, i.e., busy engagement, in school to address their learning difficulties even if they are experiencing academic stress. This possible explanation of the positive association between academic stress and school engagement takes motivation into consideration, and further investigation should be conducted to substantiate this proposition.

The results of this study show that the theoretical model fit both genders, showing that academic stress predicts mental distress, academic self-disclosure to parents and school engagement. Notably, the findings of this study suggest that girls who are experiencing academic stress are more vulnerable to developing mental distress. This finding is consistent with previous studies that concluded that females are more susceptible to the detrimental effects of academic stress in terms of mental health symptoms (19, 46, 68).

## IMPLICATIONS FOR THEORIES, POLICIES AND PRACTICES

Previous studies have suggested that factors from personal, familial and school domains trigger academic stress (2, 52, 74, 75). However, relatively few studies have explored how academic stress in turn affects adolescents' interactions in their



school and familial domains. Unlike most previous studies on academic stress that focused mainly on how academic stress affects individual physical and mental health, the present study explored the effects on interpersonal interactions in the family and engagement in the school system, which are two significant systems for adolescents. The findings of the present study support the current theoretical model, particularly when viewed in conjunction with spillover theory, suggesting that academic stress can spill over to other social systems and affect adolescents' interactions with significant others and their participation in the social environment (16, 18). Nevertheless, the directions of the effect are not the same in the family and school systems. Specifically, a higher level of academic stress discourages adolescents from disclosing their academic issues to their parents but promotes their engagement in school. The associations between academic stress and self-disclosure to parents and between academic stress and school engagement may reflect the action of inhibiting and facilitating forces, respectively. Notably, the positive association between academic stress and school engagement is in contrast with the findings of most previous empirical studies (20, 46, 68, 76). These contradictory findings suggest the need for further research into whether the association depends on certain psychosocial mechanisms, such as academic motivation or academic aspiration. Future research might include mediator(s) in the model to elucidate the pathway from academic stress to school engagement. In addition, the dimensions of school engagement, i.e., cognitive, affective and behavioral, could be investigated separately (76), as the antecedents and consequences of the different engagement dimensions may also vary (46).

Although mental health issues among high school students are well-surveyed in Hong Kong, whether academic stress is a possible factor that may influence the level of mental distress has seldom been investigated. This study provides empirical evidence that academic stress can have detrimental effect on individual mental wellbeing among adolescents. In view of the strong correlation between academic stress and mental distress in the present study, academic stress is an important entry point and intervention target to reduce the levels of depression, anxiety and somatization in students. Policymakers should allocate resources to launching campaigns to increase awareness of the harmful effects of academic stress. Education-related social policies should be re-examined by reviewing the curriculum, frequency of examinations and methods of assessment with the aim of reducing the level of academic stress. Different levels of school personnel, including principals, classroom teachers and school counselors, can work together to promote effective coping strategies among their students to reduce academic stress. Such multilevel collaborations can support students' psychological wellbeing in the long term. In addition, social work practitioners can organize psychosocial education on stress management or relaxation exercises for students who experience academic stress, which is a risk factor for developing depression, anxiety and somatization. Finally, although prevention and intervention programs could be provided to both boys and girls, particular attention and dedicated resources should be allocated to girls, who tend to

suffer more from the undesirable effects of academic stress in terms of mental health problems.

One of the major findings of the present study is that students who experience a high level of academic stress are less likely to disclose their academic issues to their parents. Parents need to be aware of this association and should remember that they cannot always rely on their children's self-disclosure of their academic difficulties. Hence, school social workers could provide family intervention and sensitivity training to parents and suggest ways in which they can take the initiative to show their concern to their children and detect the academic struggles and stress experienced by their children. Such sensitivity and alertness can facilitate the implementation of early and proactive interventions.

Although school engagement is consistently found to be associated with positive outcomes, such as better academic achievement, positive teacher-student relationships, and higher life satisfaction (46), the positive connection between academic stress and school engagement shown in this study suggests that engagement in school should not be assumed to be an exclusively positive sign. In other words, a high level of school engagement does not imply freedom from or a low level of academic stress. Teachers and school counselors should always determine what is underlying the presence or absence of engagement rather than focusing on engagement behaviors. Is engagement related to academic stress or other factors? With this awareness, individuals who are required to help students will not overlook academic stress as an underlying factor resulting in school engagement.

## LIMITATIONS

There are a few limitations of this study that should be considered when interpreting the results. First, this research was based on cross-sectional data; thus, the causal relationships among the variables cannot be ascertained. A longitudinal panel design can be adopted to investigate causality among the variables in this study. Second, our data were based exclusively on adolescents' self-reports. It is possible that the significant associations between the latent variables may be affected by shared method variance if adolescents were the sole respondents. The information collected for academic stress, mental distress, academic self-disclosure to parents and school engagement was self-reported by students, who might have exaggerated their perceptions or underreported their level of academic stress and mental distress due to social desirability bias and the sensitivity of the issue of mental health. Further studies could consider multiple informants, such as parents or teachers, to overcome the issue of shared method variance. Third, although the sample size was large, this study used a convenience sample of students in Hong Kong. Hence, the conclusions should be interpreted with caution and should not be generalized to other age groups or cultural contexts. Fourth, in view of the relatively small correlations between academic stress and academic self-disclosure to parents, the findings should be interpreted with caution. In addition, there is no analysis on how school level, as a cluster, influences the variables that were examined. Therefore, how the school may affect the association between academic stress and its associated effects, particular

school engagement, is not fully understood. Finally, the data were collected during the COVID-19 pandemic, and students may encounter insecurity about schooling and public assessment, which may have affected their experiences in school and their level of academic stress. Hence, the results of this study should be interpreted with caution.

## CONCLUSION

In summary, the present study provides empirical evidence of the effects of academic stress on mental distress, academic self-disclosure to parents and school engagement in Hong Kong. The findings indicate that academic stress has significant associations with all these effects. In addition, the results also reflect that the pattern of the association and effects on these three endogenous variables are similar across genders, although females who experience academic stress tend to develop more mental distress. This implies that policies and social work intervention can be applied to both genders, but more attention should be given to females experiencing academic stress.

## REFERENCES

- Persike M, Seiffge-Krenke I. Competence in coping with stress in adolescents from three regions of the world. *J Youth Adolesc.* (2012) 41:863–79. doi: 10.1007/s10964-011-9719-6
- Salmela-Aro K, Kiuru N, Pietikäinen M, Jokela J. Does school matter? The role of school context in adolescents' school-related burnout. *Eur Psychol.* (2008) 13:12–23. doi: 10.1027/1016-9040.13.1.12
- Feldman L, Goncalves L, Chacon-Puiguan G, Zaragoza J, Bages N, Pablo J. Relationships between academic stress, social support, mental health and academic performance in Venezuelan university students. *Univ. Psychol.* (2008) 7:739–51.
- Kim Y, Kwak K, Lee S. Does optimism moderate parental achievement pressure and academic stress in Korean children? *Curr Psychol.* (2016) 35:39–43. doi: 10.1007/s12144-015-9355-5
- Bernert RA, Merrill KA, Braithwaite SR, Van Orden KA, Joiner TE. Family life stress and insomnia symptoms in a prospective evaluation of young adults. *J Fam Psychol.* (2007) 21:58–66. doi: 10.1037/0893-3200.21.1.58
- Chen TY, Chou YC, Tzeng NS, Chang HA, Kuo SC, Pan PY, et al. Effects of a selective educational system on fatigue, sleep problems, daytime sleepiness, and depression among senior high school adolescents in Taiwan. *Neuropsychiatr Dis Treat.* (2015) 11:741–50. doi: 10.2147/NDT.S77179
- Torsheim T, Wold B. School-related stress, support, and subjective health complaints among early adolescents: a multilevel approach. *J Adolesc.* (2001) 24:701–13. doi: 10.1006/jado.2001.0440
- Boujut E, Kolec M, Bruchon-Schweitzer M, Bourgeois ML. Mental health among students: a study among a cohort of freshmen. *Ann Med Psychol.* (2009) 167:662–8. doi: 10.1016/j.amp.2008.05.020
- Reisbig AMJ, Danielson JA, Wu TF, Hafen M, Krienert A, Girard D, et al. A study of depression and anxiety, general health, and academic performance in three cohorts of veterinary medical students across the first three semesters of veterinary school. *J Vet Med Educ.* (2012) 39:341–58. doi: 10.3138/jvme.0712-065R
- Ang RP, Huan VS. Relationship between academic stress and suicidal ideation: Testing for depression as a mediator using multiple regression. *Child Psychiatry Hum Dev.* (2006) 37:133–43. doi: 10.1007/s10578-006-0023-8
- Park JY, Chung IJ. Adolescent suicide triggered by problems at school in Korea: analyses focusing on depression, suicidal ideation, plan, and attempts as four dimensions of suicide. *Child Indic Res.* (2014) 7:75–88. doi: 10.1007/s12187-013-9197-3
- Chong WH, Chye S, Huan VS, Ang RP. Generalized problematic Internet use and regulation of social emotional competence: the mediating role of maladaptive cognitions arising from academic expectation stress on adolescents. *Comput Human Behav.* (2014) 38:151–8. doi: 10.1016/j.chb.2014.05.023
- Jun S, Choi E. Academic stress and Internet addiction from general strain theory framework. *Comput Human Behav.* (2015) 49:282–7. doi: 10.1016/j.chb.2015.03.001
- The Hong Kong Federation of Youth Groups (2016). 「在青少年力〇情」查Survey on the Stress and Emotion Among Hong Kong Students. Hong Kong. Retrieved from: <https://hkfyg.org.hk/en/2016/09/20/%E9%9D%E5%8D%94%E5%AC%E5%B8%83%E3%80%8C%E5%9C%E5%B0%E5%AD%E5%B8%E9%9D%E5%B0%E5%B9%B4%E5%A3%93%E5%8A%9B%E6%83%E5%B7%E3%80%E5%8D%E8%AA%BF%E6%9F%E5%A5%E7%B5%90%E6%9E%9C/> (accessed June 10, 2021).
- The Hong Kong Paediatric Society (2017). 香港幼稚及小生及其家庭生活Survey on Hong Kong Kindergarten and Primary Students and Their Parents Life Situations. Hong Kong. Retrieved from: [http://www.medicine.org.hk/hkps/download/20%20years%20child%20health%20policy%20review%20press%20release\\_20160611.pdf](http://www.medicine.org.hk/hkps/download/20%20years%20child%20health%20policy%20review%20press%20release_20160611.pdf) (accessed March 18, 2022).
- Bolger N, DeLongis A, Kessler RC, Wethington E. The contagion of stress across multiple roles. *J Marriag Fam.* (1989) 51:175–83. doi: 10.2307/352378
- Pedersen DE, Jodin V. Stressors associated with the school spillover of college undergraduates. *Soc Sci J.* (2016) 53:40–8. doi: 10.1016/j.soscij.2014.12.008
- Bronfenbrenner U. *The Ecology of Human Development: Experiments by Nature and Design.* Harvard University Press (1979).
- Raufelder D, Kittler F, Braun SR, Lätsch A, Wilkinson RP, Hoferichter F. The interplay of perceived stress, self-determination and school engagement in adolescence. *Sch Psychol Int.* (2014) 35:405–20. doi: 10.1177/0143034313498953
- Raufelder D, Hoferichter F, Ringeisen T, Regner N, Jacke C. The perceived role of parental support and pressure in the interplay of test anxiety and school engagement among adolescents: evidence for gender-specific relations. *J Child Fam Stud.* (2015) 24:3742–56. doi: 10.1007/s10826-015-0182-y
- Arsenio WF, Loria S. Coping with negative emotions: connections with adolescents' academic performance and stress. *J Genet Psychol.* (2014) 175:76–90. doi: 10.1080/00221325.2013.806293
- Rice KG, Ray ME, Davis DE, Deblaere C, Ashby JS. Perfectionism and longitudinal patterns of stress for STEM majors: implications for academic performance. *J Couns Psychol.* (2015) 62:718–31. doi: 10.1037/cou0000097

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Chinese University of Hong Kong Survey and Behavioral Research Ethics. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

EC and J-KC: conceptualization, methodology, and data analysis. EC: writing and project administration. J-KC: review—editing. All authors contributed to the article and approved the submitted version.

23. Huang N, Qiu S, Alizadeh A, Wu H. How incivility and academic stress influence psychological health among college students: the moderating role of gratitude. *Int J Environ Res Public Health*. (2020) 17:3237. doi: 10.3390/ijerph17093237
24. Cole NN, Nonterah CW, Utsey SO, Hook JN, Hubbard RR, Opare-Henaku A, et al. Predictor and moderator effects of ego resilience and mindfulness on the relationship between academic stress and psychological well-being in a sample of Ghanaian college students. *J Black Psychol*. (2015) 41:340–57. doi: 10.1177/0095798414537939
25. Roberts JE, Monroe SM. Vulnerable self-esteem and depressive symptoms - Prospective findings comparing 3 alternative conceptualizations. *J Pers Soc Psychol*. (1992) 62:804–12. doi: 10.1037/0022-3514.62.5.804
26. World Health Organization (2021). *Mental Health: A State of Well-being*. Retrieved from: [http://www.who.int/features/factfiles/mental\\_health/en/](http://www.who.int/features/factfiles/mental_health/en/); [https://www.who.int/health-topics/mental-health#tab=tab\\_2](https://www.who.int/health-topics/mental-health#tab=tab_2) (accessed June 6, 2021).
27. Banks J, Smyth E. 'Your whole life depends on it': academic stress and high-stakes testing in Ireland. *J Youth Stud*. (2015) 18:598–616. doi: 10.1080/13676261.2014.992317
28. Caldera-Montes J, Reynoso-Gonzalez O, Gomez-Covarrubia N, Mora-Garcia O, Anaya-Gonzalez B. Explanatory and predictive model of academic stress responses in secondary school students. *Ansiedad Y Estrés Anxiety Stress*. (2017) 23:20–6. doi: 10.1016/j.anyes.2017.02.002
29. Fernandez-Gonzalez L, Gonzalez-Hernandez A, Trianes-Torres M. Relationships between academic stress, social support, optimism-pessimism and self-esteem in college students. *Electron J Res Educ Psychol*. (2015) 13:111–29. doi: 10.14204/ejrep.35.14053
30. Kim C, Seockhoon C, Suyeon L, Soyoun Y, Boram P. Perfectionism is related with academic stress in medical student. *Eur Psychiatry*. (2017) 41:S690. doi: 10.1016/j.eurpsy.2017.01.1207
31. Leung GSM, Yeung KC, Wong DFK. Academic stressors and anxiety in children: the role of paternal support. *J Child Fam Stud*. (2010) 19:90–100. doi: 10.1007/s10826-009-9288-4
32. Leung GSM, He XS. Resourcefulness: a protective factor buffer against the academic stress of school-aged children. *Educational Psychology*. (2010) 30:395–410. doi: 10.1080/01443411003682574
33. Arnett JJ. Adolescent storm and stress, reconsidered. *Am Psychol*. (1999) 54:317–26. doi: 10.1037/0003-066X.54.5.317
34. Chen WW, Wong YL. What my parents make me believe in learning: the role of filial piety in Hong Kong students' motivation and academic achievement. *Int J Psychol*. (2014) 49:249–56. doi: 10.1002/ijop.12014
35. Sue S, Okazaki S. Asian-American educational achievements: a phenomenon in search of an explanation. *Am Psychol*. (1990) 45:913. doi: 10.1037/0003-066X.45.8.913
36. Ho DYF. Filial piety and its psychological consequences. In: Bond MH, editor. *Handbook of Chinese Psychology*. Oxford University Press (1996). p. 155–165.
37. Shek DTL, Chan LK. Hong Kong Chinese parents' perceptions of the ideal child. *J Psychol*. (1999) 133:291–302. doi: 10.1080/00223989909599742
38. Ang RP, Huan VS. Academic expectations stress inventory development, factor analysis, reliability, and validity. *Educ Psychol Meas*. (2006) 66:522–39. doi: 10.1177/0013164405282461
39. Tan JB, Yates S. Academic expectations as sources of stress in Asian students. *Soc Psychol Educ*. (2011) 14:389–407. doi: 10.1007/s11218-010-9146-7
40. Chan ATY, Lee S. Education plans, personal challenges and academic difficulties: an empirical study on self-disclosure among post-90s teens in Hong Kong. *Int J Adolesc Youth*. (2014) 19:468–83. doi: 10.1080/02673843.2012.751042
41. Derlega VJ. *Self-Disclosure*. Newbury Park, CA: Sage Publications (1993).
42. Hamza C, Willoughby T. Perceived parental monitoring, adolescent disclosure, and adolescent depressive symptoms: a longitudinal examination. *J Youth Adolesc*. (2011) 40:902–15. doi: 10.1007/s10964-010-9604-8
43. Berger CR. Communicating under uncertainty. In: Roloff ME, Miller GR, editors. *Interpersonal Processes: New Directions in Communication Research*. Newbury Park, CA: Sage Publications (1987). p. 39–62.
44. Wallburg V. Burnout among high school students: a literature review. *Child Youth Serv Rev*. (2014) 42:28–33. doi: 10.1016/j.childyouth.2014.03.020
45. Fredricks JA, Blumenfeld PC, Paris AH. School engagement: potential of the concept, state of the evidence. *Rev Educ Res*. (2004) 74:59–109. doi: 10.3102/00346543074001059
46. Upadaya K, Salmela-Aro K. Development of school engagement in association with academic success and well-being in varying social contexts: a review of empirical research. *Eur Psychol*. (2013) 18:136–47. doi: 10.1027/1016-9040/a000143
47. Salmela-Aro K, Upadaya K. School burnout and engagement in the context of demands-resources model. *Br J Educ Psychol*. (2014) 84:137–51. doi: 10.1111/bjep.12018
48. Rudolph KD, Hammen C, Burge D, Lindberg N, Herzberg D, Daleys SE. Toward an interpersonal life-stress model of depression: the developmental context of stress generation. *Dev Psychopathol*. (2000) 12:215–34. doi: 10.1017/S0954579400002066
49. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol*. (2000) 55:68–78. doi: 10.1037/0003-066X.55.1.68
50. Landstedt E, Gådin KG. Seventeen and stressed - Do gender and class matter? *Health Sociol Rev*. (2012) 21:82–98. doi: 10.5172/hesr.2012.21.1.82
51. Liu YY, Lu ZH. Chinese high school students' academic stress and depressive symptoms: gender and school climate as moderators. *Stress Health*. (2012) 28:340–6. doi: 10.1002/smi.2418
52. Huan V, Yeo L, Ang R, Chong W. The influence of dispositional optimism and gender on adolescents' perception of academic stress. *Adolescence*. (2006) 41:533–46.
53. Pomerantz EM, Altermatt ER, Saxon JL. Making the grade but feeling distressed: gender differences in academic performance and internal distress. *J Educ Psychol*. (2002) 94:396–404. doi: 10.1037/0022-0663.94.2.396
54. Putwain DW, Woods KA, Symes W. Personal and situational predictors of test anxiety of students in post-compulsory education. *Br J Educ Psychol*. (2010) 80:137–60. doi: 10.1348/000709909X466082
55. Ang RP, Klassen RM, Chong WH, Huan VS, Wong IYF, Yeo LS, et al. Cross-cultural invariance of the academic expectations stress inventory: adolescent samples from Canada and Singapore. *J Adolesc*. (2009) 32:1225–37. doi: 10.1016/j.adolescence.2009.01.009
56. Lee M, Larson R. The Korean "examination hell" long hours of studying, distress and depression. *J Youth Adolesc*. (2000) 29:249–71. doi: 10.1023/A:1005160717081
57. Sung YT, Chao TY. Construction of the examination stress scale for adolescent students. *Meas Eval Counsel Dev*. (2015) 48:44–58. doi: 10.1177/0748175614538062
58. Wang YS. 國中課業壓力及課業表現之相關分析 *The Correlation Between Academic Stress and Academic Performance Among Junior High Schools' Students*. (2007). Available online at: <https://hdl.handle.net/11296/abk4d4> (accessed March 26, 2022).
59. Yang YP. *The Relationship Among Junior High School Students' Parent Expectations, Parent-Adolescent Relationship and Academic Stress in Taipei Area*. (2015). Available online at: <https://hdl.handle.net/11296/4me6j3> (accessed March 26, 2022).
60. Lee MB, Lee YJ, Yen LL, Lin MH, Lue BH. Reliability and validity of using a brief psychiatric symptom rating scale in clinical practice. *J Form Med Assoc*. (1990) 89:1081–7.
61. Kerr M, Stattin H. What parents know, how they know it, and several forms of adolescent adjustment: further support for a reinterpretation of monitoring. *Dev Psychol*. (2000) 36:366–80. doi: 10.1037/0012-1649.36.3.366
62. Tsai CL. *The Relationships of Junior High School Students' Perceptions of School Climate, Interpersonal Relationships, School Engagement and Academic Achievement in Changhua County*. (2006). Available online at: <https://hdl.handle.net/11296/cwb4pw> (accessed March 26, 2022).
63. Bentler PM. Comparative fit indexes in structural models. *Psychol Bull*. (1990) 107:238–46. doi: 10.1037/0033-2909.107.2.238
64. Blunch NJ. *Introduction to Structural Equation Modelling Using IBM SPSS Statistics and AMOS*, 2nd ed. SAGE.
65. Brown TA. *Confirmatory Factor Analysis for Applied Research*. 2nd ed. The Guilford Press (2015).
66. Kline RB. *Principles and Practice of Structural Equation Modeling*. 4th ed. The Guilford Press (2016).

67. Duval S, Wicklund RA. *A Theory of Objective Self Awareness*. New York, NY: Academic Press (1972).
68. Wang MT, Eccles JS. School context, achievement motivation, and academic engagement: a longitudinal study of school engagement using a multidimensional perspective. *Learn Instruct.* (2013) 28:12–23. doi: 10.1016/j.learninstruc.2013.04.002
69. Cassady JC, Johnson RE. Cognitive test anxiety and academic performance. *Contemp Educ Psychol.* (2002) 27:270–95. doi: 10.1006/ceps.2001.1094
70. Alpert R, Haber RN. Anxiety in academic achievement situations. *J Abnorm Soc Psychol.* (1960) 61:207–15. doi: 10.1037/h0045464
71. Appleton JJ, Christenson SL, Furlong MJ. *Student Engagement With School: Critical Conceptual and Methodological Issues of the Construct*. John Wiley & Sons, Inc. (2008).
72. Schlechty PC. *Working on the Work: An Action Plan for Teachers, Principals, and Superintendents*. 1st ed. San Francisco, CA: Jossey-Bass (2002).
73. Conner JO, Pope DC. Not just robo-students: why full engagement matters and how schools can promote it. *J Youth Adolesc.* (2013) 42:1426–42. doi: 10.1007/s10964-013-9948-y
74. Chyu EPY, Chen J-K. The correlates of academic stress in Hong Kong. *Int J Environ Res Public Health.* (2022) 19:4009. doi: 10.3390/ijerph19074009
75. Kim E, Lee M. The reciprocal longitudinal relationship between the parent-adolescent relationship and academic stress in Korea. *Soc Behav Pers.* (2013) 41:1519–31. doi: 10.2224/sbp.2013.41.9.1519
76. Salmela-Aro K, Upadyaya K. The schoolwork engagement inventory: energy, dedication, and absorption (EDA). *Eur J Psychol Assess.* (2011) 28:60–7. doi: 10.1027/1015-5759/a000091

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Chyu and Chen. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





# Mindfulness-Based Student Training Improves Vascular Variability Associated With Sustained Reductions in Physiological Stress Response

Andreas Voss<sup>1,2,3\*</sup>, Martin Bogdanski<sup>1,3†</sup>, Mario Walther<sup>4</sup>, Bernd Langohr<sup>5</sup>,  
Reyk Albrecht<sup>6</sup>, Georg Seifert<sup>3,7</sup> and Mike Sandbothe<sup>1,8</sup>

<sup>1</sup> Institute of Innovative Health Technologies (IGHT), Ernst-Abbe-Hochschule Jena, Jena, Germany, <sup>2</sup> Institute of Biomedical Engineering and Informatics (BMTI), Technische Universität Ilmenau, Ilmenau, Germany, <sup>3</sup> Department of Pediatric Oncology and Hematology, Charité—Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin and Humboldt-Universität zu Berlin, Berlin, Germany, <sup>4</sup> Department of Basic Sciences, Ernst-Abbe-Hochschule Jena, Jena, Germany, <sup>5</sup> Jena Achtsamkeit, Jena, Germany, <sup>6</sup> Department of Social and Behavioral Sciences and Department of Medicine, Friedrich-Schiller-University Jena, Jena, Germany, <sup>7</sup> Departamento de Pediatria, Faculdade de Medicina, Instituto de Tratamento Do Câncer Infantil (ITACI) Universidade de São Paulo, São Paulo, Brazil, <sup>8</sup> Department of Social Work, Ernst-Abbe-Hochschule Jena, Jena, Germany

## OPEN ACCESS

### Edited by:

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong, SAR China

### Reviewed by:

Niels Wessel,  
Humboldt University of  
Berlin, Germany  
Warhel Asim Mohammed,  
University of Duhok, Iraq

### \*Correspondence:

Andreas Voss  
andreas.voss@eah-jena.de

<sup>†</sup>These authors have contributed  
equally to this work and share first  
authorship

### Specialty section:

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

**Received:** 27 January 2022

**Accepted:** 17 June 2022

**Published:** 18 July 2022

### Citation:

Voss A, Bogdanski M, Walther M,  
Langohr B, Albrecht R, Seifert G and  
Sandbothe M (2022)  
Mindfulness-Based Student Training  
Improves Vascular Variability  
Associated With Sustained  
Reductions in Physiological Stress  
Response.  
Front. Public Health 10:863671.  
doi: 10.3389/fpubh.2022.863671

In today's fast-paced society, chronic stress has become an increasing problem, as it can lead to psycho-physiological health problems. University students are also faced with stress due to the demands of many courses and exams. The positive effects of mindfulness-based stress reduction (MBSR) on stress management and self-regulation have already been studied. We have developed a new mindfulness intervention tailored for students—the Mindfulness-Based Student Training (MBST). In this study, we present longitudinal results of the MBST evaluation. Biosignal analysis methods, including pulse wave variability (PWV), heart rate variability, and respiratory activity, were used to assess participants' state of autonomic regulation during the 12-week intervention and at follow-up. The progress of the intervention group (IGR,  $N = 31$ ) up to 3 months after the end of MBST was compared with that of a control group (CON,  $N = 34$ ). In addition, the long-term effect for IGR up to 1 year after intervention was examined. The analysis showed significant positive changes in PWV exclusively for IGR. This positive effect, particularly on vascular function, persists 1 year after the end of MBST. These results suggest a physiologically reduced stress level in MBST participants and a beneficial preventive health care program for University students.

**Keywords:** mindfulness-based stress reduction, mindfulness-based interventions, autonomic regulation, pulse wave variability, heart rate variability, non-linear dynamics, higher education, University students

## INTRODUCTION

The broad field of stress research—including the study of stress factors (stressors), physiological and psychological effects, and strategies for coping with stress—has received increasing attention over many years. Inadequate stress management can lead to chronic stress, which is considered a major risk factor for physical and mental illness (1–5).

This involves impairment of the immune system (6) and promotion of inflammatory processes (7) as well as higher risk for cardiovascular diseases (CVD) (8–10). The relation of mental disorders from inadequate stress management have already been examined for anxiety, depression, and burnout (11, 12). There is also consent that stress-related impairments often connects both aspects, the physiological and psychological level (13, 14). Recent studies investigated the mechanisms and consequences of occupational stress that leads to burnout (15–17). The new revision of the World Health Organization on burnout as “an occupational phenomenon resulting from chronic workplace stress” in the 11th Revision of the International Classification of Diseases (ICD-11) (18, 19) underlines this important field of research. This also applies to students in University as the campus is their workplace. Since, as shown, stress is seen as a relevant risk factor to cause or promote different types of diseases, there is also a need to strengthen the health literacy of University students. A link between perceived stress and quality of life was shown by Ribeiro, Pereira (20). In their review they found a “negative association between stress and QoL in University students, through the deterioration of various aspects related to physical and mental health.” In another study Keech, Hagger (21) suggest interventions for active stress management which might also improve student’s academic performance. Therefore, we were encouraged in our commitment of developing and evaluating our novel Mindfulness-Based Student Training (MBST) program to enforce the student’s stress management and coping, quality of life and health prevention.

Based on classical elements of Mindfulness-based Stress Reduction (MBSR), originally introduced by Jon Kabat-Zinn (22), we had developed and established a new mindfulness intervention for students at University. The additions and modifications to the MBSR methods were especially tailored to the students’ needs in everyday life. The mediated training was intended, among other things, to strengthen stress management as well as self- and emotion regulation and thus to contribute to a personal health benefit. This approach should be accompanied by scientific examinations based on physiological biomarkers. The effects of MBSR have been the subject of numerous studies. However, in the majority of evaluations this was assessed by self-reporting measures (23–26) and only a minority used biomarkers (27, 28) or biosignal analysis (29–31). Most studies that included biosignal measurements were limited in their variety of assessment methods. They considered only a limited selection of single heart rate variability (HRV) characteristics or non-continuously derived biosignals (such as discrete values of systolic blood pressure). In our evaluation study, we aimed for a broader but also more detailed characterization that includes variability features from multiple biosignals and is represented by different domains of biosignal analysis (e.g., time, frequency, and non-linear dynamics). Repeated measurements of electrocardiogram (ECG), finger pulse photoplethysmogram (PPG, derived by pulse oximetry), and breathing activity (RESP) from the MBST intervention group and a passive control group provided information about the condition of participant’s autonomic regulation. Several indices of heart rate variability (HRV), pulse wave variability (PWV), and RESP characterizing

autonomic functions in different domains of biosignal analysis had been extracted and statistically analyzed. Based on this, a significant effect in terms of reduced vascular regulation (specific systolic PWV estimates) was found in our first preliminary study (32). This improvement was observed exclusively in MBST participants and demonstrated a positive health benefit in an initial examination after 8 weeks of intervention. The presented second part of this study aimed to investigate longitudinally to what extent stress reduction can be demonstrated after the complete 12-week MBST intervention. Therefore, we were now interested in examining what effect could be demonstrated at the end of the 12-week intervention and how it compared to controls up to 3 months into follow-up. In addition, we wanted to examine long-term effects in the intervention group over multiple measurement periods up to 1 year after completion of the MBST.

## MATERIALS AND METHODS

In our previous study (32), the preliminary effects of the MBST program from pre to 8 weeks after starting the 12-week intervention for University students has been evaluated. The training’s impact was measured in terms of HRV, PWV and RESP, and compared to a passive control group. Now the findings of the entire study with measurements until 1-year follow-up after end of MBST will be presented.

### Study Design

All procedures performed in this study involving human participants were approved by the Institutional Ethics Commission of the University Hospital Jena (4509-08/15), and in accordance with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants included in the study.

The basic study design can be described as a (restricted randomized) controlled trial comparing two groups over time. This evaluation study included the comparison of the intervention group (IGR) and a (passive waitlist) control group (CON) at four measurement times until 3 months after end of MBST. Additionally, the follow up of the MBST participants until 1 year after end of MBST was assessed with a fifth and sixth measurement. More details on the measurement times are shown in **Table 1**.

We recorded attendance at the weekly courses *via* study certificates, which acted as proof for the participants that they had passed the course for their student record book. A maximum of one absence was allowed over the 12 weeks of the course. In addition, participants kept a Mindfulness Diary, which recorded, among other things, their personally spent practice time at home. Of course, a real control of these self-reported statements could not take place. In the follow-up, after the end of the MBST course, the participants were asked about their further practice *via* several online surveys.

### Participants

At the beginning of the study, 40 participants for each of both groups were recruited. For the comparison up to the fourth

**TABLE 1** | Measurement points with description.

Measurement	Description	Comment
M0	Acclimation measurement	–
M1	Before MBST	At semester start
M2	After 8 weeks of MBST	During semester
M3	After end (12 weeks) of MBST	Near semester end, at start of exams
M4	3 months after end of MBST, study end for CON	After summer break, at start of next semester
M5	6 months after end of MBST	Near semester end, at start of exams
M6	1 year after end of MBST, study end for IGR	Near semester end, but before exams

**TABLE 2** | Number, sex, and age of study participants per group.

Group (measurements)	N [participants]	Sex [female/male]	Age [mean $\pm$ sd, years]
IGR (M1 to M4)	31	28/3	24.4 $\pm$ 3.8
IGR (M1 to M6)	22	20/2	24.6 $\pm$ 3.6
CON (M1 to M4)	34	31/3	24.2 $\pm$ 7.2

measurement, involving the 12-week MBST and 3 months follow up, 31 participants in IGR and 34 in CON finished the data acquisition. This provided the basis for the statistical comparison of the two progressions. In addition, 22 IGR participants completed the final M6 measurement to enable insight into the long-term effects of the intervention. Due to dropouts, the number of participants for the final analysis is less than those recruited at the beginning. More information about the groups and their compositions is given in **Table 2**.

The recruitment at the campus was directed to full-time students at the local universities (Ernst-Abbe-Hochschule Jena and Friedrich Schiller University Jena) and preferred early semesters to ensure a long participation in this study. In addition to these eligibility requirements, the following exclusion criteria were defined: Pregnancy, advanced experience with mindfulness interventions, (semi)professional athletes, diabetes, hypertension, or known heart disease. The enrollment followed a first come, first serve process. Finally, most of the participants were students of social sciences, but also of economics and engineering. In a preparatory meeting, the participants were subjected to a familiarization measurement, among other things, to become familiar with the measurement situation.

## MBST Intervention

Based on classical elements of Mindfulness-based Stress Reduction (MBSR), originally introduced by Jon Kabat-Zinn (22), we developed and established a new mindfulness intervention for students at University. The main reason for changing the authorized MBSR curriculum (<https://lotheijke.com/wp-content/uploads/2020/11/8-week-mbsr-authorized-curriculum-guide-2017.pdf>) was the goal to offer a course with a time structure that meets the standards of academic seminars

in Germany (90 min per week in a semester), so that students can receive credit points for it across universities and faculties. In addition, it has been shown that the duration of the MBSR exercises (approximately 2.5 to 3.5 h for weekly session), while useful in the clinical context of MBSR as well as in outpatient MBSR courses, is too long for students in an academic setting. The same is true for the mindfulness day.

The resulting changes in the temporal structure of the curriculum, as well as the need to directly address students' specific issues in the course and to reduce the number of medical inputs, have led to a significant change in the course format, as expressed by the new name (MBST). This is at the same time a response to the following request found in the authorized Curriculum Guide for MBSR: "Currently, there are a wide-range of mindfulness-based programs that have developed out of the basic structure and format of MBSR. We applaud these adaptations and experiments while strongly urging our colleagues to call what they do MBSR only if they adhere to the structure and standards described herein." (<https://lotheijke.com/wp-content/uploads/2020/11/8-week-mbsr-authorized-curriculum-guide-2017.pdf>, p. 1).

The 12-week MBST intervention includes weekly 90-min sessions and a 5-h "mindfulness retreat day." In addition, there is an introductory and final session at the beginning and end. The practices taught consist of informal and formal exercises (such as body scan, different meditations, and mindful yoga) guided by MBSR trainers. Among other things, the training provided was to strengthen stress management as well as self- and emotion regulation, thereby contributing to personal health benefits and improve quality of life.

## Data Acquisition & Pre-processing

All measurements took place in a quiet and exclusive room at the campus. While sitting comfortably on an office chair the participants were asked to not talk or move during the recording. The application of the measurement equipment and verification of the signals was carried out professionally by the investigating researcher. After coming to rest, about 12 min were recorded of which 10 min were later used for analysis. At each measurement, notes on (medical) status and recent activities or changes were recorded to capture significant changes in eligibility criteria during the study period.

The acquisition and processing of the measured biosignals included derivations from ECG, PPG, and breathing activity *via* respiration belt. Beat-to-beat intervals (RR time series) from detected R-peaks in the ECG provided later HRV analysis. Analogous to the systogram and diastogram from blood pressure, the amplitude series from detected systolic maxima (PSYS) and diastolic minima (PDIA) from the PPG were linearly transformed and then allowed PWV analysis. The maxima and minima in the RESP signal resulted in inspiration (RESPin) and expiration (RESPex) time series, respectively. Finally, the RR as well as the PSYS and PDIA series were subjected to an adaptive filtering which corrected ectopic beats and artifacts that could affect further analysis (RR intervals then denoted as NN/normal-to-normal intervals). These interval and amplitude series formed the basis for all further feature calculations. Representative PSYS series showing typical examples of vascular variability

for both groups at different measurements are provided in the Supplementary Materials (**Supplementary Figure 1**).

More details about the study design, participants recruitment and grouping, an MBST description and curriculum as well as further explanations to data acquisition and pre-processing have already been given in the first publication.

## Feature Extraction

The preselection of measured variables for the preliminary feature set of the following statistical analysis was done with regard to the findings of our prior study and to the most common standard features of variability indices in time and frequency domains as suggested by the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (32, 33). These include (among others) mean values and measures of dispersion (e.g., meanNN and sdNN), proportional measures of specific values (in this case pNN50), the power in specific frequency bands (such as low or high frequency powers, and their ratio LF/HF), but also features of symbolic and non-linear dynamics.

In the present analysis some additional and modified features were included. These are the SDA1 and RMSSD of the amplitude variabilities in the PSYS and PDIA series. Analogous to the HRV counterparts, these variables give a measure of the standard deviation of the averages of amplitude series in all 1-min segments (\_sdaAMP1 with prefixed PSYS or PDIA) and the square root of the mean squared differences of successive amplitudes (\_rmssd with prefixed PSYS or PDIA). Another change was made to the estimates given by the high-resolution joint symbolic dynamics (HRJSD). Instead of specific single patterns quantifying non-linear interactions in the given series, a more summarized approach by using the Rényi entropy (with  $\alpha = 2$ ) of the interactions between the beat-to-beat interval series of HRV and the amplitude series of PWV (HRJSDrenyi2\_BBIPSYS or HRJSDrenyi2\_BBIPDIA) as well as within all three of these series in the multivariate HRJSD (mHRJSDrenyi2) has been utilized. The Rényi entropy serves as a measure for the complexity and randomness of a time series. In this case, the method is used to quantify the complexity of the joint patterns of symbolic dynamics of two or three input series. For further details, please see the variable-list and description in the supplementary materials (**Supplementary Table 1**).

Using these features from different disciplines of biosignal analysis, the physiological state of the participants will be determined. This concerns in particular functions of the autonomic nervous system and the antagonistic parts of the sympathetic and parasympathetic nervous system functioning in it. Sympatho-vagal balance can provide information about physical stress levels but also about disease-related dysfunctions or imbalances. Therefore, these biomarkers are a valuable measure for the evaluation of interventions or therapies as well as for the detection or differentiation of disease patterns (8, 33–36).

## Statistical Analysis

To avoid gaps in the paired samples or replacing them with an artificial value in an additional step, the statistical analysis was performed only with the data of the participants that were

available without missing values from M1 to M4 (IGR vs. CON) or to M6 (IGR only). The statistical analysis based on the 32 selected features from both groups was carried out in three major consecutive steps. At first, the measured variables from the feature set were transformed into one joint dimension to eliminate inconsistencies in the data from different origins. After this precondition was met, a factor analysis to further summarize and reduce the feature set in a second step was performed. In the last step the statistical evaluation based on the remaining feature set was completed *via* a multivariate analysis of variance (MANOVA) in a two-way repeated measures design.

## Standardizing the Variables

In preparation of further statistical analysis the measured variables were standardized. The adapted transformation used the sample mean and standard deviation with reference to the first measurement to compute the z-scores. Since the observed variables were almost the same in both groups at the beginning of the study, the first measurement was set as a common reference point. The standardizing was an important preparation for the subsequent factor analysis where the variable values must come from a uniform dimension. Otherwise, due to the different origins of the variables in physiological and technical terms, the values would have different magnitudes, scales, and units. That imbalance would then lead to incorrect weightings and thus over- or underestimations in the factor analysis.

## Factor Analysis

With 31 (IGR) and 34 (CON) participants we wanted to further reduce the feature set of still 32 measured variables. This was meant to ensure the statistical accuracy (regarding the ratio of participants/cases to measured variables) and to enhance the statistical power as well as to condense the information from the given variability indices. To achieve this, a factor analysis was performed based on the 32 variables in our feature set. This statistical method searches for representations of correlations in the given data and thus offers the possibility to summarize many variables into fewer factors. The resulting factors define new artificial variables representing a grouping of variables with the same or similar implication. A factor is a linear combination of the respective input variables. It has its own value (score) and holds the information (explained variance) of the variables loading on it. These are weighted according to their information contribution to the factor. Despite a reduced number of variables (the new factor scores), in sum all factors may contain a significant part of the information content of the original data. The mathematical summary of (different) variables into new artificial factor scores does not need to necessarily appear logical and their meaning may be difficult to interpret. However, by using factor analysis, the number of variables could be considerably reduced from 32 measured features to seven factor scores. The factorization seemed logical, and a good interpretation of the individual factors was still given. The factor analysis has been carried out in IBM SPSS Statistics (Version 26). The extraction method was Principal Components Analysis (PCA), the rotation method



**TABLE 3 |** Final factors from factor analysis and their representation.

Factor	Description (number of loading variables)
F1	PWV—PSYS & PDIA variability (10)
F2	HRV—time domain & symbolic dynamics (9)
F3	PWV—correlation & trans-information PSYS & PDIA (5)
F4	HRV—frequency domain (2)
F5	PSYS & PDIA amplitudes (2)
F6	(m)HRJSD—high-resolution joint symbolic dynamics (3)
F7	RESP_meanBPM (1)

set to Varimax, the resulting factor scores saved as new variables *via* linear regression method and the input variables consisted of the 32 measured variables at time M1 (over both groups). The following criteria have been considered for an appropriate number of factors: Eigenvalue > 1; contribution to explained variance  $\geq 5\%$ ; explained total variance (cumulative)  $\geq 80\%$ .

It was found that the single respiratory variable RESP\_meanBPM (average respiratory rate for the entire time series in breaths per minute) had an approximately equal load on several factors. Therefore, a clear assignment to a specific factor was not possible and we decided to define an exclusive factor with only this variable. Subsequently, the factor analysis was performed again with only 31 variables (excluding RESP\_meanBPM), resulting in a set of six factors that met the requirements. The total variance explained by these six factors was 84.4% and with addition of the single seventh respiratory factor 87%. The SPSS function calculated the new factor scores using linear regression, but with the contribution of all variables to all factors, no matter how small the actual loadings were. For a stricter differentiation of the factors and a reduction of redundancy in the data, we set two more requirements for factorization:

- variables must have a minimum load of 0.5 on a factor (variables below are discarded because the contribution is too low)
- each variable may only load on one factor (based on its highest contribution)

For this reason, the rotated component matrix, containing the loadings of each variable on each factor, was revised according to these specifications. As this changed the weightings of the linear combinations used to build the factor scores, the coefficients had to be re-estimated. Therefore, another linear regression was performed, but this time with only the specific variables with high loadings on each factor. Using the new coefficients, the factor scores could now be recalculated *via* the sum product of the fixed coefficients and the values of the measured variables. The final factors and their representative meanings are shown in Table 3. A more detailed overview about the six derived factors (excluding factor 7 with only one exclusive respiration variable) and their loading variables are stated in the rotated component matrix in the supplementary materials (Supplementary Table 2).

## MANOVA

As described above, the study design was based on two groups which were repeatedly measured at up to six times and numerous medical indices were collected per measurement. A two-way repeated measures MANOVA was performed to model and evaluate the multivariate data with a two-factorial design. This was done using the syntax of the GLM (general linear model) function in IBM SPSS Statistics. The grouping variable GROUP was set as between-subject factor and a new variable TIME was defined as within-subject factor to indicate the number of repetitions of the multivariate data (dependent variables). The alpha level as significance criteria was set to 0.05. The MANOVA was conducted in three different configurations. The first two variants built on each other, and the third explored a further question about the long-term effects of the MBST program. In addition, the estimated marginal means (EMMEANS) were computed as a *post-hoc* test from the MANOVA model. The pairwise comparisons of the EMMEANS provided more detailed insights into which variables potentially indicate differences between the levels of GROUP or TIME. The EMMEANS refer to data estimates based on the model rather than the observed data themselves. However, the observed data formed the model in the first place. In the first run, the seven derived factor scores were taken as dependent variables to examine whether there were statistically significant main effects in GROUP, TIME, or the interaction of both. Following the trace of these results, the statistical analysis continued with a second MANOVA, this time including only the measured PWV features from factor 1 as dependent variables. More specifically, eight out of ten PWV features were used to obtain a more condensed set of features. We have set a threshold of contribution to 0.8 in absolute. Due to the low loading magnitude of 0.6 for PSYS\_sdaAMP1 and PDIA\_sdaAMP1 compared to the high loadings ( $> = 0.8$ ) of the other variables on factor 1, these two were excluded from further analysis steps. Moreover, both, long-term and short-term indices were already given by sdAMP and RMSSD, respectively. The averaged 1-min standard deviation windows of the PSYS and PDIA amplitudes as a kind of middle ground between the two standard indices were not considered essential for the evaluation. A third MANOVA configuration was then used to provide a further view of the development of IGR up to the last measurement M6 (1 year follow up). In this case, only the main effect TIME and its pairwise comparisons in EMMEANS have been investigated for IGR exclusively. To address the multiple comparison problem, the Sidak adjustment has been applied. This method was chosen as a good balance between the very conservative Bonferroni correction and the Least Significant Difference (LSD), which has practically no correction for multiple comparisons.

## RESULTS

### IGR and CON at M1 to M4 Regarding 7 Factors

The performed two-way MANOVA examining main GROUP and TIME effects based on the seven factors as dependent

**TABLE 4 |** MANOVA results on 7 factors—multivariate results from TIME (4 levels) BY GROUP (2 levels) analysis with 7 factors as dependent variables.

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta squared
<b>Multivariate tests—TIME and GROUP main effects</b>							
Between Subjects	Group	0.868	1.239b	7.000	57.000	n.s.	0.132
Within Subjects	Time	0.221	7.214b	21.000	43.000	<0.00	0.779
	Time * Group	0.624	1.234b	21.000	43.000	n.s.	0.376

Sig. based on Wilks-Lambda at level 0.05. Design, Group; Within Subjects Design, Time. Exact statistic.

**TABLE 5 |** Results of EMMEANS from MANOVA with 7 factors indicating TIME (4 levels) effect within each GROUP.

Group[0 = CON, 1 = IGR]	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
<b>EMMEANS—Multivariate Tests with TIME effect per GROUP</b>						
0	0.281	5.244	21.000	43.000	<0.00	0.719
1	0.383	3.294	21.000	43.000	<0.00	0.617

Each F tests the multivariate simple effects of Time within each level of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means. Exact statistic using Wilks' lambda at significance level 0.05.

variables revealed a statistically significant multivariate TIME effect (Table 4). That indicates a significant change over time across both groups involving the multivariate data. There was no multivariate significant effect for GROUP across all times and for the interaction effect of TIME\*GROUP. Moreover, in the model-based EMMEANS results, there were also no indications for significant differences between IGR and CON within the four levels of TIME (M1 to M4) regarding multivariate data of the seven factors. The multivariate TIME effect from EMMEANS within the two levels of GROUP (IGR, CON) confirmed the significant changes over time in both groups from the previous results of the observed data (Table 5). However, within the pairwise comparisons of the EMMEANS tables we found evidence for specific significant changes over time within factor F1 (Table 6). While this applied to both groups, changes in CON were always related to measurement M4, whereas changes from M1 to M2 were also evident in IGR. Since M4 was probably strongly influenced by the fact of the summer break at the University, we particularly put our attention on measurements between the intervention period M1 to M3. The comparison between M1 and M3 was never significant for CON, no matter which adjustment was chosen. The same comparison for IGR instead was significant with Fisher's Least Significant Difference (LSD) adjustment, which, though, does not correct for multiple comparisons (not reported here). With the proposed Sidak adjustment, the comparison M1 to M3 for IGR in F1 is no more significant (IGR  $p \leq 0.140$ ; CON  $p \leq 1.0$ ). We have merely regarded this as a trend. Visual inspection *via* plots of factors and variables supported our assumption of a strong impact of summer break (involving M4) on both groups. These insights seemed to support our findings of altered PWV from the first preliminary study (concerning M1 to M2), and therefore the following analysis focused on the vascular PWV features from factor F1 (see vascular variability progress in Figure 1).

## IGR and CON at M1 to M4 Regarding PWV Variables

The multivariate results of the MANOVA based on eight PWV features from factor F1 as dependent variables showed statistically significant main effects in GROUP and TIME, but not in the interaction of both (Table 7). This means a multivariate difference between both groups across all times as well as differences over time across both groups. Regarding multivariate effects in EMMEANS, there were no significant differences between the groups within the specific four levels of TIME, but a significant effect of TIME within both separate groups (Table 8). This translates to no differentiation of the groups at M1 to M4 across all variables, while both groups vary significantly over time. Further, the significant main effect for GROUP cannot be attributed to a specific measurement time point but arises from the variations across all time points.

Further, we considered the individual pairwise comparisons among the specific eight PWV variables and found no evidence for significant differences between IGR and CON. However, a decreasing trend in  $p$ -values was observed, indicating a slightly greater potential for differentiation over the duration of the intervention, particularly in M2 and M3 compared to baseline in M1.

After direct comparisons between the groups, pairwise longitudinal comparisons were examined regarding changes over time within both groups. First, significant differences were again seen in relation to M4. This applied to all eight PWV features and both groups, just as the results from the analysis of factor F1 had already shown. In the second, however, significant changes in M1 to M2 or M3 were found exclusively for the intervention group. In detail, PSYS\_renyi2 and PSYS\_wpsum02 (see Figure 2) revealed statistically significant changes within IGR from M1 to M2 (PSYS\_renyi2  $p \leq 0.031$ ; PSYS\_wpsum02  $p \leq 0.007$ ) as well as from M1 to M3 (PSYS\_renyi2  $p \leq 0.041$ ; PSYS\_wpsum02  $p \leq 0.018$ ). The results of the other PWV features supported

**TABLE 6 |** Pairwise comparisons from EMMEANS indicating TIME (4 levels) effects between specific measurement times for each GROUP in terms of the measure of factor F1.

Measure	Group [0 = CON, 1 = IGR]	Time		Mean Difference (I–J)	Std. Error	Sig.	95% Confidence interval for difference	
		I	J				Lower bound	Upper bound
EMMEANS—Pairwise comparisons of TIMES per GROUP								
F1	0	1	2	0.198	0.161	n.s.	−0.241	0.636
			3	0.038	0.158	n.s.	−0.392	0.468
			4	0.976	0.162	<0.00	0.536	1.417
		2	1	−0.198	0.161	n.s.	−0.636	0.241
			3	−0.160	0.128	n.s.	−0.508	0.187
			4	0.779	0.171	<0.00	0.314	1.243
		3	1	−0.038	0.158	n.s.	−0.468	0.392
			2	0.160	0.128	n.s.	−0.187	0.508
			4	0.939	0.154	<0.00	0.520	1.358
		4	1	−0.976	0.162	<0.00	−1.417	−0.536
			2	−0.779	0.171	<0.00	−1.243	−0.314
			3	−0.939	0.154	<0.00	−1.358	−0.520
	1	1	2	0.467	0.169	0.044	0.008	0.926
			3	0.381	0.166	n.s.	−0.069	0.831
			4	1.149	0.170	<0.00	0.688	1.610
		2	1	−0.467	0.169	0.044	−0.926	−0.008
			3	−0.086	0.134	n.s.	−0.450	0.279
			4	0.682	0.179	0.002	0.196	1.169
		3	1	−0.381	0.166	n.s.	−0.831	0.069
			2	0.086	0.134	n.s.	−0.279	0.450
			4	0.768	0.161	<0.00	0.329	1.206
		4	1	−1.149	0.170	<0.00	−1.610	−0.688
			2	−0.682	0.179	0.002	−1.169	−0.196
			3	−0.768	0.161	<0.00	−1.206	−0.329

Based on estimated marginal means. The mean difference is significant at the 0.05 level. Adjustment for multiple comparisons: Sidak.

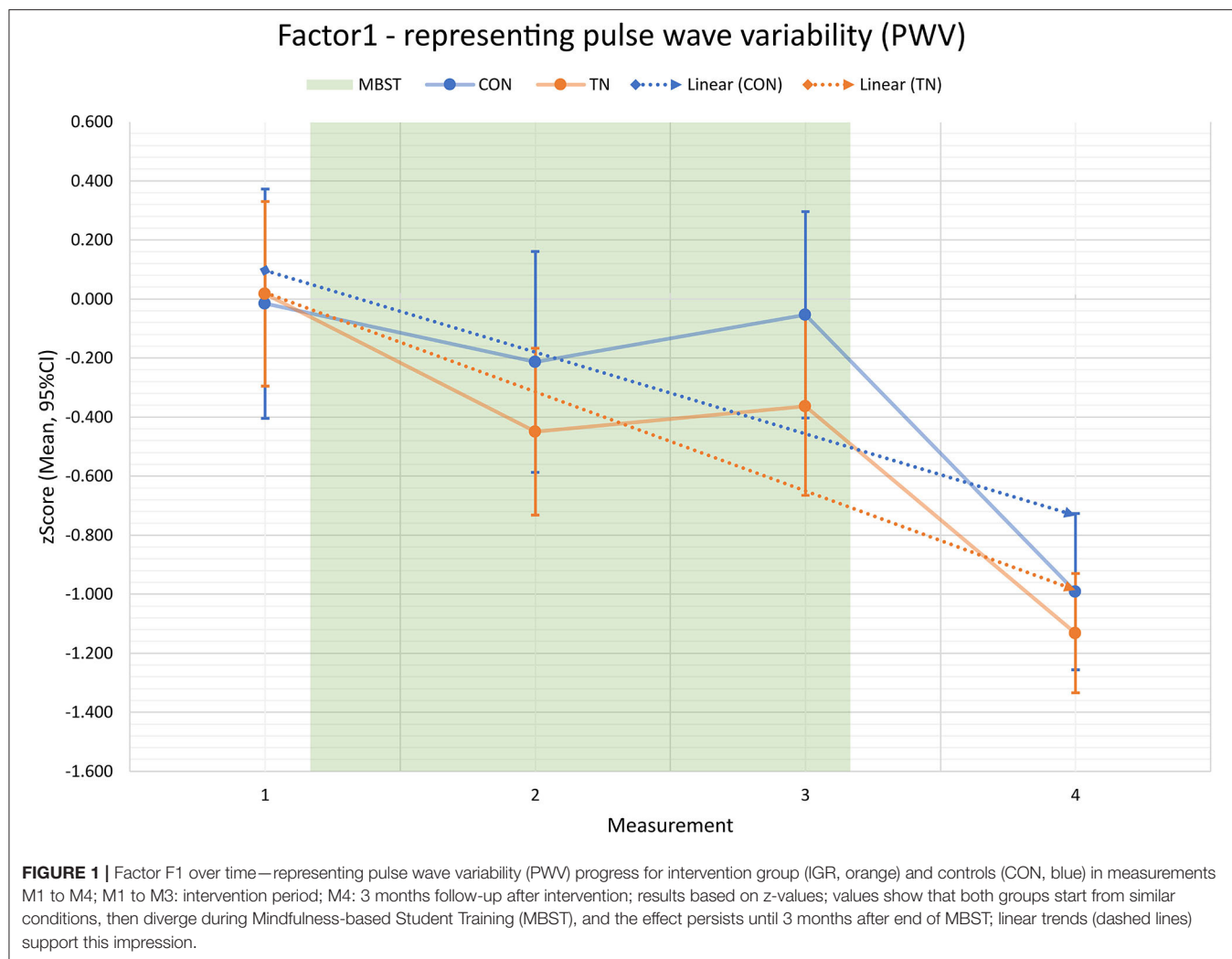
this outcome of exclusive changes for IGR only as trends. The comparison from M2 to M3 was not significant indicating a constant level. Except for M4, we did not notice any significant changes within the progress of CON.

### IGR at M1 to M6 Regarding PWV Variables

First, the multivariate analysis based on the observed data revealed a statistically significant TIME effect (Table 9). But second, there was no statistically significant TIME effect with respect to the multivariate data from the model. However, the pairwise comparisons showed some comparable results to the previous longitudinal comparisons within IGR on the eight PWV features. Most comparisons involving M4 or M6 point to significant differences related to these times. Further, the systolic PWV features PSYS\_sdAMP, PSYS\_renyi2 and PSYS\_wpsum02 revealed significant alterations after 8 weeks of MBST (M1 to M2). However, this time there was no evidence of significant changes from M1 to M3 or M2 to M3 either. Visualization by plots illustrated the progression with decreasing PWV after 8 weeks of MBST (M1 to M2), followed by a slight increase in variability at the end of MBST (M3) and just before the exams. Yet, it remained below the level of M1. Then there

was a notable drop 3 months after the end of the intervention and after summer break (M4). After another 3 months and before the next exams (M5), there was again a major increase to near M1 level. Finally, one year after the end of MBST and during the subsequent semester (M6), the PWV showed another strong reduction toward the level of M4. To provide an entire overview (Figure 3), we have integrated the mixed data into one chart to illustrate the progress of IGR and CON up to 3 months after MBST (M4) as well as the long-term prospect for the intervention participants up to one year in follow-up (M6). Underlying data were based on complete participant strength for both groups through M4 and then continued with reduced participant numbers in IGR through M6. Linear trendlines support the visualization of the progress. Particularly, the graph shows both the built-up difference in vascular variability (represented by PSYS\_sdAMP) between intervention group and controls due to significant MBST induced alterations, and the continuing trend of former MBST participants up to 1 year after course end.

In addition, information was gathered on participants' weekly formal exercise time at home. The weekly officially guided sessions during MBST period were not included in this summary.



**TABLE 7 |** MANOVA results on 8 PWV features—multivariate results from TIME (4 levels) BY GROUP (2 levels) analysis based on 8 pulse wave variability features as dependent variables.

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta squared
<b>Multivariate Test—TIME and GROUP main effects</b>							
Between subjects	Group	0.741	2.440	8	56	0.024	0.26
Within subjects	Time	0.160	8.767	24	40	<0.00	0.84
	Time * Group	0.600	1.111	24	40	n.s.	0.40

Sig. based on Wilks–Lambda at level 0.05 Design, Group; Within Subjects Design, Time. Exact statistic.

The overview in **Figure 4** illustrates the weekly total exercise across all participants as well as the individual averaged exercise time. During the 12-week MBST period the weekly protocolled total exercise time decreased to about 65% at the end of the intervention compared to the first week. The individual time spent for home practice decreased from 75 min after start to 50 min per week at the end of MBST. The surveyed exercise times with increasing intervals in the follow-up showed a further decrease in the months after the end of the course, but also

a slight increase at the measurement dates M4 to M6. The impressions from the short personal interviews showed that most of the former participants had either completely abandoned the exercises they had learned or had increasingly integrated them into their everyday lives. A moderate intermediate path was rarely reported. Based on this information with progressively more divergent engagement in continuation of exercise practice, the results for IGR until M6 are as mentioned only a vague prospect.



**TABLE 8 |** Results of EMMEANS from MANOVA based on 8 PWV features indicating TIME effect within each GROUP.

Group [0 = CON, 1 = IGR]	Value	F	Hypothesis df	Error df	Sig.	Partial Eta squared
<b>EMMEANS—multivariate tests with TIME effect per GROUP</b>						
0	0.249	5.020	24.000	40.000	<0.00	0.751
1	0.255	4.865	24.000	40.000	<0.00	0.745

Each F tests the multivariate simple effects of Time within each level of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means. Exact statistic using Wilks' lambda at significance level 0.05.

# DISCUSSION

In the present longitudinal study, we examined the effects of a 12-weeks Mindfulness-Based Student Training on the autonomic regulation of the intervention participants. Among detailed methodological elements, this student-tailored intervention was primarily intended to strengthen stress management as well as self- and emotion regulation for coping with everyday University life. In this study, the potential beneficial physiological effects were assessed by analyzing HRV, PWV, and respiratory indices. The comparison included the evaluation of a passive control group to estimate group and time effects between and within both groups. The statistical analysis was based on two major steps: factor analysis for summarizing and reducing the rich feature set as well as MANOVA with additional *post-hoc* testing for multivariate and univariate time and group effects.

## Comparison of IGR and CON Up to Three Months Follow-Up

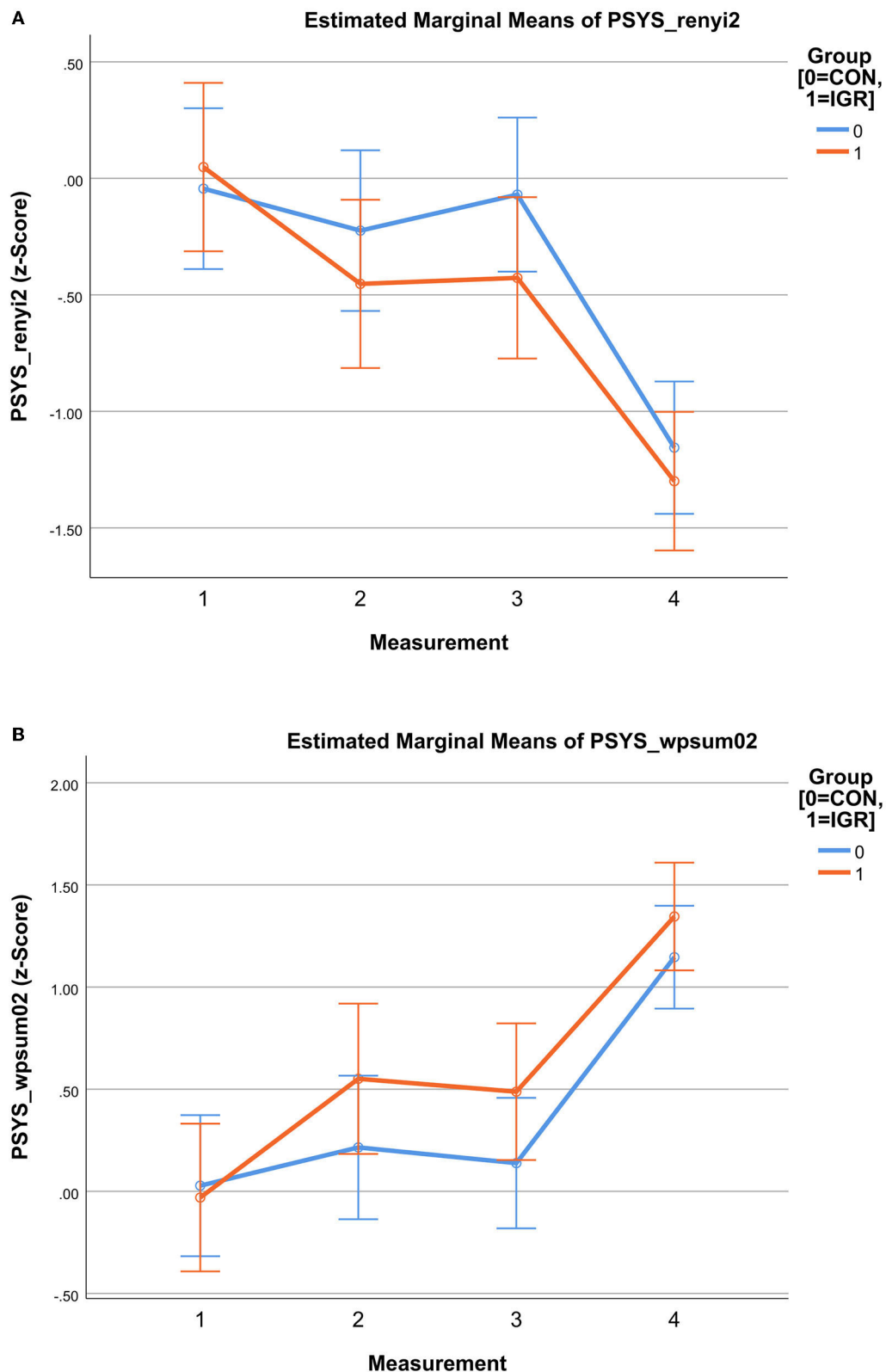
In summary we can admit a positive impact on vascular functions for the MBST intervention group. The first step utilizing a MANOVA with components of a factor analysis estimating HRV, PWV and respiration activity pointed to statistical differences within the PWV. In the second step, the pairwise comparisons gave evidence of significantly reduced PWV after 12 weeks of intervention exclusively within the MBST participants. It can be seen that both groups follow the same trend across the measurement points, though to different degrees. This correlates with the study situation during the semester and is consistent with our perceptions on campus and feedback from participants. This is reflected in slight stress at the beginning of the semester due to new courses and requirements (M1), less stress in the middle of the semester (M2), high stress at exam time at the end of the semester (M3), and significant relaxation at/after semester break (M4). Nevertheless, the MBST with the taught methods for stress management seems to have an effect, as the described trend of the stress effect toward the measurement points is lower in the intervention group and/or a stronger resistance or adaptation can be observed here. Although both groups started at almost the same baseline, the difference in PWV between IGR and CON grew over the intervention duration. Even in a phase of elevated stress due to exams at the University at the end of the intervention, the observed effect persisted. Moreover, the difference was reduced but still observed in the 3-month follow up after end of MBST. Although the effects of summer break on both groups were much greater at this time, resulting in a

decreased PWV and less stress for both groups, there was still a measurable difference in favor of the intervention group. Apart from the vascular features estimated by the PWV, we could not identify evidence of significant changes in HRV or breathing rate, neither over time nor between the groups.

The main finding from this study is that especially the vascular component (surrogate to systolic blood pressure) is positively modeled by MBST. In particular, the systolic vascular variability parameters showed significant differences in non-linear dynamics (renyi2, wpsum02) and in the time domain (sdAMP). This reduced PWV can be interpreted as clear signs of stress reduction, which is discussed in more detail below. Additionally, the trend of the other but non-significant systolic as well as diastolic variability parameters supports this finding.

Short-term blood pressure variability or short-term pulse wave variability on a beat-to-beat basis, as linear and non-linear markers of the (cardio-) vascular system, have not, to our knowledge, been investigated in any other study of mindfulness training in University students to date. A few systematic reviews and meta-analyses suggested that mindfulness-based interventions can reduce blood pressure (37). These studies mostly showed only a reduction in systolic and diastolic blood pressure in people with hypertension (38) or elevated blood pressure. Increased stress levels are associated with coronary heart disease incidence, increased mortality, and poorer health in patients with acute myocardial infarction or hypertension, independent of traditional risk factors. This is a consequence of an altered (cardio-) vascular situation. Long term variability in blood pressure is associated with cardiovascular and mortality outcomes, over and above the effect of mean blood pressure (39). Limited data for mid-term and short-term variability showed similar associations (40). Blood pressure is a continuous, not a static, variable. Individuals exhibiting similar clinic or home blood pressure can differ considerably with respect to their average day and nighttime values, beat-by-beat blood pressure variation during wakefulness and sleep, responses to mental and physical stimuli, and intersession and seasonal variation (41).

High blood pressure variability may be a predictor for the risk of dementia or cognitive impairment. The relative contribution of variability in blood pressure exceeded that of mean blood pressure (42). It could be shown that blood pressure variability has significant association with the quality of life in a small group of mildly hypertensive patients (43). It was concluded that an improvement in quality of life may lead to a favorable change (reduction) in blood pressure variability. Accordingly, the reduction in vascular variability by MBST intervention found in

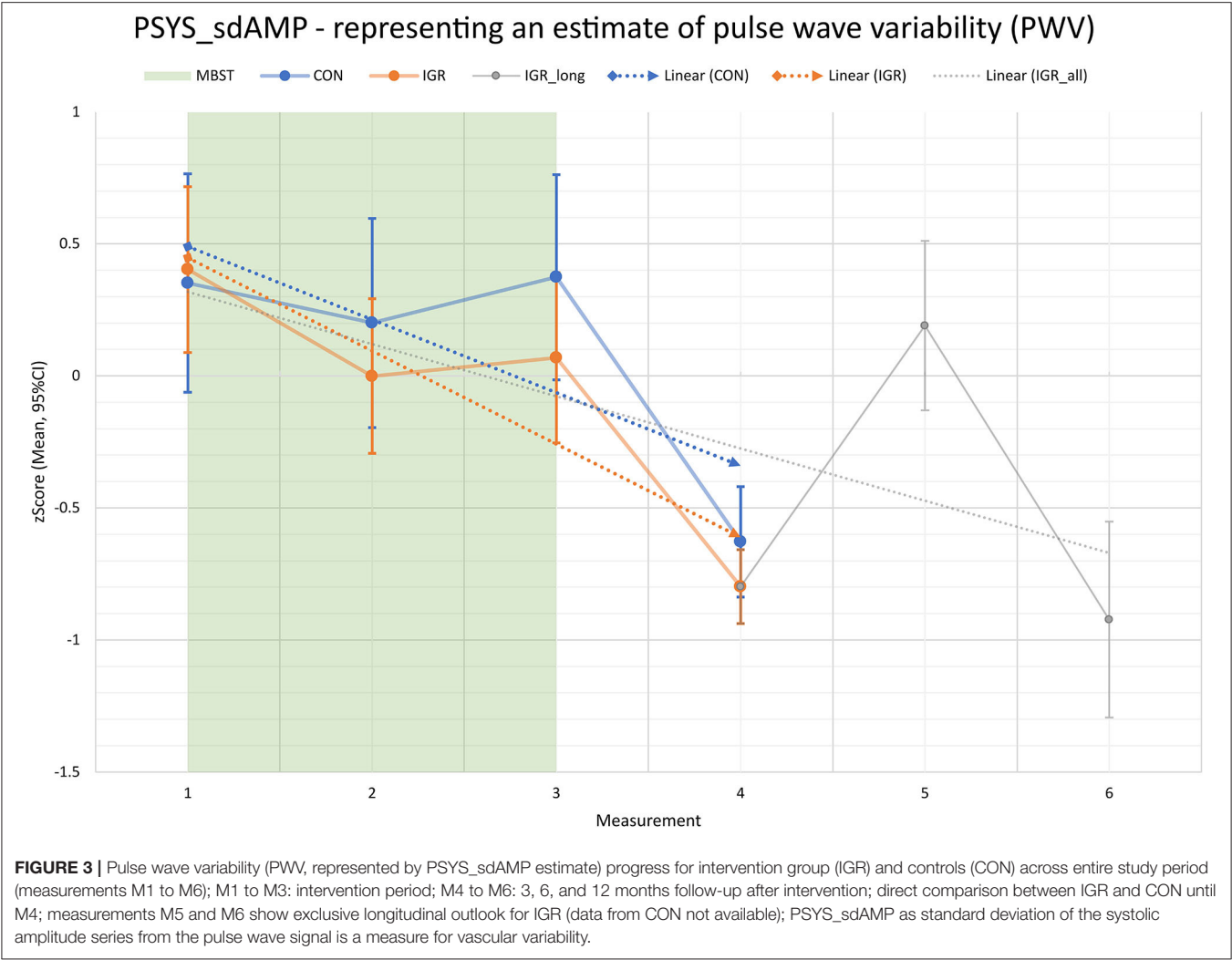


**FIGURE 2 |** Mindfulness-based Student Training (MBST)—results of Estimated Marginal Means of pulse wave variability (PWV) showing the progress for intervention group (IGR) and controls (CON) in measurements M1 to M4; M1 to M3: intervention period; M4: 3 months follow-up after intervention; results based on z-values **(A)** PSYS\_renyi2 as PWV estimate; Rényi2 entropy is a measure for complexity; cardiovascular variability starts similar (M1), then diverges with lower levels for IGR until MBST end (M3) and still remains lower in follow-up (M4); **(B)** PSYS\_wpsum02 as PWV estimate; wpsum02 is a measure for decreased variability (higher values means lower variability); cardiovascular variability starts similar (M1), then diverges with higher levels for IGR until MBST end (M3) and still remains higher in follow-up (M4).

**TABLE 9 |** MANOVA results—multivariate results for intervention group from TIME (6 levels) effect analysis based on 8 pulse wave variability features as dependent variables.

Within subjects effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta squared
<b>Multivariate test—TIME main effect</b>							
Time	Wilks' Lambda	0.162	5.278	40	408.172	<0.00	0.305

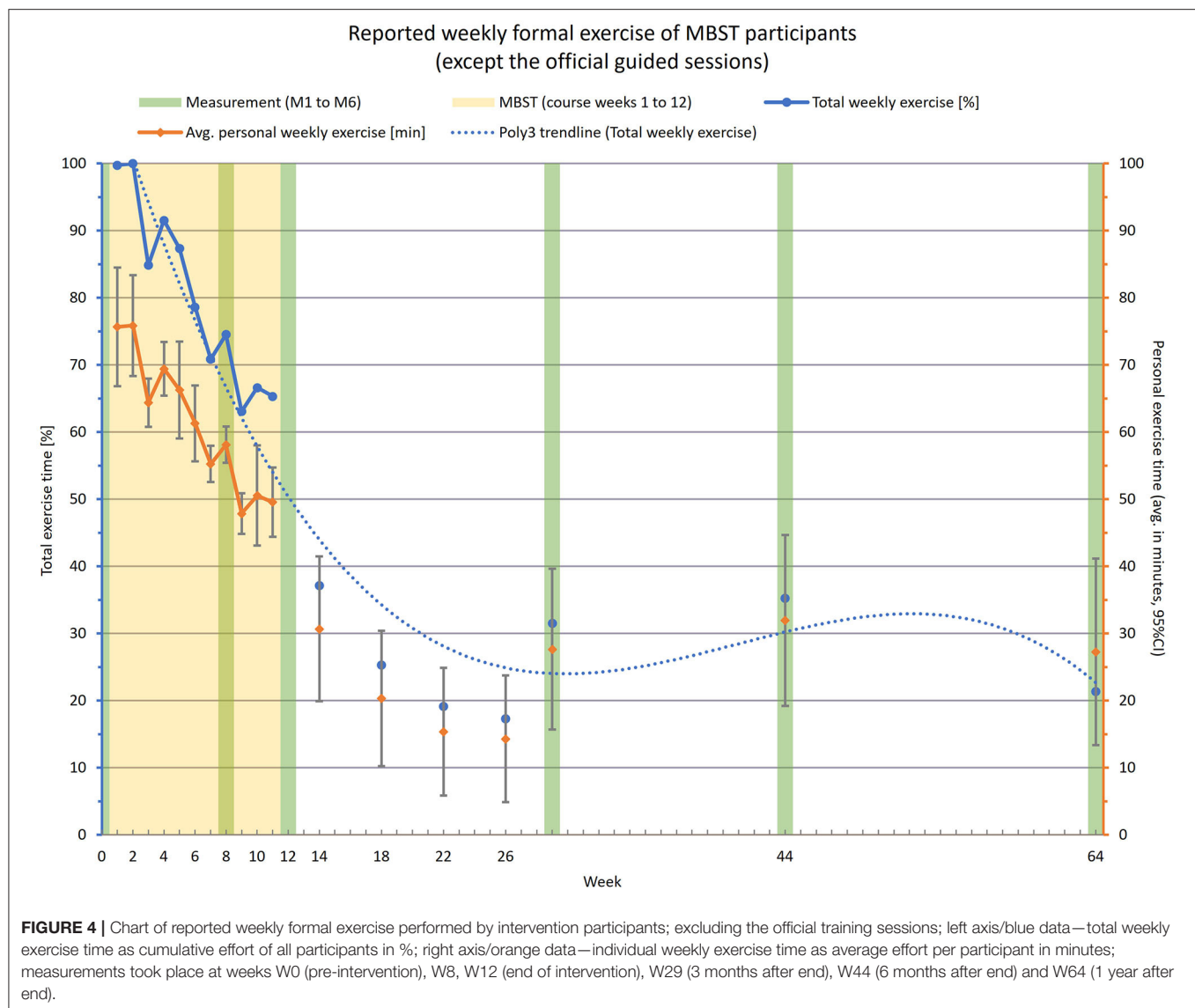
Within Subjects Design: Time. Tests are based on averaged variables. The statistic is an upper bound on F that yields a lower bound on the significance level.



our study may be a clear response in this direction, toward more relaxed, and thus healthier, regulation.

The brain controls the heart directly through the sympathetic and parasympathetic branches of the autonomic nervous system. Cardiac function can be profoundly altered by the reflex activation of cardiac autonomic nerves in response to inputs from baro-, chemo-, nasopharyngeal and other receptors as well as by central autonomic commands, including those associated with stress, physical activity, arousal, and sleep (44). Among other effects, cardiac functions are altered, for example, by disinhibition of subregions of the medial pre-frontal cortex and adjacent regions (45). The autonomic outflow to the heart is

regulated by a central autonomic network of interconnected brain structures, which includes the medial pre-frontal cortex and insular cortex, the amygdala and the bed nucleus of the stria terminalis, the lateral region of the hypothalamus and the paraventricular nucleus and dorsomedial hypothalamic nucleus, the periaqueductal gray matter of the midbrain, the parabrachial Kölliker–Fuse region of the lateral pons, as well as several regions of the medulla (44). Thus, increased mean arterial pressure has been shown to correlate with the response of several cortical and subcortical brain regions thought to be responsible for controlling cardiovascular responses to behavioral stressors (46). These regions include the perigenual



and middle anterior cingulate cortex, medial and lateral regions of the pre-frontal cortex, the insula, the periaqueductal gray mat, and the cerebellum. We hypothesize that the reduction in vascular variability found by stress reduction originates in these brain regions and is ultimately mediated by the baroreflex. A study by Sevinc et al. (47) also points in this direction, showing that mindfulness training improves cognition and strengthens intrinsic connectivity between the hippocampus and posteromedial cortex in healthy older adults.

## Exclusive Long-Term Outlook for IGR Up to One Year Follow-Up

Regarding the longitudinal progress exclusively for the intervention group with up to 1 year follow-up after end of MBST, we can confirm the results and trend of reduced vascular variability. Furthermore, before the exams at the end of the next semester (6 months follow-up), the PWV of

the former participants raised to nearly pre-intervention level and though higher than at the end of MBST. Nevertheless, at 1-year follow-up, another strong decrease in PWV was observed, indicating a positive long-term effect. The linear trend function for the progress of PWV estimates from the (former) MBST participants supports the assessment of a sustainable positive effect.

## Limitations

When considering all the data and results, some limitations of the study should be noted. Since this training was specifically designed for and conducted by University students, the conclusions are not necessarily valid for the general public. In addition, it must be mentioned that most of the participants were students of social sciences (besides students of economics and engineering) and that the gender ratio was biased in favor of women. This double imbalance, in combination with possible



affinities or sensitivities of participant composition, may yield specific influences on the effects of mind-body interventions. The registration process was quasi-randomized (first come first serve due to knowledge of recruitment advertising at University) but not strictly following the procedures of an RCT. Also, the influence of some meta-information as cofactors such as age, gender, sports activities, and meditation or yoga experience has not been investigated. These might affect the impact of MBST training on the participants and thus the results of the study. However, possible influencing factors due to certain diseases and conditions were already excluded at the time of registration due to eligibility requirements. Finally, the outlook on the progress of former intervention participants up to 1 year in follow-up can only serve as an orientation. There was no record of controls for the times beyond the 3 months follow-up which prevents a detailed between-groups comparison regarding long-term effects at 6 months and 1 year after end of intervention. Additionally, many factors in daily life of the former participants might have changed over time (such as the degree of integration of MBST elements in daily routine). The insights from the participants' responses about the (in average) decreasing but also widely diverging extent of reported exercise at home during and after the MBST intervention may emphasize this point.

Stress reduction, as mentioned earlier, is of great personal as well as public health importance in a wide variety of areas. For young people and students, various approaches are being taken in this regard (48), such as the use of yoga (49), meditation (50), biofeedback procedures (51, 52), and even different mindfulness-based interventions (37, 53, 54).

The use of questionnaires in the detection and/or assessment of stress or stress levels has been or is the main approach. Though, there is a growing interest in identifying the physiological parameters representing autonomic regulation that correlate with the detection of stress as well as the reduction of stress levels. In particular, these include electrodermal activity, heart rate, heart rate variability, respiration, blood pressure, pulse, and vascular variability (32, 37, 50, 51, 55). Stress affects the cardio-vascular system, which can be detected by parameters of the pulse curve (32) or blood pressure (56).

The physiological response to an acute stressor is usually much stronger than to a slow increase in or persistence of an elevated stress level (53, 57–59). This effect is particularly evident in studies examining the response of autonomic regulation in the form of HRV and respiration. In contrast, the parameters of the vascular system (*via* PWV) seem to be more sensitive regarding the latter effect, according to our experience.

The most important finding of this study is that MBST in particular has a positive effect on certain parameters of the cardio-vascular system not only acutely but also persistently, which can be considered as a promising marker of sustained stress level reduction in students.

## Implications of the Study

The impact analysis of mindfulness training has already been the subject of numerous scientific studies in the past. The article

by Haase and Lautenschläger (60) is specifically dedicated to the formats designed and implemented within the framework of the Thuringian Model Mindful Universities. It asks in particular to what extent the MBST can have an effect on mindfulness, stress perception, internet addiction and well-being of students. Standardized instruments were used to survey 197 participants in 12 MBST courses between April 2018 and July 2019. The results show that significant changes in mindfulness, subjective stress levels, and compulsive or unhealthy Internet use among participants can be identified from the comparison of measurements at the beginning and end of the event cycles. Even though the analysis of Haase and Lautenschläger (60) has limitations resulting from the exploratory study design, especially the lack of a control group, and even though causal relationships cannot be derived with the chosen research design, it underlines the potential of MBST for students with regard to stress management and the improvement of daily life. Their study complements the present study and points to the effectiveness of MBST also with regard to the life-serving use of digital media.

The downside of the multitude of new digital possibilities and constant accessibility is feeling permanently driven. What can be observed is a dissolution of boundaries and new dangers of addiction (61, 62). In this way, digitalization also has a considerable impact on the mental landscape of students and also on their physical health. At the same time, the observed excessive use of smartphones and social media is a risk factor for academic performance (63). Here, according to the studies, MBST has the potential to counteract at various levels.

This is especially true in light of a worrisome trend. Despite the multitude of social media, studies observe a growing loneliness (e.g., Spitzer (64) p.117ff). Sherry Turkle, Professor of Science, Technology and Society at the Massachusetts Institute of Technology (MIT) puts it in the following words: "We slip into thinking that always being connected is going to make us less lonely. But we are at risk because it is actually the reverse: If we are unable to be alone, we will be more lonely. And if we don't teach our children to be alone, they will only know how to be lonely." (65).

## Conclusion

The results of this MBST evaluation study, based on analysis of key indices of autonomic regulation represented by PWV, HRV, and respiratory activity, show a sustained positive effect toward stress reduction. Participants primarily benefit from reduced vascular variability, reflecting improved autonomic function through reduction of PWV. This effect can already be seen after 8 weeks of intervention, confirming the results of our first preliminary study. Moreover, it persists for 3 months after the end of the 12-week intervention phase. Furthermore, the results of the long-term analysis up to 1 year after the end of MBST indicate a long-lasting effect among former participants. This effect could be further enhanced by continued practice and integration of the taught exercises as well as the concepts into everyday life. In perspective, our results could provide guidance for future applications to monitor individual stress levels and intervention progress through wearables with pulse wave analysis.

Due to the positive physiological effect, the MBST intervention can make a meaningful and sustainable contribution to stress reduction and thus to health prevention among students.

## DATA AVAILABILITY STATEMENT

The data of this study are not publicly available because the study has not yet been completed, and further evaluations are currently in progress. However, the data are available on request from the corresponding author.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Ethics Commission of the University Hospital Jena (4509-08/15). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

Conceptualization: AV, MB, and MS. Methodology, validation, and formal analysis: AV, MB, and MW. Software, visualization,

writing—original draft preparation, and project administration: AV and MB. Investigation: MB, BL, and RA. Resources: AV, MB, BL, and RA. Data curation: MB. Writing—review and editing: AV, MB, MW, MS, and GS. Supervision: AV. Funding acquisition: AV and MS. All authors have read and agreed to the published version of the manuscript.

## FUNDING

The proposed study was funded by the health insurance AOK PLUS as a member of The Federal Association of AOK-Bundesverband GbR in Germany. An exertion of influence by the funder did not take place. The funder was not involved in the study design, collection, analysis, interpretation of data, the writing of this article or the decision to submit it for publication.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.863671/full#supplementary-material>

## REFERENCES

- Hong H, Ji M, Lai D. Chronic stress effects on tumor: pathway and mechanism. *Front Oncol.* (2021) 11:738252. doi: 10.3389/fonc.2021.738252
- Ilich JZ, Gilman JC, Cvijetic S, Boschiero D. Chronic stress contributes to osteosarcopenic adiposity via inflammation and immune modulation: the case for more precise nutritional investigation. *Nutrients.* (2020) 12:12040989. doi: 10.3390/nu12040989
- McEwen BS, Stellar E. Stress and the individual. mechanisms leading to disease. *Arch Intern Med.* (1993) 153:2093–101. doi: 10.1001/archinte.153.18.2093
- Mohammadi S, Zandi M, Dousti Katay P, Karimi Zandi L. Chronic stress and Alzheimer's disease. *Biotechnol Appl Biochem.* (2021). doi: 10.1002/bab.2216
- Straub RH, Cutolo M. Psychoneuroimmunology-developments in stress research. *Wien Med Wochenschr.* (2018) 168:76–84. doi: 10.1007/s10354-017-0574-2
- Glaser R, Kiecolt-Glaser J. How stress damages immune system and health. *Discov Med.* (2005) 5:165–9. doi: 10.1038/nri1571
- Tian R, Hou G, Li D, Yuan T-F. A possible change process of inflammatory cytokines in the prolonged chronic stress and its ultimate implications for health. *Sci World J.* (2014) 2014:8. doi: 10.1155/2014/780616
- Voss A, Fischer C, Schroeder R, Figulla HR, Goernig M. Segmented poincare plot analysis for risk stratification in patients with dilated cardiomyopathy. *Methods Inf Med.* (2010) 49:511–5.
- Schwartz BG, French WJ, Mayeda GS, Burstein S, Economides C, Bhandari AK, et al. Emotional stressors trigger cardiovascular events. *Int J Clin Pract.* (2012) 66:631–9. doi: 10.1111/j.1742-1241.2012.02920.x
- Wirtz PH, von Kanel R. Psychological stress, inflammation, and coronary heart disease. *Curr Cardiol Rep.* (2017) 19:111. doi: 10.1007/s11886-017-0919-x
- Koschke M, Boettger MK, Schulz S, Berger S, Terhaar J, Voss A, et al. Autonomy of autonomic dysfunction in major depression. *Psychosom Med.* (2009) 71:852–60. doi: 10.1097/PSY.0b013e3181b8bb7a
- Marin MF, Lord C, Andrews J, Juster RP, Sindi S, Arsénault-Lapierre G, et al. Chronic stress, cognitive functioning and mental health. *Neurobiol Learn Mem.* (2011) 96:583–95. doi: 10.1016/j.nlm.2011.02.016
- Agorastos A, Stiedl O, Heinig A, Sommer A, Hager T, Freundlieb N, et al. Inverse autonomic stress reactivity in depressed patients with and without prior history of depression. *J Psychiatr Res.* (2020) 131:114–8. doi: 10.1016/j.jpsychires.2020.09.016
- Wekenborg MK, Hill LK, Thayer JF, Penz M, Wittling RA, Kirschbaum C. The longitudinal association of reduced vagal tone with burnout. *Psychosom Med.* (2019) 81:791–8.
- Sjors Dahlman A, Jonsdottir IH, Hansson C. The hypothalamo-pituitary-adrenal axis and the autonomic nervous system in burnout. *Handb Clin Neurol.* (2021) 182:83–94. doi: 10.1016/B978-0-12-819973-2.00006-X
- Kakiashvili T, Leszek J, Rutkowski K. The medical perspective on burnout. *Int J Occup Med Environ Health.* (2013) 26:401–12. doi: 10.2478/s13382-013-0093-3
- Aronsson G, Theorell T, Grape T, Hammarstrom A, Hogstedt C, Marteinsdottir I, et al. A systematic review including meta-analysis of work environment and burnout symptoms. *BMC Public Health.* (2017) 17:264. doi: 10.1186/s12889-017-4153-7
- WHO. Burn-out an “occupational phenomenon”: International Classification of Diseases: World Health Organization (2019). Available from: <https://www.who.int/news/item/28-05-2019-burn-out-an-occupational-phenomenon-international-classification-of-diseases> [cited 2021 August 6, 2021].
- WHO. Burnout in the International statistical classification of diseases and related health problems (11th ed.): World Health Organization (2021). Available from: <https://icd.who.int/browse11/l-m/en#/http://id.who.int/icd/entity/129180281> [cited 2021 August 6, 2021].
- Ribeiro ÍJS, Pereira R, Freire IV, de Oliveira BG, Casotti CA, Boery EN. Stress and quality of life among University students: a systematic literature review. *Health Prof Edu.* (2018) 4:70–7. doi: 10.1016/j.hpe.2017.03.002
- Keech JJ, Hagger MS, O'Callaghan FV, Hamilton K. The influence of University Students' Stress mindsets on health and performance outcomes. *Ann Behav Med.* (2018) 52:1046–59. doi: 10.1093/abm/kay008
- Kabat-Zinn J. *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness*. NYC: Dell Paperbacks/Delacorte Press (1990).
- Christopher MS, Rogers B, Hunsinger M, Colgan D, Reiss AL, Farwood HB. Distinguishing mindful process from outcome in the prediction of global health and perceived stress in a mindfulness-based stress

- reduction program. *Mindfulness*. (2015) 6:693–9. doi: 10.1007/s12671-014-0305-3
24. Hindman RK, Glass CR, Arnkoff DB, Maron DD. A comparison of formal and informal mindfulness programs for stress reduction in University Students. *Mindfulness*. (2015) 6:873–84. doi: 10.1007/s12671-014-0331-1
  25. Janssen M, Heerkens Y, Kuijter W, van der Heijden B, Engels J. Effects of mindfulness-based stress reduction on employees' mental health: a systematic review. *PLoS ONE*. (2018) 13:e0191332. doi: 10.1371/journal.pone.0191332
  26. Stefan CA, Capraru C, Szilágyi M. Investigating effects and mechanisms of a mindfulness-based stress reduction intervention in a sample of college students at risk for social anxiety. *Mindfulness*. (2018) 9:1509–21. doi: 10.1007/s12671-018-0899-y
  27. Sanada K, Montero-Marin J, Alda Diez M, Salas-Valero M, Perez-Yus MC, Morillo H, et al. Effects of mindfulness-based interventions on salivary cortisol in healthy adults: a meta-analytical review. *Front Physiol*. (2016) 7:471. doi: 10.3389/fphys.2016.00471
  28. Sanada K, Alda Diez M, Salas Valero M, Perez-Yus MC, Demarzo MM, Montero-Marin J, et al. Effects of mindfulness-based interventions on biomarkers in healthy and cancer populations: a systematic review. *BMC Complement Altern Med*. (2017) 17:125. doi: 10.1186/s12906-017-1638-y
  29. Abbott RA, Whear R, Rodgers LR, Bethel A, Thompson Coon J, Kuyken W, et al. Effectiveness of mindfulness-based stress reduction and mindfulness based cognitive therapy in vascular disease: a systematic review and meta-analysis of randomised controlled trials. *J Psychosom Res*. (2014) 76:341–51. doi: 10.1016/j.jpsychores.2014.02.012
  30. Sharma M, Rush SE. Mindfulness-based stress reduction as a stress management intervention for healthy individuals: a systematic review. *J Evid Based Complementary Altern Med*. (2014) 19:271–86. doi: 10.1177/2156587214543143
  31. Wielgosz J, Schuyler BS, Lutz A, Davidson RJ. Long-term mindfulness training is associated with reliable differences in resting respiration rate. *Sci Rep*. (2016) 6:27533. doi: 10.1038/srep27533
  32. Voss A, Bogdanski M, Langohr B, Albrecht R, Sandbothe M. Mindfulness-Based student training leads to a reduction in physiological evaluated stress. *Front Psychol*. (2020) 11:645. doi: 10.3389/fpsyg.2020.00645
  33. TaskForce. Heart rate variability: standards of measurement, physiological interpretation and clinical use. task force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. *Circulation*. (1996) 1:1043–65. doi: 10.1111/j.1542-474X.1996.tb00275.x
  34. Hoyer D, Leder U, Hoyer H, Pompe B, Sommer M, Zwiener U. Mutual information and phase dependencies: measures of reduced nonlinear cardiorespiratory interactions after myocardial infarction. *Med Eng Phys*. (2002) 24:33–43. doi: 10.1016/S1350-4533(01)00120-5
  35. Schulz S, Tupaika N, Berger S, Haueisen J, Bar KJ, Voss A. Cardiovascular coupling analysis with high-resolution joint symbolic dynamics in patients suffering from acute schizophrenia. *Physiol Meas*. (2013) 34:883–901. doi: 10.1088/0967-3334/34/8/883
  36. Kurths J, Voss A, Saparin P, Witt A, Kleiner HJ, Wessel N. Quantitative analysis of heart rate variability. *Chaos*. (1995) 5:88–94. doi: 10.1063/1.166090
  37. Zhang D, Lee EKP, Mak ECW, Ho CY, Wong SYS. Mindfulness-based interventions: an overall review. *Br Med Bull*. (2021) 138:41–57. doi: 10.1093/bmb/ldab005
  38. Clemow LP, Pickering TG, Davidson KW, Schwartz JE, Williams VP, Shaffer JA, et al. Stress management in the workplace for employees with hypertension: a randomized controlled trial. *Transl Behav Med*. (2018) 8:761–70. doi: 10.1093/tbm/iby018
  39. Stevens SL, Wood S, Koshieris C, Law K, Glasziou P, Stevens RJ, et al. Blood pressure variability and cardiovascular disease: systematic review and meta-analysis. *BMJ*. (2016) 354:i4098. doi: 10.1136/bmj.i4098
  40. Palatini P, Reboldi G, Beilin LJ, Casiglia E, Eguchi K, Imai Y, et al. Added predictive value of night-time blood pressure variability for cardiovascular events and mortality: the Ambulatory Blood Pressure-International Study. *Hypertension*. (2014) 64:487–93. doi: 10.1161/HYPERTENSIONAHA.114.03694
  41. Floras JS. Blood pressure variability: a novel and important risk factor. *Can J Cardiol*. (2013) 29:557–63. doi: 10.1016/j.cjca.2013.02.012
  42. de Heus RAA, Tzourio C, Lee EJL, Opozda M, Vincent AD, Anstey KJ, et al. Association between blood pressure variability with dementia and cognitive impairment: a systematic review and meta-analysis. *Hypertension*. (2021) 78:1478–89. doi: 10.1161/HYPERTENSIONAHA.121.17797
  43. Sung J, Woo JM, Kim W, Lim SK, Chung AS. Relationship between blood pressure variability and the quality of life. *Yonsei Med J*. (2014) 55:374–8. doi: 10.3349/ymj.2014.55.2.374
  44. Silvani A, Calandra-Buonaura G, Dampney RA, Cortelli P. Brain-heart interactions: physiology and clinical implications. *Philos Trans A Math Phys Eng Sci*. (2016) 374:181. doi: 10.1098/rsta.2015.0181
  45. Hassan SF, Cornish JL, Goodchild AK. Respiratory, metabolic and cardiac functions are altered by disinhibition of subregions of the medial prefrontal cortex. *J Physiol*. (2013) 591:6069–88. doi: 10.1113/jphysiol.2013.262071
  46. Gianaros PJ, Derbyshire SW, May JC, Siegle GJ, Gamalo MA, Jennings JR. Anterior cingulate activity correlates with blood pressure during stress. *Psychophysiology*. (2005) 42:627–35. doi: 10.1111/j.1469-8986.2005.00366.x
  47. Sevinc G, Rusche J, Wong B, Datta T, Kaufman R, Gutz SE, et al. Mindfulness training improves cognition and strengthens intrinsic connectivity between the Hippocampus and posteromedial cortex in healthy older adults. *Front Aging Neurosci*. (2021) 13:702796. doi: 10.3389/fnagi.2021.702796
  48. Tortella GR, Seabra AB, Padrao J, Diaz-San Juan R. Mindfulness and other simple neuroscience-based proposals to promote the learning performance and mental health of students during the COVID-19 pandemic. *Brain Sci*. (2021) 11:11050552. doi: 10.3390/brainsci11050552
  49. Elstad T, Ulleberg P, Klonteig S, Hisdal J, Dyrdaal GM, Bjorndal A. The effects of yoga on student mental health: a randomised controlled trial. *Health Psychol Behav Med*. (2020) 8:573–86. doi: 10.1080/21642850.2020.1843466
  50. Kashevnik A, Othman W, Ryabchikov I, Shilov N. Estimation of motion and respiratory characteristics during the meditation practice based on video analysis. *Sensors (Basel)*. (2021) 21:3771. doi: 10.3390/s21113771
  51. Subhani AR, Kamel N, Mohamad Saad MN, Nandagopal N, Kang K, Malik AS. Mitigation of stress: new treatment alternatives. *Cogn Neurodyn*. (2018) 12:1–20. doi: 10.1007/s11571-017-9460-2
  52. Can YS, Iles-Smith H, Chalabianloo N, Ekiz D, Fernandez-Alvarez J, Repetto C, et al. How to relax in stressful situations: a smart stress reduction system. *Healthcare (Basel)*. (2020) 8:8020100. doi: 10.3390/healthcare8020100
  53. Kuhlmann SM, Huss M, Burger A, Hammerle F. Coping with stress in medical students: results of a randomized controlled trial using a mindfulness-based stress prevention training (MediMind) in Germany. *BMC Med Educ*. (2016) 16:316. doi: 10.1186/s12909-016-0833-8
  54. Klingbeil DA, Renshaw TL, Willenbrink JB, Copek RA, Chan KT, Haddock A, et al. Mindfulness-based interventions with youth: a comprehensive meta-analysis of group-design studies. *J Sch Psychol*. (2017) 63:77–103.
  55. Vavrinsky E, Stopjakova V, Kopani M, Kosnacova H. The concept of advanced multi-sensor monitoring of human stress. *Sensors (Basel)*. (2021). 21:1103499. doi: 10.3390/s211103499
  56. Celka P, Charlton PH, Farukh B, Chowieńczyk P, Alastruey J. Influence of mental stress on the pulse wave features of photoplethysmograms. *Healthc Technol Lett*. (2020) 7:7–12. doi: 10.1049/htl.2019.0001
  57. Neureiter E, Hajfani L, Ahnis A, Mierke A, Rose M, Danzer G, et al. An introduction to the 'Psycho-Physiological-Stress-Test' (PPST)-a standardized instrument for evaluating stress reactions. *PLoS ONE*. (2017) 12:e0187859. doi: 10.1371/journal.pone.0187859
  58. Meeuwse KD, Groeneveld KM, Walker LA, Mennenga AM, Tittle RK, White EK. Z-score neurofeedback, heart rate variability biofeedback, and brain coaching for older adults with memory concerns. *Restor Neurol Neurosci*. (2021) 39:9–37. doi: 10.3233/RNN-201053
  59. van der Zwan JE, Huizink AC, Lehrer PM, Koot HM, de Vente W. The effect of heart rate variability biofeedback training on mental health of pregnant and non-pregnant women: a randomized controlled trial. *Int J Environ Res Public Health*. (2019) 16:1051. doi: 10.3390/ijerph16061051
  60. Haase H, Lautenschläger A. Wie wirken MBST und MBET auf Achtsamkeit, Stressempfinden, Internetabhängigkeit und Wohlbefinden? In: Sandbothe M, Albrecht R, editors. *Achtsame Hochschulen in der digitalen Gesellschaft*. Bielefeld, Germany: transcript Verlag (2022).
  61. Brewer J, Kabat-Zinn J. *The Craving Mind: From Cigarettes to Smartphones to Love—Why We Get Hooked and How We Can Break Bad Habits*. New Haven: Yale University Press (2017).

62. Shapka JD. Adolescent technology engagement: it is more complicated than a lack of self-control. *Human Behav Emerg Technol.* (2019) 1:103–10. doi: 10.1002/hbe2.144
63. Domoff SE, Foley RP, Ferkel R. Addictive phone use and academic performance in adolescents. *Human Behav Emerg Technol.* (2020) 2:33–8. doi: 10.1002/hbe2.171
64. Spitzer M. *Einsamkeit - Die Unerkannte Krankheit: Schmerzhaft, Ansteckend. Tödlich*: Droemer eBook (2018).
65. Turkle S. *Reclaiming Conversation: The Power of Talk in a Digital Age*. NY: Penguin Pres (2015).

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Voss, Bogdanski, Walther, Langohr, Albrecht, Seifert and Sandbothe. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.





## OPEN ACCESS

## EDITED BY

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

## REVIEWED BY

Chuanhua Gu,  
Central China Normal University, China  
Lutchmie Narine,  
Syracuse University, United States  
Patrick Soh,  
Multimedia University, Malaysia  
Wenhao Pan,  
South China University of  
Technology, China

## \*CORRESPONDENCE

Xiaochen Wang  
leo197837@163.com

## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

RECEIVED 27 March 2022

ACCEPTED 30 June 2022

PUBLISHED 26 July 2022

## CITATION

Li Q, Xia B, Zhang H, Wang W and  
Wang X (2022) College students'  
cyberloafing and the sense of meaning  
of life: The mediating role of state  
anxiety and the moderating role of  
psychological flexibility.  
*Front. Public Health* 10:905699.  
doi: 10.3389/fpubh.2022.905699

## COPYRIGHT

© 2022 Li, Xia, Zhang, Wang and Wang.  
This is an open-access article  
distributed under the terms of the  
[Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/)  
(CC BY). The use, distribution or  
reproduction in other forums is  
permitted, provided the original  
author(s) and the copyright owner(s)  
are credited and that the original  
publication in this journal is cited, in  
accordance with accepted academic  
practice. No use, distribution or  
reproduction is permitted which does  
not comply with these terms.

# College students' cyberloafing and the sense of meaning of life: The mediating role of state anxiety and the moderating role of psychological flexibility

Qing Li<sup>1</sup>, Bingnan Xia<sup>2</sup>, Huijia Zhang<sup>3</sup>, Wei Wang<sup>4</sup> and  
Xiaochen Wang<sup>2\*</sup>

<sup>1</sup>School of Marxism, Communication University of Zhejiang, Hangzhou, China, <sup>2</sup>School of Business Administration, Zhejiang Gongshang University, Hangzhou, China, <sup>3</sup>Office of Academic Research, Zhejiang Gongshang University Hangzhou College of Commerce, Hangzhou, China, <sup>4</sup>Hangzhou Zhongxing Hospital, Hangzhou, China

**Background:** With the gradual penetration of network media into various fields of people's life, the relationship between network behavior and the sense of meaning of life is bound to be closer and closer. The purpose of this study is to explore the mediating role of state anxiety between cyber loafing and the sense of meaning of life, and the moderating role of psychological flexibility in this mediating relationship.

**Methodology:** With 964 undergraduates recruited as subjects three-wave-time-lagged quantitative research design was conducted in China. All participants were required to complete a self-reported electronic questionnaire. Then, the mediating mechanism and moderating effect were explored with utilization of SPSS25.0.

**Results:** The results showed that cyberloafing had significant negative correlation with the sense of meaning of life. Our analysis testing the mediating effect showed that state anxiety partially mediated the relationship between cyberloafing and the sense of meaning of life (indirect effect =  $-0.05$ ,  $p < 0.01$ ), while the mediating effect was 31.25% of the total effect. Our analysis testing the moderating effect showed that psychological flexibility significantly moderated the relationship between cyberloafing and state anxiety (interaction effect =  $-0.26$ ,  $p < 0.01$ ). And our analysis testing the moderated mediating effect showed that psychological flexibility played a moderating role in the mediating effect of state anxiety.

**Conclusion:** Based on the findings of this study, college students' cyberloafing negatively affects their sense of meaning of life. Therefore, appropriate measures should be taken to supervise and restrict college students' Internet use and provide them with corresponding guidance; certain psychological adjustment measures should also be taken when necessary to help college students with low psychological flexibility in reducing their state anxiety and improving their sense of meaning of life.

## KEYWORDS

college students, cyberloafing, the sense of meaning of life, psychological flexibility, state anxiety

## Introduction

With the leaping development of Internet technology, the widespread use of computers, mobile phones and other devices in the e-learning environment has not only created great convenience for learning, but also prompted college students to enter the era of pan-entertainment. The use of electronic media by college students not for the purpose of learning, in or out of class when completing learning tasks (1, 2) is referred to as cyberloafing in learning. Researchers believe that cyberloafing is a problematic behavior of network use (3), and it has become a prevailing topic in the field of psychological research exploring the impact of this commonly seen network behavior among college students.

Cyberloafing was originally used to describe the phenomenon that employees use the network tools provided by the organization to browse non-work-related websites, sending and receiving personal e-mails, which has an impact on job performance during working hours. Recent research studies on cyberloafing mainly focus on the field of organizational behaviors in firms. However, some studies have revealed that cyberloafing among college students, which has deviated them from learning, is even more serious than that among employees (1). However, empirical studies on college students' cyberloafing mainly focus on the impact of college students' cyberloafing on their academic performance and mental health. For example, college students' cyberloafing could lead to decreased attention toward their academic work and poor performance in learning (4, 5). Also, cyberloafing is negatively correlated with subjective wellbeing (6), which can lead to depression (7). Such studies mainly focus on the outcome variables of cyberloafing, leaving the internal mechanism of this negative impact caused by cyberloafing insufficiently explored. Therefore, this study would provide certain theoretical value and practical significance through expanding the research on the impact of college students' cyberloafing and revealing related internal mechanisms.

## The relationship between cyberloafing and the sense of meaning of life

Current research evidence still show some inconsistencies on the impact caused by cyberloafing. Among these researches, some believe that cyberloafing has a negative impact on both organizations and employees. For example, it is found that cyberloafing will lead to loss of organizational productivity (8) and psychological stress of employees (9); it also triggers negative emotions (10) and reduces job satisfaction among employees (11). Nonetheless, some researchers believe that cyberloafing can promote the recovery of work, temporarily reduce pressure and mental tension brought by work; through

providing a feeling of relaxation to employees, cyberloafing can improve employees' devotion to follow-up work; this is because cyberloafing can further complement important emotional resources for employees and indirectly promotes their efficiency in achieving work tasks (12). Research on college students' cyberloafing showed that using the Internet in class was related to lower emotional wellbeing, which showed more depression symptoms and higher social anxiety (13). However, some studies have found that students would experience more positive emotions and less negative emotions after participating in cyberloafing (14). Therefore, it is necessary to explore the impact of cyberloafing on individual psychology and behavior.

The social displacement hypothesis holds that the use of network media encroaches on people's time for social interaction and other activities in their daily life and makes it easier for them to fall into depression and suffer alienation, which would eventually reduce individual sense of happiness (15). For college students, cyberloafing takes up a large portion of their time which should have been devoted to learning and consumes certain amount of scarce attention resources (16). The sense of meaning of life is understood as having a strong sense of life purpose, pursuing valuable personal goals, or having a clear value system that can guide one's actions (17). Internet addiction negatively predicted the sense of meaning of life (18). With the gradual penetration of network media into all fields of people's life, the relationship between network behavior and the sense of meaning of life is bound to be closer and closer. However, at present, few studies pay attention to the relationship between cyberloafing and the sense of meaning of life. Therefore, we presume that cyberloafing may create anxiety and trigger confusion as regard to the value and goal of life and learning, and put forward the following hypothesis.

H1: Cyberloafing significantly and negatively predict the sense of meaning of life.

## The mediating role of state anxiety

State anxiety refers to the state of immediate anxiety in a specific scene at present or in a specific period of time (19). When an individual encounters external or internal stimulus (such as thought, psychological needs, etc.), the existence of threat can be felt by his or her body, and the emotion of state anxiety will arise. Researchers have pointed out that cyberloafing will increase employees' work anxiety, thus depleting their emotional resources and weakening their sense of meaning in work (20). In addition, excessive use of the Internet will have a negative impact on the physical and mental health of individuals, such as the increase of anxiety and depression (13). Previous studies have shown that addiction to social media would have a negative impact on individuals. For example, excessive use of Wechat (a social media platform in China which is equivalent to

twitter) will also affect teenagers' physical and mental health, as well as their academic performance (21). According to the stress transactional model of Lazarus and Folkman (22), when people think the events they experience are harmful or threatening, exposure to these pressures will lead to negative physical (such as elevated blood pressure), psychological (anger and anxiety) or behavioral (leaving the status quo) results. According to the research by Becker et al. (13) students who used the Internet in class exhibited more depressive symptoms, higher stress and anxiety. Thus, it can be inferred that college students' cyberloafing during learning can be regarded as an investment of limited learning resources (such as time and energy) in non-learning fields. This irrational allocation of learning resources can be problematic, which would lead to increased psychological pressure and anxiety. This transient experience of tension in learning can be very easily changed with variation of the surrounding environment. This is a typical manifestation of psychological distress leading to resource loss (23). Therefore, this study puts forward the following hypothesis.

H2: Cyberloafing is positively correlated with state anxiety.

With occurrence of anxiety in social communication, college students' perceived subjective wellbeing will also decrease (24). The higher one's state anxiety level is, the lower one's sense of wellbeing is, and the sense of wellbeing is positively correlated with the sense of meaning of life (25). In addition, anxiety is a kind of negative emotion. Negative emotional experience increases the risk of anxiety and depression (26), which would diminish their sentiment in the sense of meaning of life (27, 28). Zhang et al. (29) found that there was a significant negative correlation between negative indicators of mental health (such as trait anxiety) and the sense of meaning of life. Individuals with trait anxiety are easily attracted by negative emotional information in the environment, which leads to habitual indulgence in anxiety, resulting in state anxiety, and then in reduced the sense of meaning of life (30). Thus, we propose that cyberloafing will intensify college students' state anxiety and reduce their sense of meaning of life. Therefore, the following assumptions are put forward.

H3: State anxiety has a negative impact on the sense of meaning of life.

H4: State anxiety mediates the relationship between cyberloafing and the sense of meaning of life.

## The moderating role of psychological flexibility

According to the organism-environment interaction model, individuals develop differently (more or less sensitive) to

similar environments depending on certain intrinsic personal attributes, and thus show different adaptive outcomes (31). Yet, there are no empirical studies examining the moderating role of individual intrinsic attributes in the direct or indirect relationship between online loafing and sense of meaning in life. Psychological flexibility means that individuals consciously contact the present situation in a flexible and independent way, and act according to their own values in light of the conditions provided by the environment (32). Individuals with psychological flexibility pay attention to their current life experience and feelings with a receptive attitude, by observing those conceptualized self-experiences from the perspective of a third party, and actively dealing with negative emotional events. As a protective factor (33, 34), psychological flexibility may affect the link between state anxiety and mental health through a moderating effect and can help resist the adverse effects caused by trauma (35). It is considered as an adaptive coping strategy and plays an important role in recovering from adversity and stress (36). Therefore, cyberloafing, individuals with high level of psychological flexibility can pay attention to the current experience and feelings with a receptive attitude, which lead to improved physical and mental functions and reduced level of state anxiety; in comparison, individuals with low psychological flexibility have a more rigid thinking mode, which would lead to a tendency to fall into and be trapped with negative emotions and cognition, thus intensifying their state anxiety. Based on the analysis above, this study puts forward the following assumptions.

H5: Psychological flexibility negatively moderates the relationship between cyberloafing and state anxiety. The stronger an individual's psychological flexibility, the weaker the positive relationship between cyberloafing and state anxiety. And the weaker an individual's psychological flexibility, the stronger the positive relationship between cyberloafing and state anxiety.

The relationships demonstrated by H4 and H5 further reveals the moderated mediation model, that is, the mediating effect of state anxiety between cyberloafing and the sense of meaning of life is strengthened under the condition of low psychological flexibility. Based on the above, this study constructs a moderated mediation model with an overall theoretical framework shown in Figure 1.

H6: Psychological flexibility moderates the mediating effect of state anxiety between cyberloafing and sense of life meaning, that is, the stronger the psychological flexibility of college students, the weaker the mediating effect of state anxiety; while the weaker the psychological flexibility of college students, the stronger the mediating effect of state anxiety.

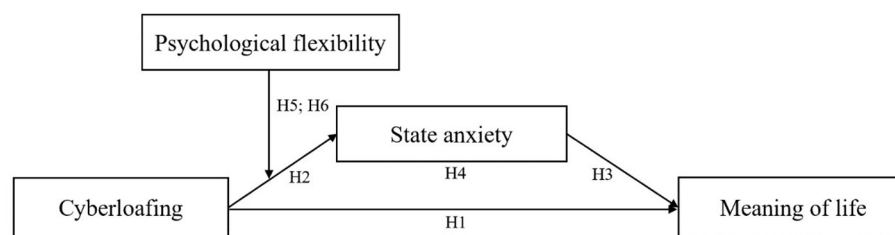


FIGURE 1  
Theoretical model.

## Methods

### Participants

The study hosted a questionnaire on an online survey platform (Survey Star, [www.wjx.com](http://www.wjx.com)). Completion of the questionnaire was voluntary and anonymity was assured. Since common method bias may inflate the correlations among variables and reduce the accuracy of our conclusions, we created a temporal separation by introducing a time lag between the measurement (37). Our data was collected at three phases, separated by about 2 weeks. In Time-1 (End of October 2021), participants were requested respond to some demographic questions (including gender, age and the experience of using the network) and to evaluate the level of cyberloafing and their own level of psychological flexibility. One thousand one hundred and thirty seven questionnaires were collected, and 1,109 valid questionnaires were obtained after excluding invalid ones. In Time-2 (Mid November 2021), the survey was conducted following the same procedures, with participants being requested to assess their state anxiety. In this phase, 1,031 valid samples were collected. In Time-3 (Early December 2021), participants were requested to evaluate their sense of meaning of life. Finally, a total of 964 valid questionnaires were obtained. The overall data return rate was 84.8%.

Among the valid participants, 39.32% were male, 60.68% were female, the average age was 18.67 years ( $SD = 1.36$ ). As for the experience of using network, 12.1% of participating students had an experience of network using of <5 years; 53.2% of them had 5-to-10-year experience, and 34.6% of them have used network for more than 10 years.

### Measures

#### Cyberloafing

Cyberloafing was measured by the original cyberloafing scale, which was designed by Van Doorn (38). The questionnaire consisted of two dimensions and only the activity dimension was used in our study. The activity dimension was referred

to as the specific activities that individuals can participate through the Internet, which could be divided into four types (social activities, information activities, leisure activities and virtual emotional activities). The activity dimension subscale contained 12 items, 3 for each activity type; for example: “I engage in cyberloafing in order to maintain social network” (social activity); “I engage in cyberloafing in order to search for information” (informational activity); “I engage in cyberloafing in order to play an online game” (leisure activity); “I engage in cyberloafing in order to shop online” (virtual emotional activity). The scale was scored from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s  $\alpha$  for this measure was 0.89.

#### State anxiety

State anxiety was measured by the subscale of the State-Trait Anxiety Inventory (STAI) (39), which was revised by Li and Qian (40). The questionnaire consisted of 20 items, including 20 sentences (10 sentences describing negative emotions and 10 sentences describing positive emotions). An example item was “I feel afraid.” The scale was scored from 1 (strongly disagree) to 5 (strongly agree). The higher the score, the more severe the state anxiety; among the questions, 10 of them were reversely scored. The Cronbach’s  $\alpha$  for this measure was 0.92.

#### The sense of meaning of life

The sense of meaning of life was measured by the Meaning of Life Questionnaire (MLQ), which consisted of two aspects, the presence of meaning and the search for meaning. The scale measured the individual’s experience of meaning in life and the motivation to search for meaning in life, respectively. Each subscale contained 5 items, such as “I understand my life’s meaning” and “I am looking for something that makes my life feel meaningful.” The scale was scored from 1 (strongly disagree) to 5 (strongly agree) and higher scores indicate higher sense of meaning of life (41). The Cronbach’s  $\alpha$  for the overall scale was 0.91.



## Psychological flexibility

Psychological flexibility was measured by the Acceptance and Action Questionnaire-2nd Edition (AAQ-II) (42), which was revised by Cao et al. (43) and had been extensively tested for reliability in China. The questionnaire consisted of 7 items. An example item was “It seems like most people are handling their lives better than I am.” The scale was scored from 1 (strongly disagree) to 5 (strongly agree), with higher scores after reverse scoring suggesting greater psychological flexibility. The Cronbach's  $\alpha$  for the scale was 0.84.

## Control variables

In this study, we controlled several demographic characteristics including gender, age and the experience of using the network. Gender was coded as a dummy variable (1 = male, 2 = female). Age was measured by the number of years. The experience of using the network was divided into 3 levels (1 = <5 years, 2 = 5 to 10 years, 3 = more than 10 years).

## Data analysis

SPSS 25.0 and Amos 26.0 were used for data analysis and testing. Also, the Bootstrap method *via* SPSS macro program PROCESS V3.3 was applied. Firstly, in order to test the validity and calculate the Cronbach alpha coefficient to estimate internal consistency, confirmatory factor analysis was conducted by AMOS. Secondly, descriptive statistics and Pearson correlations were calculated among variables. Thirdly, PROCESS macro for SPSS (Model 4) was applied to examine the mediating effect of state anxiety, and PROCESS macro (Model 7) was applied to examine the moderating effect of psychological flexibility on the indirect relationship between cyberloafing and the sense of meaning of life. Meanwhile, demographic variables (gender, grade, experience of using the network) were controlled when we examined the mediating effect and moderating effect. The bootstrap confidence intervals (CIs) determine whether the effects in Model 4 and Model 7 are significant based on 5,000 random samples. An effect is regarded as significant if CIs do not include zero.

## Results

### Common method bias

The Harman single-factor test was used to test common method deviation (37). The results revealed that the mutation rate interpretation of the first factor was 28.63%, which was less than the critical value of 40%, indicating that there was no obvious deviation of common method in this study.

We compared our hypothesized model (i.e., model 4, the baseline four-factor model) with a three-factor model

(i.e., model 3, combining cyberloafing and state anxiety), a two-factor model (i.e., model 2 combining cyberloafing and state anxiety and combining the sense of meaning of life and psychological flexibility), and a one-factor model combining all items (i.e., model 1) (Table 1). Considering the changes in chi-square (i.e.,  $\chi^2$ ), two major fit indicators [i.e., comparative fit index (CFI) and incremental fit index (IFI)], and root mean square error of approximation (RMSEA), our hypothesized four-factor model [with  $\chi^2/df = 2.41$ ,  $IFI = 0.95$ ,  $CFI = 0.95$ , and  $RMSEA = 0.04$ ] showed better fit than other alternative models (44, 45).  $RMSEA < 0.05$ , and  $\chi^2/df < 3$  indicated good model fit (46), while the other indices such as  $CFI$ ,  $IFI > 0.90$  can be construed as an acceptable fit (47). Therefore, the discriminant validity of the constructs was confirmed. This suggests that the participants of our survey could distinguish the focal constructs clearly.

## Descriptive statistics and correlation analysis

Mean value, standard deviations, Cronbach's alpha, and correlation coefficient of the variables are shown in Table 2. Correlation analysis showed that cyberloafing is significantly positively correlated with state anxiety ( $r = 0.33$ ,  $p < 0.01$ ) and negatively correlated with the sense of meaning of life ( $r = -0.16$ ,  $p < 0.01$ ); state anxiety is significantly negatively correlated with the sense of meaning of life ( $r = -0.20$ ,  $p < 0.01$ ). Thus, these results preliminarily support the subsequent regression analysis.

## Hypotheses testing

Model 4 (a simple mediation model) in the SPSS expansion macro-PROCESS prepared by Hayes (48) was used to test the mediating effect of state anxiety on the relationship between cyberloafing and the sense of meaning of life. Cyberloafing was a significant predictor of the state anxiety ( $\beta = 0.34$ ,  $SE = 0.01$ ,  $p < 0.01$ ) and the sense of meaning of life ( $\beta = -0.17$ ,  $SE = 0.03$ ,  $p < 0.01$ ). State anxiety was a significant predictor of the sense of meaning of life ( $\beta = -0.20$ ,  $SE = 0.03$ ,  $p < 0.01$ ). Results of the bootstrapping test ( $\beta = -0.16$ ,  $SE = 0.03$ ,  $p < 0.01$ ) supported that CI did not contain zero. Therefore, the hypothesis that state anxiety plays a partial mediating role in the relationship between cyberloafing and the sense of meaning of life was supported. The direct ( $-0.11$ ) and mediated ( $-0.05$ ) prediction effects accounted for 68.75 and 31.25% of the overall effect, respectively.

In the second step, we employed Model 7 in the SPSS extension macro, and the moderated mediation model was tested. As shown in Table 3, after inputting psychological

TABLE 1 Results of confirmatory factor analysis of the measurement models.

Measurement models	$\chi^2$	df	$\chi^2/df$	RMSEA	IFI	CFI
Model 1: One-factor (combined all items into one factor)	14,999.23	1,080	13.89	0.12	0.55	0.55
Model 2: Two-factor (combined CL and SA into one factor, and combined ML and PF into one factor)	11,389.34	1,079	10.56	0.10	0.67	0.67
Model 3: Three-factor (combined CL and SA into one factor)	9,096.35	1,077	8.45	0.09	0.74	0.74
Model 4: Four-factor	2,592.34	1,074	2.41	0.04	0.95	0.95

CL, Cyberloafing; SA, State anxiety; ML, Meaning of life; PF, Psychological flexibility.

TABLE 2 Descriptive statistics and correlation analysis.

Variable	M	SD	1	2	3	4	5	6
1 Gender	1.71	0.45						
2 Age	18.67	1.36	−0.03					
3 Internet	2.23	0.65	−0.13**	0.11**				
4 Cyberloafing	2.56	1.06	0.00	0.00	0.07*			
5 State anxiety	2.56	0.48	0.05	−0.01	−0.04	0.33**		
6 Psychological flexibility	3.31	0.75	0.00	−0.01	0.09**	−0.20**	−0.55**	
7 Meaning of life	3.57	0.46	−0.07*	0.02	0.13**	−0.16**	−0.20**	0.19**

\* $p < 0.05$ ; \*\* $p < 0.01$ .

flexibility into the model, the interaction between cyberloafing and psychological flexibility was a significant predictor of state anxiety (Cyberloafing  $\times$  Psychological flexibility:  $\beta = -0.26$ ,  $SE = 0.03$ ,  $p < 0.01$ ), indicating that psychological flexibility moderated the relationship between cyberloafing and state anxiety (Model 1). All results are presented in Figure 2.

In addition, we plotted the interaction effects at different levels (i.e., +1 SD or −1 SD) of psychological flexibility using the recommendation of Aiken and West (49). Figure 3 shows that cyberloafing is more positively related to state anxiety when psychological flexibility is low rather than high. Accordingly, the hypothesis that the moderating effect of psychological flexibility on the cyberloafing–state anxiety relationship was supported.

We further estimated the conditional indirect effect of cyberloafing on the sense of meaning of life via state anxiety across levels of psychological flexibility by bootstrapping the bias-corrected CI. The results are presented in Table 4. The indirect effect of cyberloafing on the sense of meaning of life through state anxiety was stronger and significant at a low level of psychological flexibility (effect size =  $-0.08$ , 95% bias-corrected CI from  $-0.13$  to  $-0.03$ ), but was weaker at a high level of psychological flexibility (effect size =  $-0.00$ , 95% bias-corrected CI from  $-0.01$  to  $0.01$ ). Thus, hypothesis that psychological flexibility moderates the mediating effect of state anxiety between cyberloafing and sense of life meaning was supported.

## Discussion

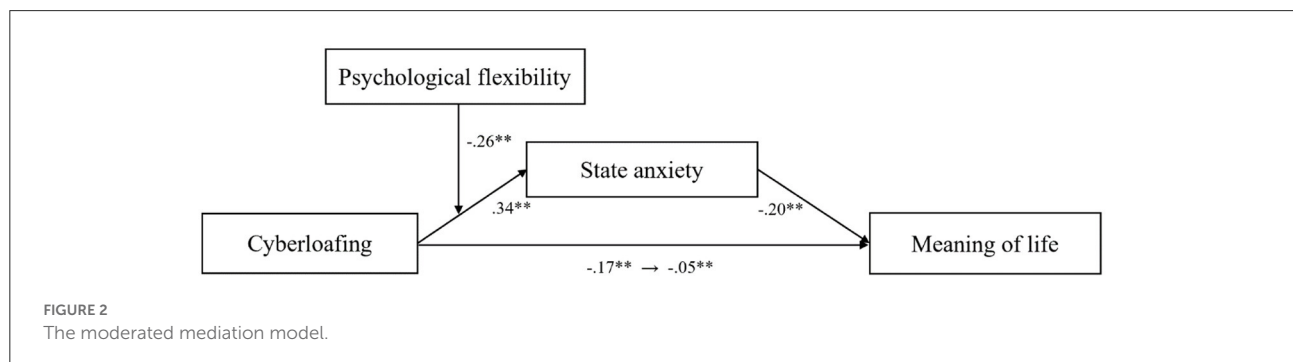
### Result analysis

Based on the social displacement hypothesis and the stress transactional model, this paper discusses the impact of college students' cyberloafing on the sense of meaning of life through state anxiety.

Firstly, this study found that cyberloafing has a significant negative effect on college students' sense of meaning of life. With the application of the Internet in the classroom, it brings convenience to learning, but it also brings some disadvantages. Cyberloafing on the Internet brings temporary pleasure, but it causes deeper academic problems (50). This is due to the fact that cyberloafing while studying has occupied a portion of college students' time which should have been devoted in academic and social activities; the consumption of scarce attention resources by cyberloafing has resulted in a sense of loss and helplessness (16), which creates a negative impact on the sense of meaning of life (27, 28). This finding has verified previous research (7) to a certain extent. More importantly, problematic network behaviors could cause college students to lose the pursuit of life and the meaning of life (18), which may be one of the reasons why contemporary youth lack a sense of meaning in life. Therefore, how to guide college students to use the Internet more reasonably in class, and better allocate

TABLE 3 Moderated mediation effect analysis.

	Model1 (criterion: state anxiety)				Model2 (criterion: meaning of life)			
	$\beta$	SE	<i>p</i> -value	95% CI	$\beta$	SE	<i>p</i> -value	95% CI
<b>Control variables</b>								
Gender	0.13*	0.05	0.02	[0.02, 0.24]	−0.10	0.07	0.15	[−0.24, 0.03]
Age	−0.01	0.02	0.69	[−0.04, 0.03]	0.00	0.02	0.87	[−0.04, 0.05]
Internet	0.00	0.04	0.91	[−0.07, 0.08]	0.19**	0.05	<0.01	[0.09, 0.28]
<b>Independent variable</b>								
Cyberloafing	0.26**	0.03	<0.01	[0.21, 0.31]	−0.11**	0.03	<0.01	[−0.18, −0.05]
<b>Mediator</b>								
State anxiety					−0.16**	0.03	<0.01	[−0.22, −0.09]
<b>Moderator</b>								
Psychological flexibility	−0.37**	0.03	<0.01	[−0.42, −0.31]				
<b>Interaction term</b>								
Cyberloafing × Psychological flexibility	−0.26*	0.03	<0.01	[−0.31, −0.21]				
<i>R</i> <sup>2</sup>	0.42	0.07						
<i>F</i>	114.12**	14.01**						

\**p* < 0.05; \*\**p* < 0.01.

attention and study time, is a problem that educators have to face.

Secondly, our results show that state anxiety partially mediates the relationship between cyberloafing and the sense of meaning of life. That is, as a problematic network using behavior (3), cyberloafing consumes resources and tends to cause college students' negative emotions such as stress and state anxiety, thus reducing their sense of meaning of life. This conclusion is consistent with the findings of Becker et al. (13), that is, cyberloafing could lead to higher level of social anxiety among college students. With the occurrence of social anxiety, college students' subjective wellbeing and sense of meaning of life will also decline (24). Therefore, it is of great significance for college students to maintain a stable and peaceful mental state in their daily study and life and learn to reduce their anxiety.

Finally, psychological flexibility can moderate the relationship between cyberloafing and state anxiety. In particular, by testing the moderated mediation model, this study

further shows that psychological flexibility negatively moderates the mediating effect of state anxiety on the relationship between cyberloafing and sense of meaning of life. Specifically, individuals with high level of psychological flexibility have more effective adaptive and coping strategies and can better recover from the stressful situation of cyberloafing (36), therefore, their level of state anxiety can be reduced and their sense of value and meaning in life can be maintained and improved.

## Theoretical significance

The theoretical significance of this paper can be reflected in the following three aspects. First, extant researches on cyberloafing at home and abroad mainly focus on the field of organizational behaviors within firms, while there are few empirical studies carried out in the context of the educational situation. This study focuses on the impact of college students'

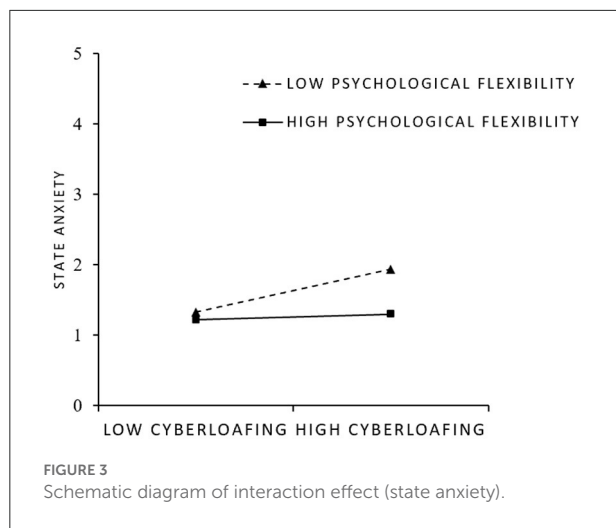


TABLE 4 Results for conditional indirect effect across levels of psychological flexibility.

Level	Effect size	Boot SE	LL 95% CI	UL 95% CI
<i>M</i> - <i>SD</i>	-0.08	0.02	-0.13	-0.03
<i>M</i>	-0.04	0.01	-0.07	-0.02
<i>M</i> + <i>SD</i>	<-0.01	0.01	-0.02	0.01

cyberloafing on the sense of meaning of life, which has expanded the research scope on cyberloafing and has revealed a hypothesized internal mechanism of this negative impact; this has, to some extent, contributed to the development of the cyberloafing field. Second, although there are numerous studies on the sense of meaning of life both at home and abroad, previous studies mainly focus on the impact of the sense of meaning of life on other variables, while hardly has any studies turn their research lenses toward the antecedent variables of the sense of meaning of life and the individual factors affecting the generation of the sense of meaning. This study reveals a possible mechanism of cyberloafing on the sense of meaning of life based on the social displacement theory, which has provided a brand-new perspective for the study of the influencing factors of meaning of life. Third, this study has introduced the variable of psychological flexibility to explore the causes of the sense of meaning of life, which has not only enriched the existing research on the sense of meaning of life, but also has provided a reasonable approach to construct the theoretical system of the sense of meaning of life.

## Practical implication

Firstly, this study found that college students' cyberloafing will negatively affect their sense of meaning of life. It is extremely

necessary to guide them to use the Internet reasonably and moderately, enhance their self-control ability, and remind them of the potential harm of excessive cyberloafing; meanwhile, it is also necessary to exert the influence of mutual support and encouragement of peers to contribute to the formation of a good learning atmosphere and reduce cyberloafing behavior.

Secondly, the important intermediary mechanism of state anxiety found in this study requires educators to pay active attention to the mental health and emotional state of college students, and effectively intervene their negative emotions through activities such as individual or group psychological counseling, emotional management lectures, mental health therapies and so on, so as to enhance college students' ability of emotional adjustment and provide supportive measures for the maintenance of their good emotional state.

Finally, this study also shows that there exist individual disparities as regard to the mechanism of cyberloafing. Individuals with low level of psychological flexibility tend to adopt more rigid and negative coping styles, resulting in more anxiety; while individuals with high level of psychological flexibility tend to more easily give up their defense against the current situation, feel and experience their current thoughts and feelings, and alleviate their own anxiety. College students are advised to avoid falling into the trap thinking and complaining about the negative results brought by cyberloafing; instead, they should accept the current situation, switch to a more positive way of thinking, and maintain and enhance their own sense of meaning of life. Therefore, educators are advised to provide relevant trainings aiming at enhancing the psychological strength for college students with low level of psychological flexibility, and carry out necessary activities of psychological adjustment, through which the psychological flexibility of such college students can be improved.

## Limitations and prospects

First, the utilization of time-lagged data in this paper cannot guarantee very clear evaluation of the causal relationship among variables, which would inevitably result in inaccurate research conclusions. Future research is suggested to adopt a longitudinal research method to reduce homologous deviation and further improve the validity of conclusions. Second, due to the limitations in time, manpower and resources, the scope of this study is relatively limited. Future research can improve the external validity of conclusions by expanding the source and scope of samples. Third, this study found that state anxiety plays a partial mediating role between cyberloafing and sense of life meaning, which indicates the existence of other mediating variables. Future research can be carried out to explore other types of variables, such as satisfaction from basic psychological needs and so on.



## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of Communication University of Zhejiang. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

QL was in charge of the formulation of the general research topic and the proposing of the theoretical hypothesis. BX analyzed the data and conceptualized the models. HZ and WW collected the data. XW supervised the project. All authors contributed to the article and approved the final manuscript.

## Funding

This research was supported by the General Project of National Social Science Foundation in China in 2020 [Grant

No. 20BSH130], the Youth Project of Humanities and Social Sciences of the Ministry of Education in China in 2017 [Grant No. 17YJC190012], and the Zhejiang Federation of Humanities and Social Sciences Research Project in 2017 [Grant No. 2017Z10].

## Acknowledgments

We sincerely extend our acknowledgment to those who have participated in our survey investigation.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

- Cutino CM, Nees MA. Restricting mobile phone access during homework increases attainment of study goals. *Mob Media Commun.* (2016) 5:63–79. doi: 10.1177/2050157916664558
- Flanigan AE, Kiewra KA. What college instructors can do about student cyber-slacking. *Educ Psychol Rev.* (2018) 30:585–97. doi: 10.1007/s10648-017-9418-2
- Kim SJ, Byrne S. Conceptualizing personal web usage in work contexts: a preliminary framework. *Comput Hum Behav.* (2011) 27:2271–83. doi: 10.1016/j.chb.2011.07.006
- Berry MJ, Westfall A. Dial D for distraction: the making and breaking of cell phone policies in the college classroom. *College Teaching.* (2015) 63:62–71. doi: 10.1080/87567555.2015.1005040
- Roberts N, Rees M. Student use of mobile devices in university lectures. *Australas J Educ Tec.* (2014) 30:415–26. doi: 10.14742/ajet.589
- Hinsch C, Sheldon KM. The impact of frequent social Internet consumption: Increased procrastination and lower life satisfaction. *J Consum Behav.* (2013) 12:496–505. doi: 10.1002/cb.1453
- Dilek DS, Irem MO. An investigation of cyberloafing in relation to coping styles and psychological symptoms in an educational setting. *Psychol Rep.* (2021) 124:1559–87.
- Taylor A. *Gambling at Work Costs Employers £300M a Year.* In: Financial Times (2007).
- Sonnentag S, Reinecke L, Mata J, Vorderer P. Feeling interrupted—being responsive: How online messages relate to affect at work. *J Organ Behav.* (2018) 39:369–83. doi: 10.1002/job.2239
- Sonnentag S, Venz L, Casper A. Advances in recovery research: what have we learned? what should be done next? *J Occup Health Psych.* (2017) 22:365–80. doi: 10.1037/ocp0000079
- Lim VKG, Chen DJQ. Cyberloafing at the workplace: gain or drain on work? *Behav Inform Technol.* (2012) 31:343–53. doi: 10.1080/01449290903353054
- Anandarajan M, Simmers C. (Eds.) *Personal Web Usage in the Workplace: A Guide to Effective Human Resources Management.* IGI Global. (2004). doi: 10.4018/978-1-59140-148-3
- Becker, MW. Alzahabi R, Hopwood CJ. Media multitasking is associated with symptoms of depression and social anxiety. *Cyberpsychol Behav Soc Netw.* (2013) 16:132–5. doi: 10.1089/cyber.2012.0291
- Barry S, Murphy K, Drew S. From deconstructive misalignment to constructive alignment: exploring student uses of mobile technologies in university classrooms. *Comput Educ.* (2015) 81:202–10. doi: 10.1016/j.compedu.2014.10.014
- Kraut R, Patterson M, Lundmark V, Kiesler S, Mukhopadhyay T, Scherlis W. Internet paradox: a social technology that reduces social involvement and psychological well-being? *Am Psychol.* (1998) 53:1017–31. doi: 10.1037/0003-066X.53.9.1017
- Knippenberg DV, Dahlander L, Haas M, George G. Information, attention, and decision making. *Acad Manage J.* (2015) 58:649–57. doi: 10.5465/amj.2015.4003
- Ryff CD, Singer B. The contours of positive human health. *Psychol Inq.* (1998) 9:1–28. doi: 10.1207/s15327965pli0901\_1
- Chen LS, Bao JW, Huang D. Relationship between meaning in life, pathological internet use and time management in college student. *China J health psych.* (2019) 27:919–23. doi: 10.13342/j.cnki.cjhp.2019.06.012
- Spielberger CD. *Theory and Research on Anxiety.* New York, NY: Academic Press. (1966). p. 101–5. doi: 10.1016/B978-1-4832-3131-0.50006-8

20. Zhong J, Chen Y, Yan J, Luo J. The mixed blessing of cyberloafing on innovation performance during the COVID-19 pandemic. *Comput Hum Behav.* (2022) 126:106982. doi: 10.1016/j.chb.2021.106982
21. Li Y, Sallam MH, Ye Y. The impact of WeChat use intensity and addiction on academic performance. *Soc Behav Pers Int J.* (2019) 47:1–7. doi: 10.2224/sbp.7331
22. Lazarus RS, Folkman S. *Stress, Appraisal, and Coping*. New York, NY: Springer Publishing Company (1984). p. 1.
23. Hobfoll SE, Lilly RS. Resource conservation as a strategy for community psychology. *J Commun Psychol.* (1993) 21:128–48. doi: 10.1002/1520-6629(199304)21:2<128::AID-JCOP2290210206>3.0.CO;2-5
24. Yu WW, Wang JN, Zhao MY. Research on the relationship between the current situation of shopping and subjective well-being, anxiety and depression in college students. *Psychol Mag.* (2019) 14:1–4. doi: 10.19738/j.cnki.psy.2019.18.001
25. Zhang F, Liu Y, Wang M, Wei X, Chen C, Liu W. The relationship between sense of hope, state anxiety and subjective well-being college students during the epidemic of COVID-19. *Psychol Tech Appl.* (2021) 9:432–9. doi: 10.16842/j.cnki.issn2095-5588.2021.07.006
26. Weger M, Sandi C. High anxiety trait: a vulnerable phenotype for stress-induced depression. *Neurosci Biobehav Rev.* (2018) 87:27–37. doi: 10.1016/j.neubiorev.2018.01.012
27. Updegraff JA, Silver RC, Holman E A. Searching for and finding meaning in collective trauma: results from a national longitudinal study of the 9/11 terrorist attacks. *J Pers Soc Psychol.* (2008) 95:709–22. doi: 10.1037/0022-3514.95.3.709
28. Van den Bos K. Making sense of life: the existential self trying to deal with personal uncertainty. *Psychol Inq.* (2009) 20:197–217. doi: 10.1080/10478400903333411
29. Zhang C, Jin X, Chen H, Hou W. Relationship between meaning in life and mental health: A meta-analysis. *China J Health Psych.* (2021) 29:821–5. doi: 10.13342/j.cnki.cjhp.2021.06.005
30. Stegmann Y, Reicherts P, Andreatta M, Pauli P, Wieser M J. The effect of trait anxiety on attentional mechanisms in combined context and cue conditioning and extinction learning. *Sci Rep-UK.* (2019) 9:105–35. doi: 10.1038/s41598-019-45239-3
31. Cummings EM, Davies PT, Campbell SB. *Developmental Psychopathology and Family Process: Theory, Research and Clinical Implications*. New York, NY: The Guilford Press (2002)
32. Hayes SC, Strosahl KD, Wilson KG. *Acceptance and Commitment Therapy: An Experiential Approach to Behavior Change*. New York, NY: Guilford Press (1999).
33. Crasta D, Daks JS, Rogge RD. Modeling suicide risk among parents during the COVID-19 pandemic: psychological inflexibility exacerbates the impact of COVID 19 stressors on interpersonal risk factors for suicide. *J Context Behav Sci.* (2020) 18:117–27. doi: 10.1016/j.jcbs.2020.09.003
34. Smith BM, Twohy AJ, Smith GS. Psychological inflexibility and intolerance of uncertainty moderate the relationship between social isolation and mental health outcomes during COVID-19. *J Context Behav Sci.* (2020) 18:162–74. doi: 10.1016/j.jcbs.2020.09.005
35. Kroska EB, Roche AI, Adamowicz JL, Stegall MS. Psychological flexibility in the context of COVID-19 adversity: associations with distress. *J Context Behav Sci.* (2020) 18:28–33. doi: 10.1016/j.jcbs.2020.07.011
36. Bryan CJ, Ray-Sannerud B, Heron EA. Psychological flexibility as a dimension of resilience for post-traumatic stress, depression, and risk for suicidal ideation among air force personnel. *J Context Behav Sci.* (2015) 4:263–8. doi: 10.1016/j.jcbs.2015.10.002
37. Podsakoff PM, MacKenzie SB, Lee J-Y, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol.* (2003) 88:879–903. doi: 10.1037/0021-9010.88.5.879
38. Van Doorn ON. *Cyberloafing: A multi-dimensional construct placed in a theoretical framework* (Master's Thesis). Department Industrial Engineering and Innovation Sciences, Eindhoven University of Technology (2011)
39. Spielberger CD, Gorsuch RL, Lushene L. *Manual for the State Trait Anxiety Inventory (Form Y): "Self-Evaluation Questionnaire"*. Palo Alto, CA: Consulting Psychologists Press (1983).
40. Li WL, Qian MY. Revision of the state-trait anxiety inventory with sample of chinese college students. *Acta Scientiarum Naturalium, Universitatis Pekinensis.* (1995) 31:108–12. doi: 10.13209/j.0479-8023.1995.014
41. Steger MF, Frazier P, Oishi S, Kaler M. The meaning in life questionnaire: assessing the presence of and search for meaning in life. *J Couns Psychol.* (2006) 53:80–93. doi: 10.1037/0022-0167.53.1.80
42. Bond FW, Hayes SC, Baer RA, Carpenter KM, Guenole N, Orcutt HK, et al. Preliminary psychometric properties of the acceptance and action questionnaire–ii: a revised measure of psychological inflexibility and experiential avoidance. *Behav Ther.* (2011) 42:676–88. doi: 10.1016/j.beth.2011.03.007
43. Cao J, Ji Y, Zhu ZH. Reliability and validity of the chinese version of the acceptance and action questionnaire-second edition (AAQ-II) in college students. *Chinese Mental Health J.* (2013) 27:873–7. doi: 10.3969/j.issn.1000-6729.2013.11.014
44. Bentler PM, Bonett DG. Significance tests and goodness of fit in the analysis of covariance structures. *Psychol Bull.* (1980) 88:588–606. doi: 10.1037/0033-2909.88.3.588
45. Bagozzi RP Yi Y, Phillips LW. Assessing construct validity in organizational research. *Admin Sci Quart.* (1991) 36:421–58. doi: 10.2307/2393203
46. Hu LT, Bentler PM. Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychol Methods.* (1998) 3:424–53. doi: 10.1037/1082-989X.3.4.424
47. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equat Model.* (1999) 6:1–55. doi: 10.1080/10705519909540118
48. Hayes AF. *PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling* (White paper). (2012). Available online at: <http://www.afhayes.com/public/process2012.pdf>
49. Aiken LS, West SG. *Multiple Regression: Testing and Interpreting Interactions*. Newbury Park, CA: Sage Publications (1991). p. 212.
50. Wood E, Zivcakova L, Gentile P, Archer K, De Pasquale D, Noskoet A, et al. Examining the impact of off-task multi-tasking with technology on real time classroom learning. *Comput Educ.* (2012) 58:365–74. doi: 10.1016/j.compedu.2011.08.029



## OPEN ACCESS

## EDITED BY

Agnes Lai,  
The University of Hong Kong,  
Hong Kong SAR, China

## REVIEWED BY

Johanna Järvinen-Tassopoulos,  
National Institute for Health  
and Welfare, Finland  
Ernest So,  
Hong Kong Institute of Technology,  
Hong Kong SAR, China

## \*CORRESPONDENCE

Simon Ching Lam  
simlc@alumni.cuhk.net;  
simonlam@twc.edu.hk

## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

RECEIVED 10 May 2022

ACCEPTED 08 July 2022

PUBLISHED 05 August 2022

## CITATION

Tang ACY, Lee PH, Lam SC, Siu SCN,  
Ye CJ and Lee RLT (2022) Prediction  
of problem gambling by  
demographics, gaming behavior  
and psychological correlates among  
gacha gamers: A cross-sectional  
online survey in Chinese young adults.  
*Front. Psychiatry* 13:940281.  
doi: 10.3389/fpsy.2022.940281

## COPYRIGHT

© 2022 Tang, Lee, Lam, Siu, Ye and  
Lee. This is an open-access article  
distributed under the terms of the  
[Creative Commons Attribution License](#)  
(CC BY). The use, distribution or  
reproduction in other forums is  
permitted, provided the original  
author(s) and the copyright owner(s)  
are credited and that the original  
publication in this journal is cited, in  
accordance with accepted academic  
practice. No use, distribution or  
reproduction is permitted which does  
not comply with these terms.

# Prediction of problem gambling by demographics, gaming behavior and psychological correlates among gacha gamers: A cross-sectional online survey in Chinese young adults

Anson Chui Yan Tang<sup>1</sup>, Paul Hong Lee<sup>2</sup>, Simon Ching Lam<sup>1\*</sup>,  
Summer Cho Ngan Siu<sup>3</sup>, Carmen Jiawen Ye<sup>4</sup> and  
Regina Lai-Tong Lee<sup>5</sup>

<sup>1</sup>Tung Wah College, Hong Kong, Hong Kong SAR, China, <sup>2</sup>University of Leicester, Leicester, United Kingdom, <sup>3</sup>Hong Kong Metropolitan University, Hong Kong, Hong Kong SAR, China, <sup>4</sup>Lingnan University, Hong Kong, Hong Kong SAR, China, <sup>5</sup>The Chinese University of Hong Kong, Hong Kong, Hong Kong SAR, China

**Objective:** The objective of this study is to explore the association of problem gambling with demographics, psychological distress, and gaming behavior in young adult gacha gamers in Hong Kong.

**Materials and methods:** Cross-sectional data was collected in the first and fifth waves of COVID-19 pandemic in Hong Kong online. Participants who aged 18–25 years and had been playing gacha games over the past 12 months were recruited. Stepwise multiple regression was used to explore the association among risk of problem gambling, gaming behavior, participation in gaming activities and psychological distress. A two-sided p-value <0.05 was considered as statistical significance.

**Results:** Three hundred and thirty-seven completed questionnaires were received with no missing data. 34.7% ( $n = 117$ ) of the participants had non/low-risk of problem gambling. About 40% ( $n = 136$ ) of them had moderate-risk and the remaining 25% ( $n = 84$ ) were at high risk of problem gambling. A higher proportion of female participants (78.6%) were found in high-risk group as compared to 39.7% and 55.6% only in the non/low-risk and moderate-risk groups, respectively. The regression model ( $R^2 = 0.513$ ,  $F = 71.895$ ,  $p < 0.001$ ) showed that 51.3% of the variance of the total problem gambling score could be explained by stress, anxiety, monthly expenses on gacha purchases, number of motives for gacha purchase and number of gambling activities engaged.

**Conclusion:** The present study provides empirical evidence to support the association between problem gambling and microtransaction especially for gacha which is the most popular type of video game microtransaction in Asia.

The established regression model suggests that gacha gamers with higher risk of problem gambling tend to have greater stress, higher anxiety level, spend more on gacha purchase, have more motives for gacha purchases and engage in more gambling activities. In contrast to the extant literature, higher proportion of female participants in high-risk group indicates that female gacha gamers are also at very high risk of becoming problem gamblers.

#### KEYWORDS

problem gambling, gacha, psychological distress, video game microtransaction, Chinese young adults

## Introduction

Microtransaction is the mainstream to monetize gaming activities in gaming industry. As of 2018, 50–91% of the highest grossing mobile games in United Kingdom, Australia and China contain microtransactions (1–3). Gacha and loot box are the two common forms of video game microtransaction dominant in Asian and Western regions, respectively. Both share a similarity that game players have to pay for the chance of obtaining virtual items that could advance the game progress or enhance character abilities (4). In Asian region, gacha is currently predominant in the mobile game market especially in Freemium (i.e., free-to-play) games. It replicates the feature of capsule toy vending machines popularized in Japan where gacha gamers pay to obtain in-game randomized virtual items such as weapons and costumes that can enhance the power and appearance of their game avatar. The virtual items' degree of rarity is determined and controlled by gaming companies (4, 5). The popularity of gacha can be glimpsed from the market share and rapidly growing revenue of mobile game market. The domestic Chinese game market was projected to reach US\$42 billion in revenue by 2022 and over one quarter of the global mobile gaming revenue comes from China (6). In 2020, 78% of the total revenue of digital games spending came from Freemium games and 58% of the digital game spending occurred on smartphones (7). The total revenue of Hong Kong mobile game market increased dramatically from HK\$15 million in 2010 to HK\$44.6 million in 2014 (8). The increased possession of smartphones facilitate participation in gacha games. A report showed that 86.3% of Hong Kong gamers used smartphone most frequently as their primary gaming device (9). It is estimated that among the two million game players in Hong Kong, 15% of them play gacha games (10).

The chance-based item-purchasing process of video game microtransaction, which is closely connected to the opportunity of winning games, is compelling to gamers and could promote gambling among game players (11). Social media has frequently reported the excessive spending on gacha games in adolescents and young adults which result in gambling and emotional

problems (12). About 30% of gacha game players are students with no income or monthly income less than HK\$5,000 (12). They spend from HK\$2,000 to up to HK\$10,000 per month (13). Gambling cases caused by uncontrollable gacha purchases have increased drastically. The number of reported gambling cases due to gacha purchases in the first quarter of 2019 was 70% of the total cases in the preceding year (14).

Adolescents and young adults who participate in video game microtransaction have been identified as the most susceptible group for problem gambling. Empirical evidence has shown that the prevalence of problem gambling in adolescents and young adults is higher than the other age groups (15). Studies in Europe and United States have shown that among the 63.82% of adolescents and young adults who participated in gambling activities, 4–7% of them manifested serious gambling symptoms and 10–15% of them were at risk for developing serious gambling problem (16). In addition, they are the dominant consumers for video games, 50–60% of which contain microtransactions to monetize gaming activities (1–3, 17, 18). And 62.6–94.9% of these mobile games were deemed suitable for adolescents aged 12 years or above (19). Relatedly, recent statistics for loot box showed that 36%–46% of video game players make in-game purchases (20, 21). This phenomenon was believed to be amplified by the COVID-19 locally and internationally. Claesdotter-Knutsson et al. (22) reported that 16–39 years people showed increased engagement in loot box gaming during COVID-19 pandemic in Sweden. Similar statistics were found in Hong Kong. During the COVID-19 pandemic, nearly all normal economic activities were suspended. People worked and studied online at home. Adolescents and young adults were forced to stay at home most of the time with very limited outdoor activities but playing games to kill time (13). A recent local report about gacha gaming behavior in adolescents and adults showed that over half of them spend 3 h or more to play gacha games every day (13). These findings are alarming to stakeholders including social and healthcare professionals as the gambling behavior developed at a young age is likely to continue and be amplified, eventually resulting some form of gambling disorder (23). Thus, there is



a pressing need to recognize young adult gacha game players predisposition to problem gambling.

Gambling disorder is a non-substance-related mental disorder listed in the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (24). It is currently defined as persistent and recurrent engagement in gambling behavior that leads to clinically significant impairment or distress (24). Recent studies have shown that video game microtransactions are associated with a greater risk of problem gambling (25–30). Systematic reviews, meta-analyses, and cross-sectional studies have reported a significant relationship between problem gambling and video game microtransaction, mainly through loot box (31–37) but rarely with gacha. For example, Garea et al. (36) and Delfabbro and Cairns (30) found a significant small-to-moderate positive relationship between loot box spending and gambling symptoms. One cross-sectional study reported a moderate-to-large effect for the relationship between loot box purchase and problem gambling in a sample of older adults (18). While many studies have recruited adolescent samples, e.g., Kristiansen and Severin (32) and Zendle et al. (18), only a few have focused on young adults (38, 39).

Although spending on video game microtransactions is often the major focus in the extant literature concerning problem gambling in video game microtransactions, it appears that it is not the only predisposing factor for problem gambling among gamers. Some researchers have attempted to determine problem gambling's relationship with other gaming-related behavior, such as the symptoms of problem gaming and the motives behind video game microtransactions. Recent cross-sectional studies demonstrated a relationship between problem gaming and problem gambling such as King et al. (39) and Drummond et al. (40), with the former (39) revealing that problem gamblers are 5.62 times more likely to engage in problem gaming. A handful of studies identified loot box game players' motives for conducting video game microtransactions. Motives that were positively correlated with loot box spending were mostly connected to social recognition, excitement, obtaining specific items/characters, gaining privileges to progress in a game, among others (18, 31, 37). Enhancing self-esteem was also found to be positively correlated with loot box purchase (37).

In addition, researchers examined the risk of problem gambling in terms of gamers' psychological wellbeing. Studies on loot box spending found that both positive and negative moods, as well as psychological distress were positively associated with loot box spending (37). Depression and anxiety were often reported to be associated with more loot box spending as well as symptoms of problem gaming and problem gambling (35, 41–43). Behavioral factors such as coping strategies, inattention, and conduct problems were also associated with more in-game item purchases and symptoms of problem gaming and gambling (42, 44). Furthermore, male gamers were found, by and large, to spend more on loot box as

compared to female gamers (15, 25, 32, 37, 41, 45–47). Gamers with habits of online gambling and other gambling activities also had a higher risk of problem gambling (28, 48).

Apparently, whether gamers who participate in video game microtransactions will become problem gamblers depends on multiple factors. Some researchers have suggested that factors potentially contributing to the relationship between problem gambling and video game microtransactions should be considered altogether when exploring the relationship of problem gambling with video game microtransactions (30, 34). In addition, the studies conducted so far are mainly in Western samples, so the generalizability of these findings to Chinese samples is still under-investigated as studies have shown that there are significant cultural differences in gambling behavior (49, 50). Furthermore, as highlighted earlier, previous studies related to problem gambling in video game microtransactions focused on loot box but rarely gacha. The inherent differences between gacha and loot box may further limit the generalizability of the findings in previous studies. For example, gacha is mostly found in Freemium mobile games that are built on in-game item purchases and is the primary monetization strategy while loot box is often found in PC and console and is an additional monetization element besides selling the games themselves (4). In comparison to loot box, gacha has more varieties to attract gamers to pay for the games such as Box Gacha (virtual box of set items with known probabilities), Sugoroku Gacha (A gacha acts like a dice which then allowed the player to move on a board to unlock special items). Hence, the present study aimed to investigate the relationship between problem gambling and gacha with a broader spectrum by constructing a model to predict the risk of problem gambling according to demographics, gaming behavior, and psychological distress in gacha gamers.

The study objectives are as follows:

1. to explore the gacha gaming behavior and risk of problem gambling in Chinese young adults in Hong Kong and
2. to investigate the relationship between risk of problem gambling, gacha gaming behavior, demographics, and psychological distress in Chinese young adult gacha gamers.

## Materials and methods

### Study design and participants

An anonymous cross-sectional online survey was conducted in two periods: January to March of 2020 and January and March of 2022. The former period was the initial outbreak of COVID-19 in Hong Kong and the latter period was the fifth wave of COVID-19 in Hong Kong. Convenience sampling

method was adopted to recruit eligible participants online. The project was promoted at three local universities/tertiary institutions as well as on local online gaming forums. Emails were sent to target students to complete the online survey in the participating universities/tertiary institutions. Students were encouraged to disseminate the online survey to their peers if they meet the selection criteria. The inclusion criteria were individuals (1) aged 18–25 years old (2) who had been playing gacha games over the past 12 months. The exclusion criterion was that individuals who cannot read Chinese. The online survey requested participants answer every question, so there was no missing data in the dataset. The minimum sample size required to achieve a study power of 0.8, alpha of 0.05, and medium effect size for association ( $f^2 = 0.15$ ) is 91 for five independent variables (51). A total of 337 participants were recruited over the aforementioned recruitment periods, thus giving the sufficient power for analysis.

Before commencing the online survey, the study objectives were clearly described to participants. All participants had to click the box “agree to participate in this study” to indicate their agreement to voluntarily participate in the study prior to starting the survey. Ethics approval of this study was obtained from the ethics committee of the corresponding author’s affiliated institution.

## Measures

### Dependent variable

Risk of problem gambling was measured using the Problem Gambling Severity Index – Chinese version (PGSI-C). The PGSI-C is a 9-item questionnaire measuring one’s risk of problem gambling according to his/her gambling behavior and corresponding adverse consequences (52). It was translated from the original English version developed by Ferris and Wynne (53). Each item is rated via a 4-point Likert scale (0 = “never” to 3 = “almost always”). The total PGSI-C score is computed by summing all item ratings, with a score range of 0 to 27. The total PGSI-C score could also be categorized into three levels of gambling risk: (1) 0–2 = non/low-risk problem gambler; (2) 3–7 = moderate-risk problem gambler; and (3)  $\geq 8$  = high-risk problem gambler.

The PGSI-C was validated by Loo et al. in the Chinese adult population (52). The results showed good concurrent, discriminant, and predictive validity. Concurrent validity was measured by comparing the correlations of PGSI-C with other gambling scales such as South Oaks Gambling Screen, The Gambling Related Cognitions Scale, with  $r$  ranging from 0.34 to 0.53. Discriminant validity was investigated by examining whether PGSI-C discriminated between non-problem gamblers and possible problem gamblers. The discriminant function

had significant difference between non-problem and possible problem gambling groups (Wilk’s Lambda = 0.60,  $\chi^2 = 197.68$ ,  $df = 3$ ,  $p < 0.001$ ). Hierarchical multiple regression analysis was conducted to investigate the predictive validity of PGSI-C. The model explained 28.1% of the variance (adjusted  $R^2 = 0.281$ ,  $p < 0.001$ ), with 26.5% variance explained by PGSI-C. In addition, Cronbach’s alpha of the PGSI-C was 0.77 (52). As PGSI-C was originally developed for screening general gambling activities, the authors had modified a few words on some items to fit the context of gacha games. Face validity and test-retest reliability were undertaken to ensure the modified version was comprehensible to the target population and sufficiently reliable. Twelve university students meeting the described selection criteria were recruited to complete the modified survey twice with a 2-week interval. The results demonstrated excellent test-retest reliability with an  $r$  of 0.954.

### Independent variables

#### Psychological distress

Psychological distress was operationalized by the Depression, Anxiety and Stress 21 – Chinese version (DASS-21-C). The DASS-21-C was translated and validated by Gong et al. (54) based on the original English version established by Lovibond and Lovibond (55). The questionnaire consists of three subscales consisting of seven items each: Depression (items 3, 5, 10, 13, 16, 17, 21), Anxiety (items 2, 4, 7, 9, 15, 19, 20), and Stress (items 1, 6, 8, 11, 12, 14, 18). Respondents rate the items based on their experience in the past week on a 4-point Likert scale from 0 (“did not apply to me at all”) to 3 (“applied to me very much or most of the time”). Subscale scores are calculated by summing the ratings of the corresponding seven items and then multiplying by 2. The subscales range from 0 to 42 with higher scores indicating more symptoms. The DASS-21-C was found to have good psychometric properties. Cronbach’s alphas for depression, anxiety, and stress subscales were 0.896, 0.859, and 0.873, respectively, which indicate good internal consistency for each subscale (56). Moderate convergent validity of the Depression and Anxiety subscales was demonstrated via significant correlations with the Chinese Beck Depression Inventory ( $r = 0.64$ ) and the Chinese State-Trait Anxiety Inventory ( $r = 0.41$ ), respectively. Confirmatory factor analyses supported the original 3-factor model (non-normed fit index = 0.964, comparative fit index = 0.968 and root mean square of approximation = 0.079) (57). The test-retest reliabilities ( $r$ ) of the depression, anxiety and stress subscales were 0.867, 0.917, and 0.913 respectively.

#### Gaming behavior

Gaming behavior was measured via three items: (1) average daily time spent playing gacha purchase in terms of hours; (2) average monthly expenses for gacha purchases; and (3) motives

for gacha purchases. The first two items were ordinal data and referred to the experience in the past year. In contrast, motives for gacha purchases were nominal data. Participants could select more than one choice on the list provided.

### Demographics and participation in gambling activities

Age, gender (male/female), and educational level (secondary school, diploma/certificate, associate degree/higher diploma, bachelor's degree or above) were collected as they were reported to be associated with the risk of problem gambling in video game microtransactions. In addition, participation in gambling activities was included to measure the number and types of gambling activities (other than video game microtransactions) participants have engaged over the past year, such as football betting, lottery, horse racing, online gambling activities, etc. The gambling items were devised with reference to a local study about Hong Kong people's participation in gambling activities (58). Age was continuous data. Gender and participation in gambling activities were nominal data and educational level was ordinal.

## Statistical analysis

The data analysis was performed using the SPSS version 26.0. Descriptive statistics were calculated to describe demographic variables, participation in gambling activities, gaming behavior, and psychological distress among the three levels of problem gamblers. Means and standard deviations or median and interquartile ranges were reported for continuous variables. Frequencies and percentages were computed for categorical and ordinal variables. To compare study variables with the three levels of problem gambling, the following tests were used: chi-squared test (nominal variables); one-way analysis of variance (ANOVA) or Kruskal-Wallis one-way ANOVA (continuous and ordinal variables) and adjusted by Bonferroni correction for multiple tests. Spearman's rank correlation analysis was performed to test the correlation between the risk of problem gambling (i.e., total PGSI score) and other study variables. Stepwise multiple regression analysis was used to model the relationship among the total PGSI score, demographic variables, gaming behavior, participation in gambling activities, and psychological distress. A two-sided  $p$  value below 0.05 was considered statistically significant.

## Results

A total of 337 completed online surveys were returned with no missing data. Among all the participants, 34.7% ( $n = 117$ ) had no or a low risk, 40.4% ( $n = 136$ ) had a moderate risk, and 24.9% ( $n = 84$ ) had a high-risk of problem gambling. There

was a significant difference in age and gender among the three levels of problem gambling ( $p = 0.001$  and  $<0.001$ , respectively). High-risk problem gamblers were significantly older than those in the non/low-risk and moderate-risk groups ( $p = 0.001$  and  $0.004$ , respectively). In addition, a higher proportion of females (78.6%) was found in the high-risk group compared to the other two groups, which ranged from approximately 39–55%.

All study variables were found to have significant differences among the three problem gambling groups. As compared with the non/low-risk and moderate-risk gamblers, high-risk gamblers were found to participate significantly more in gambling activities and have more motives for gacha purchase. In terms of daily time spent and monthly expenses for gacha purchases, high-risk gamblers spent significantly more time and money on gacha games compared to participants in the other two groups ( $p < 0.001$ ). Approximately 60–80% of participants in the non/low-risk and moderate-risk problem gambling groups spent less than 4 h per day on playing gacha games. Conversely, about 55% of high-risk problem gamblers played gacha games for more than 4 h a day.

Regarding monthly spending on gacha purchases, 74–93% of non/low-risk and moderate-risk problem gamblers spent USD \$50 or less on gacha games. In contrast, approximately 65% of high-risk problem gamblers spent over USD \$50 every month on gacha purchases. Among them, 25% reported spending more than USD \$200 per month. Furthermore, high-risk problem gamblers had significantly higher scores for the three DASS-21-C subscales compared to the other two groups ( $p = 0.000$ ). Their median scores for depression, anxiety, and stress were 16, 13, and 18, respectively, thus indicating that high-risk problem gamblers exhibit moderate levels of depression, anxiety and stress, as suggested by Lovibond and Lovibond (55). **Table 1** summarizes the comparison among the three risk levels of problem gambling in terms of demographic variables, gaming behavior, and psychological variables.

**Table 2** describes the motives for gacha purchase. The study found that all motives were significantly different among the three groups except for “no specific purposes” and “support income of gaming companies.” High-risk problem gamblers exhibited the highest percentages in the following motives: felt excited (69%), gained social recognition (63.1%), obtained what friends had had (59.5%), sped up the game progress (59.5%), obtained favorite virtual items (91.7%), and seized the time-limited offer (61.9%).

The total PGSI score was positively correlated with age ( $r = 0.196$ ,  $p < 0.001$ ); daily time spent on gacha purchase ( $r = 0.259$ ,  $p < 0.001$ ); monthly expenses for gacha purchase ( $r = 0.478$ ,  $p < 0.001$ ); participation in gambling activities ( $r = 0.168$ ,  $p = 0.002$ ); motives for gacha purchase ( $r = 0.465$ ,  $p < 0.001$ ); and stress, anxiety, and depression subscale scores ( $r = 0.496$ ,  $0.437$ , and  $0.337$ ,  $p < 0.001$ , respectively). Only educational level was negatively correlated with the total PGSI

score ( $r = -0.098$ ,  $p < 0.05$ ). Table 3 presents the correlations among the variables.

## Relationship among risk of problem gambling, demographics, gaming behavior, and psychological distress

Table 4 summarizes the regression model for predicting the risk of problem gambling with demographics and other study variables. The R-squared value ( $R^2 = 0.521$ ) for the regression was significantly different from 0 [ $F(5,331) = 71.895$ ,

$p < 0.001$ ]. The overall model accounted for 52.1% of the variance of total PGSI scores, thus suggesting that 52.1% of the variance of the total PGSI score could be explained by the following five variables in the model: stress (16% unique variance), monthly expenses on gacha purchase (11.5% unique variance), number of gacha purchase motives (8.9% unique variance), anxiety (12.6% unique variance), and number of gambling activities participated (2.8% unique variance). The B coefficients showed that all five independent variables were significant predictors with none of the 95% confidence intervals being across 0. The constructed model thus suggests that gacha gamers who experience greater stress and anxiety, spend more

TABLE 1 Comparison among the three risk levels of problem gambling for demographic and independent variables ( $N=337$ ).

Study variables	Non/low-risk problem gambler ( $n=117$ )	Moderate-risk problem gambler ( $n=136$ )	High-risk problem gambler ( $n=84$ )	P-value (a/b/c)
<i>Demographics</i>				
Age (years), M $\pm$ SD	21.44 $\pm$ 2.08	21.63 $\pm$ 2.16	22.57 $\pm$ 2.05	.001(1/0.001/0.004) <sup>^</sup>
<b>Gender, n (%)</b>				
Male	52 (44.4)	82 (60.3)	18 (21.4)	<0.001*
Female	65 (55.6)	54 (39.7)	66 (78.6)	
<b>Educational level, n (%)</b>				
Secondary school	6 (5.1)	5 (3.7)	6 (7.1)	0.057 <sup>#</sup>
Diploma/Certificate	11 (9.4)	16 (11.8)	16 (19.0)	
Associate Degree/Higher Diploma	17 (14.5)	20 (14.7)	14 (16.7)	
Bachelor's degree or above	83 (70.9)	95 (69.9)	48 (57.1)	
<i>Independent variables</i>				
Participation in gambling activities, Median (IQR)	1 (0–2)	1 (0–2)	1 (1–2)	0.001 (1/0.001/0.003) <sup>#</sup>
Motives of gacha purchase, Median (IQR)	2 (1–3)	3 (2–4)	4 (3–6)	<0.001 ( <0.001/ <0.001 < 0.001) <sup>#</sup>
<b>Daily time spent on gacha game, n (%)</b>				
0–3 h	94 (80.3)	84 (61.8)	38 (45.2)	<0.001 (0.002/ <0.001/0.013) <sup>#</sup>
4–6 h	19 (16.2)	40 (29.4)	35 (41.7)	
7–9 h	3 (2.6)	9 (6.6)	6 (7.1)	
$\geq 10$ h	1 (0.9)	3 (2.2)	5 (6.0)	
<b>Monthly expenses on gacha purchase, n (%)</b>				
$\leq$ USD\$50	109 (93.2)	101 (74.3)	30 (35.7)	<0.001 (0.004/ <0.001/ <0.001) <sup>#</sup>
USD\$51–100	7 (6.0)	19 (14.0)	20 (23.8)	
USD\$101–200	0 (0)	11 (8.1)	13 (15.5)	
> or = USD201	1 (0.9)	5 (3.7)	21 (25)	
<b>DASS-21-C subscales, Median (IQR)</b>				
Depression score	4 (0–10)	10 (2–16)	16 (9–28)	<0.001 (0.003/ <0.001 < 0.001) <sup>#</sup>
Anxiety score	2 (0–6)	4 (2–8)	13 (5–22)	<0.001 (0.012/ <0.001 < 0.001) <sup>#</sup>
Stress score	4 (0–12)	10 (4–14)	18 (12–28)	<0.001 (0.005/ <0.001 < 0.001) <sup>#</sup>

M, mean; SD, standard deviation; IQR, Interquartile range; DASS-21-C, Depression, Anxiety, Stress 21 – Chinese version. a:  $p$  value between non/low-risk of problem gambler and moderate-risk of problem gambler. b:  $p$  value between non/low-risk of problem gambler and high-risk of problem gambler. c:  $p$  value between moderate-risk of problem gambler and high-risk of problem gambler. \*Chi-squared test. <sup>^</sup>One-way ANOVA. <sup>#</sup>Kruskal Wallis One-way ANOVA.

TABLE 2 Comparison of motives for gacha purchase among three levels of problem gambling.

Motives	Non/low-risk problem gambler ( <i>n</i> =117)	Moderate-risk problem gambler ( <i>n</i> =136)	High-risk problem gambler ( <i>n</i> =84)	<i>P</i> -value
<b>No specific purposes, <i>n</i>(%)</b>				
Yes	15 (12.8)	20 (14.7)	16 (19.0)	0.470
No	102 (87.2)	116 (85.3)	68 (81.0)	
<b>Feel relaxed, <i>n</i>(%)</b>				
Yes	7 (6.0)	20 (14.7)	26 (31.0)	<0.001*
No	110 (94.0)	116 (85.3)	58 (69.0)	
<b>Feel excited, <i>n</i>(%)</b>				
Yes	18 (15.4)	48 (35.3)	43 (51.2)	<0.001*
No	99 (84.6)	88 (64.7)	41 (49.8)	
<b>Seize time-limited offers, <i>n</i>(%)</b>				
Yes	47 (40.2)	71 (52.2)	52 (61.9)	0.009**
No	70 (59.8)	65 (47.8)	32 (38.1)	
<b>Gaining social recognition, <i>n</i>(%)</b>				
Yes	16 (13.7)	35 (25.7)	53 (63.1)	<0.001*
No	101 (86.3)	101 (74.3)	31 (36.69)	
<b>Want what my friends have, <i>n</i>(%)</b>				
Yes	8 (6.8)	15 (11.0)	50 (59.5)	<0.001*
No	109 (93.2)	121 (89.0)	34 (40.5)	
<b>Speed up the game progress, <i>n</i>(%)</b>				
Yes	40 (34.2)	57 (41.9)	50 (59.5)	0.001**
No	77 (65.8)	79 (58.1)	34 (40.5)	
<b>Obtain favourite items (e.g. costume, weapon), <i>n</i>(%)</b>				
Yes	89 (76.1)	115 (84.6)	77 (91.7)	0.012***
No	28 (23.9)	21 (15.4)	7 (8.3)	
<b>Support income of gaming companies, <i>n</i>(%)</b>				
Yes	30 (25.6)	45 (33.1)	27 (32.1)	0.399
No	87 (74.4)	91 (66.9)	57 (67.9)	

\**p* < 0.001; \*\**p* < 0.01; \*\*\**p* < 0.05.

TABLE 3 Correlations between total PGSI score and study variables (*N*=337).

	Total PGSI score	
	<i>r</i>	<i>P</i> -value
Age	0.196	<0.001*
Educational level	−0.098	0.045***
Daily time spent on gacha games	0.259	<0.001*
Monthly expenses on gacha purchase	0.478	<0.001*
DASS - stress score	0.496	<0.001*
DASS - anxiety score	0.437	<0.001*
DASS - depression score	0.337	<0.001*
Participation in gambling activities	0.168	0.002**
Motives for gacha purchase	0.465	<0.001*

DASS, Depression, Anxiety, Stress 21; PGSI, Problem Gambling Severity Index. \**p* < 0.001; \*\**p* < 0.01; \*\*\**p* < 0.05.



on gacha purchases, have more motives for gacha purchases; and participate in more types of gambling activities have a tendency to be problem gamblers.

## Discussion

### Gacha gaming behavior and risk of problem gambling

The current study found that nearly 80% of high-risk problem gamblers were female, which is more than double the percentage of females in the moderate-risk group. This is inconsistent with the extant literature, which largely presents male gamers as having higher problem gambling risk than their female counterparts (15, 25, 45). The incongruent findings between present and previous studies could be explained by the pandemic situation in Hong Kong during the period of data collection. Recent evidence has shown that females have higher stress levels and were more likely to have depression and anxiety compared to males during the COVID-19 pandemic (59–62). Also, psychological distress is one of the factors reported to be associated with problem gambling in females (63). Therefore, the pandemic-induced stress and other psychological distress may make female participants more susceptible to problem gambling. As the percentage of female mobile gamers has been progressively increasing over the past ten years, i.e., from 38 to 46%, it is foreseeable that more female gamers may engage in mobile games with microtransactions (64). Accordingly, healthcare providers must pay special attention to female gamers who are under stressful situations and offer preventive measures such as fostering their coping efficacy to improve their psychological well-being (59).

The present study found that high-risk problem gamblers did spend significantly more time on gaming compared to the non/low-risk and moderate-risk groups. Nearly 55% of high-risk problem gamblers spent four or more hours (equivalent to  $\geq 28$  h/week) playing gacha games every day, which exceeds the duration reported by King et al. for gamers playing Fortnite (a kind of Freemium game) with a weekly playtime of 21.4 h (65). Although daily time spent on gacha games is not a significant predictor for problem gambling, this finding may alert healthcare professionals to the fact that gacha gamers may have problem gambling issues if they spend 4 h or more on gaming each day. It is also consistent with a local survey that over 50% of gacha gamers spent 3 h or above on gaming every day (9). Recent statistics (66) showed that Asian gamers spend much more time on gaming compared to the global weekly gaming time for all individuals, regardless of geography (8.45 h/week). China was ranked the first (12.69 h/week), followed by Vietnam (10.16 h/week) and India (8.61 h/week). Asian gamers, especially Chinese, are therefore at the greatest risk of problem gambling. The risk of becoming a problem

gambler may have further increased during the pandemic given that people's video game playtimes during the pandemic increased by 42% in the Asia-Pacific region (67). One point worthy noting is that the average daily hours spent gaming in the present study was much higher than those reported in other studies. The reasons for that are (1) the present study reported the daily hours spent on gaming according to the three risk levels of problem gambling but did not mix them together; (2) the study focused on time spent playing gacha games but not all kinds of video games; and (3) the study was conducted at the peaks of the COVID-19 pandemic in Hong Kong, during which all schools, including university/tertiary institutions, either switched to online learning or temporarily suspended classes. In addition, many economic activities were partially or totally suspended. More free time at home may have resulted in spending more time on video gaming in the young adult population.

### Relationship between risk of problem gambling, gaming behavior, and psychological distress

Unlike time spent on gacha games, monthly expenses on gacha purchases and motives are positively associated with the risk of problem gambling. This suggests that gamers would have a higher risk of problem gambling if they spend more on gacha games and have more motives for gacha purchases. The positive association between spending on gacha purchase and risk of gambling is supported by previous studies for loot box (33, 36, 40, 68). Garea et al. found a positive correlation between loot box spending and gambling symptoms (36). Drummond et al. found that the association between loot box spending and problem gambling symptoms was significant (40). The motives that were found to exist in significantly higher proportions in the high-risk group than in the other two groups are related to social recognition and stress relief, such as feeling relaxed, gaining social recognition, and want what their peers have. Similar motives were identified in Zendle et al. (18). This finding is also supported by previous studies. In a study of Swedish adolescents, Hellostrom et al. (69), found that gaming for escape, gain social status, or to pacify others rather than time spent gaming was associated with an increased risk of problem gambling and other negative consequences. Lelonek-Kuleta and Bartzuk found that an escape-type coping strategy was associated with a higher risk of gambling disorders in E-sport gamers (70).

Approximately 65% of the participants in the high-risk group reported spending USD \$51 or more every month on gacha purchases, among which 25% had spent an astonishing more than USD \$200 per month. It is similar to the local report that about 75% participants with an average of 26.8 years

TABLE 4 Predictors of the total PGSI score modelled by stepwise multiple regression ( $N=337$ ).

Predictor	Standardized coefficient ( $\beta$ )	Unstandardized coefficient ( $\beta$ )	$t$	$P$ -value
DASS - stress score	0.272	0.039	3.818	<0.001*
DASS - anxiety score	0.224	0.046	3.210	0.001**
Monthly expenses on gacha purchase	0.265	0.250	6.283	<0.001*
Motives of gacha purchase	0.189	0.132	4.258	<0.001*
Participation in gambling activities	0.117	0.199	2.961	0.003**
<i>Model statistics</i>				
$R^2$			0.521	
Adjusted $R^2$			0.513	
$R$			0.722	
$F$			71.895	<0.001*

DASS, Depression, Anxiety, Stress 21. \* $p < 0.001$ ; \*\* $p < 0.01$ .

spent USD\$125 or below for gacha purchase under COVID-19 pandemic (9). The significantly higher spending on gacha in the high-risk group may be attributable to their intention to gain recognition among peers or cope with stress (27, 31, 71). Using distractions such as gaming to cope with stress is an emotion-focused coping strategy. If gacha gamers are used to adopting emotion-focused strategies to cope with stress, they may have a higher problem gambling risk. Furthermore, those categorized as high sensation seekers are also more likely to become problem gamblers as a significantly higher proportion of those in the high-risk group reported feeling excited as a factor compared to the other two groups. Stress and anxiety are another two factors that significantly contributed to predicting the risk of problem gambling. Their positive association indicates that higher stress and anxiety levels would lead to higher risk of problem gambling, which is congruent with previous studies related to loot box (35, 41–43, 68). In response, healthcare professionals should focus on building up gacha gamers' internal and external resources to manage stress so as to consolidate their resilience against stressful situations or environments. In addition, a proper stress management approach could reduce gamers' stress and anxiety. It is especially important in these last few years as the COVID-19 pandemic has greatly hampered normal economic activities and people's daily lives. The World Health Organization recently published a scientific brief presenting the impacts of the COVID-19 pandemic on mental health worldwide. Anxiety disorders were found to have increased by about 25.6% under the COVID-19 pandemic (62). By age, young adults those aged 20–24 years were more affected than older adults (62). These statistics echo those of the present findings in which 25% of the study participants (all in the high-risk group) were found to have moderate stress, anxiety, and depression. Seemingly, the COVID-19 pandemic has greatly affected young adults' psychological well-being. Accordingly, devising preventive measures targeted at gacha gamers who possess more risk factors of problem gambling belongs at the top of the agenda for mental health professionals, particularly

given that there is still a long way to go before the COVID-19 pandemic ends.

## Limitations

This study has several limitations. First, data was collected through a self-report survey. Consequently, although face validity and test-retest reliability were performed with satisfactory results prior to the main study, the collected data may be susceptible to social desirability bias. Second, the data collection was confined to Hong Kong. The demographic characteristics of young adults and the pandemic situation in Hong Kong may differ from those in Mainland China. Therefore, the results may not be generalizable to the context of Mainland China. Third, the predictive model was established with cross-sectional data. Causal relationship between the dependent and independent variables cannot be drawn. To verify the present model and widen the generalizability of the results, future studies should adopt a longitudinal approach. Sampling should be carried out in different provinces of Mainland China or even other Asian countries.

## Practical implications

To the best of the researchers' knowledge, previous studies largely focus on problem gambling among gamers participating in loot box purchases but not in gacha purchases. As gacha is the predominant form of video game microtransaction in the Asian gaming market, the research team initiated the present study to examine the association between problem gambling and gacha purchase in Chinese gamers. It is hoped that this study fills the gap in the existing body of knowledge related to problem gambling and video game microtransactions, especially pertaining to gacha. From a primary healthcare perspective, early identification of potentially high-risk gacha gamers can prevent persistent inappropriate in-game purchase

behavior that may lead to gambling disorders. The results of the present study will add insights into the direction of preventing problem gambling in gacha gamers. From a research perspective, the model constructed in the present study might guide the direction of future gambling studies related to video game microtransaction.

## Conclusion

The constructed regression model demonstrated that stress, anxiety, expenses on gacha purchases, number of motives for gacha purchase, and participation in gaming activities are five key contributing factors that can be utilized to predict problem gambling risk in young adult gacha gamers. Young adult gacha gamers experiencing greater stress and anxiety tend to spend more on gacha purchases, have more motives for gacha purchase, and participate in more gambling activities. This group is at a particularly higher risk of becoming problem gamblers. Additionally, the present study found a significantly higher proportion of female gamers exists in the high-risk problem gambling group, indicating that female gamers are inclined to be problem gamblers, especially under COVID-19 pandemic, than male gamers because females were more emotionally affected by the pandemic and suffered more stress and anxiety. The study findings shed light on the risk factors of becoming a problem gambler among young adult gacha gamers. The five contributing factors in the constructed model could facilitate stakeholders' identification of young adult gacha gamers at risk of problem gambling in the community. Furthermore, social and healthcare professionals can develop targeted health education and promotion interventions, particularly those aimed at stress management and encouraging positive coping measures for those vulnerable gacha gamers before they become pathological gamblers. Further studies are needed to verify the causal relationships established in the constructed model using a longitudinal approach.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## References

1. Sensor Tower. *The Top Mobile Apps, Games, and Publishers of Q2 2018*. San Francisco, CA: Sensor Tower (2018).
2. Rockloff, M, Russell AM, Greer NM, Lole LR, Hing N, Browne N. *Loot boxes: Are they Grooming Youth for Gambling?* (2020). Available online at: <https://counsellorsam1.wordpress.com/2020/09/08/are-loot-boxes-grooming-youth-for-gambling/> (accessed July 26, 2022).
3. Xiao, LY, Hednerson LL, Yang Y, Newall PWS. Gaming the system: suboptimal compliance with loot box probability disclosure regulations in China. *Behav Public Policy*. (2021) 21–7. doi: 10.1017/bpp.2021.23
4. Koeder MJ, Tanaka E, Mitomo H. 'Lootboxes' in digital games – a gamble with consumers in need of regulation? An evaluation based on learning from Japan. In: *Proceedings of the 22nd Biennial Conference of the International*

## Ethics statement

The studies involving human participants were reviewed and approved by Ethics Review Committee, Tung Wah College. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## Author contributions

AT and RL conceptualized the study. AT, PL, and SL drafted the manuscript and analyzed the data. SS, CY, AT, and SL collected the data. All authors were involved in revising the manuscript and approved the final version.

## Acknowledgments

We would like to thank all those who kindly volunteered to participate in the study and student who assisted the data collection.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Telecommunications Society: "Beyond the Boundaries: Challenges for Business, Policy and Society. Seoul: International Telecommunications Society (2018).

5. Shibuya A, Teramoto M, Shoun A. In-game purchases and event features of mobile social games in Japan. In: Lee S, Pulos A editors. *Transnational Contexts of Development History, Sociality, and Society of Play*. (London: Palgrave Macmillan, East Asian Popular Culture) (2016). p. 95–122. doi: 10.1007/978-3-319-43820-7\_4

6. Nikopartners. *China Mobile Games*. Campbell, CA: Nikopartners (2022).

7. SuperData Research Inc. *Digital Games Spending Reached \$127 Billion in 2020*. New York, NY: SuperData Research Inc (2021).

8. HKEXnews. *Industry Overview*. (2016). Available online at: <https://www1.hkexnews.hk/listedco/listconews/gem/2016/0113/a6932/cgameone-20151230-14.pdf> (accessed July 26, 2022).

9. Sunshine Lutheran Centre Hong Lutheran Social Service. 香港青年人電子遊「課金」現象問卷調查結果：新冠肺炎下港人「課金」顯著上升過半受訪者每日沉淪「課金」遊戲逾 3 小時 普遍「課金」求助者同時有其他成癮行為. (2020). Available online at: <https://sunshine-cg.hkss.hk/hk/sunshine-news-and-events/in-game-transaction-2> (accessed July 26, 2022).

10. Our Voice Hksyu. 課金中獎率欠透明，港難立法監管遊戲. (2019). Available online at: <https://jmc.hksyu.edu/ourvoice/?p=10403> (accessed July 26, 2022).

11. Tirtasamita RP. *In-App Purchases on Mobile Gaming: What Makes Players Willing to Pay Base Doon Perceived Values*. A thesis. Yogyakarta: Universitas Islam Indonesia (2020).

12. Sunshine Lutheran Centre Hong Lutheran Social Service. 有網遊玩家「課金」成癮，情緒失調身負巨債. (2020). Available online at: <https://sunshine-cg.hkss.hk/hk/sunshine-news-and-events/gaming-news/91-2020-08-09-18-17> (accessed July 26, 2022).

13. Sunshine Lutheran Centre Hong Lutheran Social Service. 留家抗疫增打機時間，94%人難自控，最誇張課金14 萬. (2020). Available online at: <https://sunshine-cg.hkss.hk/hk/sunshine-news-and-events/gaming-news/97-2020-08-09-13-43> (accessed July 26, 2022).

14. Oriental Daily News. 探射燈：打機課金愈踩愈深，另類賭癮個案激增. Hong Kong: Oriental Daily News (2019).

15. Calado F, Alexandre J, Griffiths MD. Prevalence of adolescent problem gambling: a systematic review of recent research. *J Gambl Stud.* (2017) 33:397–424. doi: 10.1007/s10899-016-9627-5

16. Wong AWT. *Analysis of Global Regulatory Schemes on Chance-Based Microtransactions*. *Asper Review of International Business and Trade Law* 111. (2019). Available online at: <https://canlii.ca/t/stlz> (accessed July 26, 2022).

17. Zendle D, Meyer R, Cairns P, Waters S, Ballou N. "The prevalence of loot boxes in mobile and desktop games". *Addiction.* (2020) 115:1768–72. doi: 10.1111/add.14973

18. Zendle D, Meyer R, Over H. Adolescents and loot boxes: links with problem gambling and motivations for purchase. *R Soc Open Sci.* (2019) 19:190049. doi: 10.1098/rsos.190049

19. UK Gambling Commission. *Young People and Gambling Survey 2019: A Research Study Among 11-16 Years Olds in Great Britain*. (2019). Available online at: <https://www.gamblingcommission.gov.uk/PDF/Young-People-Gambling-Report-2019.pdf> (accessed July 26, 2022).

20. Macey J, Hamari J. eSports, skins and loot boxes: participants, practices and problematic behaviour associated with emergent forms of gambling. *New Media Soc.* (2019) 21:20–41.

21. Office of eSafety Commissioner. *State of Play – Youth and Online Gaming in Australia*. Belconnen, CAN: Office of eSafety Commissioner (2018).

22. Claesdotter-Knutsson E, Andre F, Hakansson A. Gaming activity and possible changes in gaming behavior among young people during the COVID-19 pandemic: cross-sectional online survey study. *JMIR Serious Games.* (2022) 10:e33059. doi: 10.2196/33059

23. Blaszczyński A, Walker M, Sagris A, Dickerson M. Psychological aspects of gambling behaviour: an Australian psychological society position paper. *Aust Psychol.* (2011) 34:4–16. doi: 10.1080/00050069908257418

24. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*. Arlington, TX: American Psychiatric Publishing (2013).

25. Hing N, Russell AMT. Proximal and distal risk factors for gambling problems specifically associated with electronic gaming machines. *J Gambl Stud.* (2020) 36:277–95. doi: 10.1007/s10899-019-09867-8

26. Derevensky J. Behavioral addictions: some developmental considerations. *Curr Addict Rep.* (2019) 6:313–22. doi: 10.1007/s40429-019-00257-z

27. Johansson A, Grant JE, Kim SW, Odlaug BL, Gotestam KG. Risk factors for problematic gambling: a critical literature review. *J Gambl Stud.* (2009) 25:67–92. doi: 10.1007/s10899-008-9088-6

28. Gainsbury SM. Online gambling addiction: the relationship between internet gambling and disordered gambling. *Curr Addict Rep.* (2015) 2:185–93.

29. Stevens MW, Dorstyn D, Delfabbro PH, King DL. Global prevalence of gaming disorder: a systematic review and meta-analysis. *Aust N Z J Psychiatry.* (2020) 55:553–68.

30. Delfabbro P, King DL. The convergence of gambling and monetized gaming activities. *Curr Opin Behav Sci.* (2020) 31:32–6. doi: 10.1016/j.cobeha.2019.10.001

31. Hunt, D. Microtransaction spending and problematic. gambling of UK university call of duty gamers. *Int Gambl Stud.* (2022):1–20. [Epub ahead of print]. doi: 10.1080/14459795.2022.2046843

32. Kristiansen S, Severin MC. Loot box engagement and problem gambling among adolescent gamers: findings from a national survey. *Addict Behav.* (2020) 103:106254. doi: 10.1016/j.addbeh.2019.106254

33. Zendle D, Cairns P. Video game loot boxes are linked to problem gambling: results of a large-scale survey. *PLoS One.* (2018) 13:e0206767. doi: 10.1371/journal.pone.0206767

34. Gibson E, Griffiths MD, Calado F, Harris A. The relationship between videogame micro-transactions and problem gaming and gambling: a systematic review. *Comput Hum Behav.* (2022) 131:107219. doi: 10.1016/j.chb.2022.107219

35. Ranieri PC, Montag C, Rozgonjuk D, Satel J, Pontes HM. The role of microtransactions in internet gaming disorder and gambling disorder: a pre-registered systematic review. *Addict Behav Rep.* (2022) 15:100415. doi: 10.1016/j.abrep.2022.100415

36. Garea SS, Drummond A, Sauer JD, Hall LC, Williams MN. Meta-analysis of the relationship between problem gambling, excessive gaming and loot box spending. *Int Gambl Stud.* (2021) 21:460–79. doi: 10.1080/14459795.2021.1914705

37. Yokomitsu K, Irie T, Shinkawa H, Tanaka M. Characteristics of gamers who purchase loot box: a systematic literature review. *Curr Addict Rep.* (2021) 8:481–93. doi: 10.1007/s40429-021-00386-4

38. Brooks GA, Clark L. Associations between loot box use, problematic gaming and gambling, and gambling-related cognitions. *Addict Behav.* (2019) 96:26–34. doi: 10.1016/j.addbeh.2019.04.009

39. King A, Wong-Padoongpatt G, Barrita A, Phung DT, Tong T. Risk factors of problem gaming and gambling in US emerging adult non students: the role of loot boxes, microtransactions and risk-taking. *Issues Ment Health N.* (2020) 41:1063–75. doi: 10.1080/01612840.2020.1803461

40. Drummond A, Sauer JD, Ferguson CJ, Hall LC. The relationship between problem gambling, excessive gaming, psychological distress and spending on loot boxes in Aotearoa New Zealand, Australia, and the United States—A cross-national survey. *PLoS One.* (2020) 15:e0230378. doi: 10.1371/journal.pone.0230378

41. DeCamp W. Loot boxes and gambling: similarities and dissimilarities in risk and protective factors. *J Gambl Stud.* (2020) 37:189–201. doi: 10.1007/s10899-020-09957-y

42. Richard J, Fletcher E, Boutin S, Derevensky J, Temcheff C. Conduct problems and depressive symptoms in association with problem gambling and gaming: a systematic review. *J Behav Addict.* (2020) 9:497–533. doi: 10.1556/2006.2020.00045

43. Kuss D, Gainsbury S. Debate: behavioural addictions and technology use – risk and policy recommendations for problematic online gambling and gaming. *Child Adolesc Ment Health.* (2021) 26:76–7. doi: 10.1111/camh.12449

44. Shinkawa H, Irie T, Tanaka M, Yokomitsu K. Psychosocial adjustment and mental distress associated with in-game purchases among Japanese junior high school students. *Front Psychol.* (2021) 12:708801. doi: 10.3389/fpsyg.2021.708801

45. Effertz T, Bischof A, Rumpf HJ, Meyer C, John U. The effect of online gambling on gambling problems and resulting economic health costs in Germany. *Eur J Health Econ.* (2018) 19:967–78. doi: 10.1007/s10198-017-0945-z

46. Brezing C, Derevensky JL, Potenza MN. Non-substance-addictive behaviors in youth: pathological gambling and problematic internet use. *Child Adolesc Psychiatr Clin N Am.* (2010) 19:625–41. doi: 10.1016/j.chc.2010.03.012

47. Dowling NA, Merkouris SS, Greenwood CJ, Oldenhof E, Toumbourou JW, Youssef GJ. Early risk and protective factors for problem gambling: a systematic review and meta-analysis of longitudinal studies. *Clin Psychol Rev.* (2017) 51:109–24. doi: 10.1016/j.cpr.2016.10.008

48. McCormack A, Shorter GW, Griffiths MD. An examination of participation in online gambling activities and the relationship with problem gambling. *J Behav Addict.* (2013) 2:31–41. doi: 10.1556/JBA.2.2013.1.5

49. Ellenbogen S, Gupta R, Derevensky JL. A cross-cultural study of gambling behaviour among adolescents. *J Gambl Stud.* (2007) 23:25–39. doi: 10.1007/s10899-006-9044-2

50. Raylu N, Oei TP. Role of culture in gambling and problem gambling. *Clin Psychol Rev.* (2004) 23:1087–114. doi: 10.1016/j.cpr.2003.09.005



51. Cohen J. A power primer. *Psychol Bull.* (1992) 112:155–9. doi: 10.1037/0033-2909.112.1.155
52. Loo JM, Oei TP, Raylu N. Psychometric evaluation of the problem gambling severity index-Chinese version (PGSI-C). *J Gambl Stud.* (2011) 27:453–66. doi: 10.1007/s10899-010-9221-1
53. Ferris J, Wynne HJ. *The Canadian Problem Gambling Index*. Ottawa, ON: Canadian Centre on Substance Abuse (2001).
54. Gong X, Xie XY, Xu R, Luo YJ. Psychometric properties of the Chinese versions of DASS-21 in Chinese college students. *Chin J Clin Psychol.* (2010) 18:443–6.
55. Lovibond SH, Lovibond PF. *Manual for The Depression Anxiety Stress Scales*. 2nd ed. Sydney, NSW: Psychology Foundation (1995).
56. Chang WW, Shi LX, Zhang L, Jin YL, Yu JG. The mental health status and associated factors among medical students engaged in online learning at home during the pandemic: a cross-sectional study from China. *Front Psychiatry.* (2021) 12:755503. doi: 10.3389/fpsy.2021.755503
57. Wang K, Shi HS, Geng FL, Zou LQ, Tan SP, Wang Y, Neumann, Shum DHK. Cross-cultural validation of the depression anxiety stress Scale-21 in China. *Psychol Assess.* (2016) 28:e88–100. doi: 10.1037/pas000020738
58. The Hong Kong Polytechnic University. *Report on the Study of Hong Kong people's Participation in Gambling Activities in 2016*. Hong Kong: The Hong Kong Polytechnic University (2019).
59. Xu F, Huang L. Impacts of stress and risk perception on mental health of college students during the COVID-19 pandemic: the mediating role of coping efficacy. *Front Psychiatry.* (2021) 12:767189. doi: 10.3389/fpsy.2021.767189
60. Ma L, Mazidi M, Li K, Li Y, Chen S, Kirwan R, et al. Prevalence of mental health problems among children and adolescents during the COVID-19 pandemic: a systematic review and meta-analysis. *J Affec Diso.* (2021) 293:78–89. doi: 10.1016/j.jad.2021.06.021
61. Santomauro DF, Herrera AMM, Shadid J, Zheng P, Ashbaugh C, Pigott DM, et al. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *Lancet.* (2021) 398:1700–12. doi: 10.1016/S0140-6736(21)02143-7
62. World Health Organization. *Mental Health and COVID-19: Early Evidence of The Pandemic's Impact*. Geneva: World Health Organization (2022).
63. Merkouris SS, Thomas AC, Shandley KA, Rodda SN, Oldenhof E, Dowling NA. An update on gender differences in the characteristics associated with problem gambling: a systematic review. *Curr Addict Rep.* (2016) 3:254–67. doi: 10.1007/s40429-016-0106-y
64. Clement J. *Average Age of U.S. Video Game Players in 2019*. (2021). Available online at: <https://www.statista.com/statistics/189582/age-of-us-video-game-players/> (accessed July 26, 2022).
65. King DL, Russell MT, Delfabbro PH, Polisen D. Fortnite microtransaction spending was associated with peers' purchasing behaviors but not gaming disorder symptoms. *Addict Behav.* (2020) 104:106311. doi: 10.1016/j.addbeh.2020.106311
66. Clement J. *Weekly Hours Spent Playing Video Games Worldwide 2021, by Countries*. (2021). Available online at: <https://www.statista.com/statistics/273829/average-game-hours-per-day-of-video-gamers-in-selected-countries/> (accessed July 26, 2022).
67. Clement J. *COVID-19 Impact on Time Spent Gaming Worldwide 2020*. (2021). Available online at: <https://www.statista.com/statistics/1188545/gaming-time-spent-covid/> (accessed July 26, 2022).
68. Li W, Mills D, Nower L. The relationship of loot box purchases to problem video gaming and problem gambling. *Addict Behav.* (2019) 97:27–34. doi: 10.1016/j.addbeh.2019.05.016
69. Hellstrom C, Nilsson K, Leppert J, Aslund C. Influences of motives to play and time spent gaming on negative consequences of adolescent online computer gaming. *Comput Hum Behav.* (2012) 28:1379–87. doi: 10.1016/j.chb.2012.02.023
70. Lelonek-Kuleta B, Bartczuk RP. Online gambling activity, pay-to-win payments, motivation to gamble and coping strategies as predictors of gambling disorder among e-sports bettors. *J Gambl Stud.* (2021) 37:1079–98. doi: 10.1007/s10899-021-10015-4
71. Kuss DJ, Griffiths MD. Online gaming addiction in children and adolescents: a review of empirical research. *J Behav Addict.* (2012) 1:3–22. doi: 10.1556/jba.1.2012.1.1





## OPEN ACCESS

## EDITED BY

Agnes Lai,  
The University of Hong Kong,  
Hong Kong SAR, China

## REVIEWED BY

Minh-Hoang Nguyen,  
Phenikaa University, Vietnam  
Farshid Aram,  
Polytechnic University of Madrid, Spain

## \*CORRESPONDENCE

You Peng  
y.peng@tue.nl

## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

RECEIVED 02 March 2022

ACCEPTED 08 July 2022

PUBLISHED 09 August 2022

## CITATION

Liu S, Ji Y, Li J, Peng Y, Li Z, Lai W and  
Feng T (2022) Analysis of students'  
positive emotions around the green  
space in the university campus during  
the COVID-19 pandemic in China.  
*Front. Public Health* 10:888295.  
doi: 10.3389/fpubh.2022.888295

## COPYRIGHT

© 2022 Liu, Ji, Li, Peng, Li, Lai and  
Feng. This is an open-access article  
distributed under the terms of the  
[Creative Commons Attribution License  
\(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or  
reproduction in other forums is  
permitted, provided the original  
author(s) and the copyright owner(s)  
are credited and that the original  
publication in this journal is cited, in  
accordance with accepted academic  
practice. No use, distribution or  
reproduction is permitted which does  
not comply with these terms.

# Analysis of students' positive emotions around the green space in the university campus during the COVID-19 pandemic in China

Shaobo Liu<sup>1</sup>, Yifeng Ji<sup>1</sup>, Jiang Li<sup>1</sup>, You Peng<sup>2\*</sup>, Zhitao Li<sup>3</sup>,  
Wenbo Lai<sup>4</sup> and Tao Feng<sup>5</sup>

<sup>1</sup>The Department of Environmental Design, School of Architecture and Art, Central South University, Changsha, China, <sup>2</sup>Urban Planning and Transportation Research Group, Department of the Built Environment, Eindhoven University of Technology, Eindhoven, Netherlands, <sup>3</sup>Smart Transport Key Laboratory of Hunan Province, School of Traffic and Transportation Engineering, Central South University, Changsha, China, <sup>4</sup>Department of Landscape Architecture, School of Architecture, South China University of Technology, Guangzhou, China, <sup>5</sup>Urban and Data Science Lab, Graduate School of Advanced Science and Engineering, Hiroshima University, Higashi Hiroshima, Japan

Green space around the university campus is of paramount importance for emotional and psychological restorations in students. Positive emotions in students can be aroused when immersed in green space and naturalness. However, to what extent can perceived naturalness influence students' positive emotion remains unclear, especially in the context of COVID-19 countermeasures. This study, therefore, attempts to investigate in-depth the nature and strength of the relationships between students' positive emotion and their perceived naturalness, place attachment, and landscape preference, which are potentially varying across universities in different social and environmental contexts and different restrictions policies regarding the COVID-19 pandemic. A course of questionnaire-based surveys was administered on two university campuses in Heilongjiang and Hunan Provinces, China, resulting in 474 effective samples. Structural equation modeling was used to explore the hypothetical conceptual framework of latent variables and the indicators. The findings indicate that the higher students' perceived naturalness results in greater positive emotion. Students' perceived naturalness in green spaces of campus has a positive effect on their place attachment and landscape preference. Moreover, the difference between mediate effects of place attachment and landscape preference were addressed, which verifies the contextual influences.

## KEYWORDS

COVID-19, campus green spaces, positive emotion, perceived naturalness, place attachment, landscape preference, structural equation modeling

## Introduction

As a public health issue, the global pandemic of COVID-19 poses a serious threat to the built environment and human health (1). Many countries have therefore adopted lockdown to restrict people's activities to varying degrees (2, 3). In China, university students successively returned to school in the fall of 2020. Still, the outdoor activities of students were limited in most universities in order to prevent the potential spread of the epidemic (4). Under this circumstance, some university students experienced a reduction in social activities and encountered other troubles, such as financial stresses and academic frustrations, which may cause negative outcomes regarding emotional and mental health (5). Recent research addressed that approximately 45% of Chinese students had mental health problems during the COVID-19 period (6). In fact, even before the COVID-19 period, university students' negative emotions and mental health problems were commonplace due to time pressure, competition, and the pressure to achieve good academic grades (7). Several studies showed that individuals who exhibit a high level of negative emotion often show more distress, anxiety, and dissatisfaction (8, 9). Conversely, positive emotion is thought to alleviate psychological disorders such as depression and anxiety for university students (10, 11). Hence, there is an urgent need to effectively employ preventive measures to help students with emotional regulation (12, 13).

The psycho-evolutionary theory suggests that people's emotions can be positively affected by observing the natural environment (14). As the main place of contact with nature for university students, the campus green spaces (CGSs) include lawns, woods, and other landscaped spaces available for students to meet their emotional and psychological needs (15–17). van den Bogerd et al. (18) summarized the restorative effects of the CGSs on university students' emotions, including "reducing harm," "restoring capacities," and "building capacities" (18), all of which involve students' perceived naturalness of the CGSs. A significant positive correlation between students' perceived naturalness and their restoration and health was evidenced (17), which indicates the effect of perceived naturalness in regulating students' emotions in the CGSs.

However, although green spaces have similar characteristics to a certain extent, it is not reasonable to regard the perceived naturalness of the CGSs in different areas as the same as students' restorations (19). Conceptually, the perceived naturalness in different regions is localized to cultural, social, and environmental contexts (20), involving place attachment and landscape preference (21, 22). Place attachment is defined as a complex emotional or psychological bond between an individual and the environment (23). Previous studies claim that features of the natural environment affect individuals' attachment to place (24). An increase in place attachment

is thought to improve emotions and promote psychological recovery (25). It can be inferred that, when attachment decreases, emotional improvement and psychological recovery can also be disrupted. Moreover, place attachment includes an individual's sense of belonging and familiarity with the place, which is related to landscape preference (24). The degree to which people are attached to the natural environment can affect their degree of preference and emotional state (26). Students may have different degrees of place attachment and landscape preference for the CGSs in different regions, which may lead to differences in the mechanisms by which perceived naturalness affects students' restorations.

At present, university students from different regions of China have experienced different periods of lockdown. The perception of naturalness, emotions, and the level of stress are affected by the regulations depending on the varying intensity of COVID-19 spreads (27). Researchers confirmed that individuals who reported feeling nature deprived during the COVID-19 lockdown experienced more emotional swings and mental health problems (28). More importantly, the lockdown associated with COVID-19 provided a new way for individuals to perceive the value of green space (29). Their attachment to and preference for nature has been amplified, which may also have implications for the relationship between perceived naturalness and emotions. Thus, comparative research in different social and environmental contexts will help broaden our understanding of the relationships between perceived naturalness and emotions and the mental health of university students. However, few published studies compared the different effects of perceived naturalness on emotions across different regions. Studies have not yet explored the potential effects of perceived naturalness of the CGSs on university students' emotions and the related mediate effects of place attachment and landscape preference in the context of the COVID-19 pandemic.

This study aimed to explore the hypothetical effects of place attachment and landscape preference in the relationship between the perceived naturalness of CGSs and university students' positive emotions under the restriction policies and regulations to control the spread of the COVID-19 pandemic. We comparatively investigated the hypotheses considering the social and environmental differences between two universities in Hunan and Heilongjiang provinces, China. Due to the different epidemiological conditions during the COVID-19 period in China, these two universities imposed control regulations with different intensities. The findings are expected to provide up-to-date contextual insights into the relationship between perceived naturalness and positive emotion and to systematically understand the mechanism that perceived naturalness in CGSs evokes the student's positive emotion. Furthermore, the implications are expected to help the planning and management of university green spaces for improving the mental health and well-being of university students.

## Conceptual framework

### The effect of perceived naturalness and emotions

Perceived naturalness refers to the proximity of the landscape to the perceived natural state (30), while emotion is defined as a value judgment that relates external events to inner concerns (31). A wealth of evidence has been provided for verifying the relationship between the perceived naturalness of the CGSs and university students' emotions (17, 18). Many natural elements, such as abundant plant species and large areas of vegetation may help students improve their emotional state and mental health in their daily lives (32). For instance, Malekinezhad et al. (33) found that university students' perceptions of the campus with green qualities may enhance positive emotion and contribute to improving mental health (33). On the other hand, a lack of natural elements in the environment can lead to an increase in negative emotions such as anxiety, impulsiveness, and sadness among university students (34).

Literature studies on the COVID-19 pandemic revealed that natural deprivation associated with lockdown leads to restriction of physical activity and experience of negative emotions such as anxiety and depression among university students (27, 35). On the contrary, exposure to the natural environment during COVID-19 helps enhance an individual's perception of nature and reduces negative emotions such as anger, fear, and confusion (36). Despite the rapid control of COVID-19 in China in 2020, sporadic outbreaks and lockdowns are still occurring (37). Therefore, exploring how the perceived naturalness of the CGSs can affect university students' positive emotions during the COVID-19 pandemic. Due to differences in epidemic status and lockdown regulations, the relationship between the perceived naturalness of the CGSs and university students' positive emotions needs to be understood across social and environmental contexts (19, 38). Thus, this study proposed that hypothetical regional differences exist in the influences of the university students' perceived naturalness of CGSs on their positive emotions across different universities characterized by social and environmental features.

### The mediate effect of place attachment

Place attachment, as place identification and place dependence, is a positive emotional connection established between people and places through memory and exposure to the environment (39, 40) and is associated with perceived naturalness (41). Higher perceived naturalness results in stronger attachment, more exposure, and experience with the added benefits of contact with nature (16, 17). For university students, natural environments are more popular than urban environments (42). The students' perceived naturalness of

CGSs can lead to the development of place attachment (43). In contrast, the lack of natural elements around the campus causes the absence of students' perceived naturalness and place attachment (44).

As an emotional bond between people and important places, students' place attachment is linked to their emotions (44). Students' self-esteem and sense of belonging can be enhanced by place attachment, and their positive emotions, such as relaxation and happiness, can also be increased (45). Furthermore, place attachment is used to connect the perceived naturalness of CGSs and positive emotion (46). When students are frustrated, fearful, and stressed by external events, the CGSs are conducive in forming students' place attachment and evoking their positive emotions (47). However, the mediate effect of place attachment is unclear in the relationship between students' perceived naturalness and positive emotion during the COVID-19 pandemic.

### The mediate effect of landscape preference

Landscape preference is formed through the interaction between people and the natural environment (48). The environmental preference matrix summarized human preferences for landscape as "understanding" (coherence and legibility) and "exploration" (complexity and mystery) (49). Several pieces of evidence have been presented, which explain the relationship between landscape preferences and the perceived naturalness of the CGSs (50). Compared to artificial landscapes, university students have more preference for natural landscapes with lots of trees, open areas, and water (51, 52). The well-designed CGSs as high-quality landscapes can provide university students opportunities to reduce stress and increase social interactions (53).

CGSs provided natural spaces to meet university students' landscape preferences, which contributed to generating positive emotions among students in the university (54, 55). Moreover, university students exposed to a preferred environment tend to have more positive emotions and lower negative emotions (51). It also has been demonstrated that, as a basis for the restorative effects of the environment, preferences moderate the effect of perceptions of green space on positive emotion (56). After experiencing the COVID-19 lockdown, university students were more eager to be in outdoor environments (35, 57). The positive attitude toward being outside may have an impact on students' perceived naturalness and landscape preference, which may affect their positive emotions about enjoying the CGSs.

### Hypothetical structure

Several studies showed that social and cultural contexts influence the form and function of green spaces, which

affects individuals' perceptions of the environment (38, 58). In this study, the mechanism of students' positive emotions influenced by the perceived naturalness of CGSs is assumed to vary depending on regional contexts. Moreover, this study aimed to examine the role of place attachment and landscape preference in the relationship between students' perceived naturalness of the CGSs and their positive emotions. It is assumed that the university students' positive emotion in the CGSs is proportional to their place attachment and landscape preference. In addition, the mediate effects of students' place attachment and landscape preference are hypothesized to link the perceived naturalness and positive emotion.

Figure 1 depicts the hypothetical relationships between the latent variables in the conceptual framework. We assumed that the students' perceived naturalness directly affects their positive emotion (H1), place attachment (H2), and landscape preference (H3). Place attachment and landscape preference play mediating roles to link perceived naturalness and positive emotion,

respectively (H4 and H5). In addition, place attachment influences landscape preference (H6).

The exogenous variables used for constructing latent variables are listed in Table 1. The perceived naturalness was evaluated by the perception of natural attributes and natural feeling (17). Natural attributes refer to the flora, fauna, and sounds in the environment and are measured by PN01 and PN02. Natural feeling refers to the feeling brought by the natural environment and is measured through PN03 to PN05. Students' positive emotions were measured by the Positive Affect Scale, which constitutes the emotional component of subjective well-being (59). In the Chinese cultural context, positive emotion could be assessed through nine different emotions, (60) which were presented as PE01 to PE09. Place dependence and place identity are the two main dimensions of place attachment (45). In this study, place dependence, referring to the value of the place largely above other places, was measured by PA01 to PA04, and place identity, referring to the place as a part of oneself, is measured by PA05 to PA08. According to the environmental

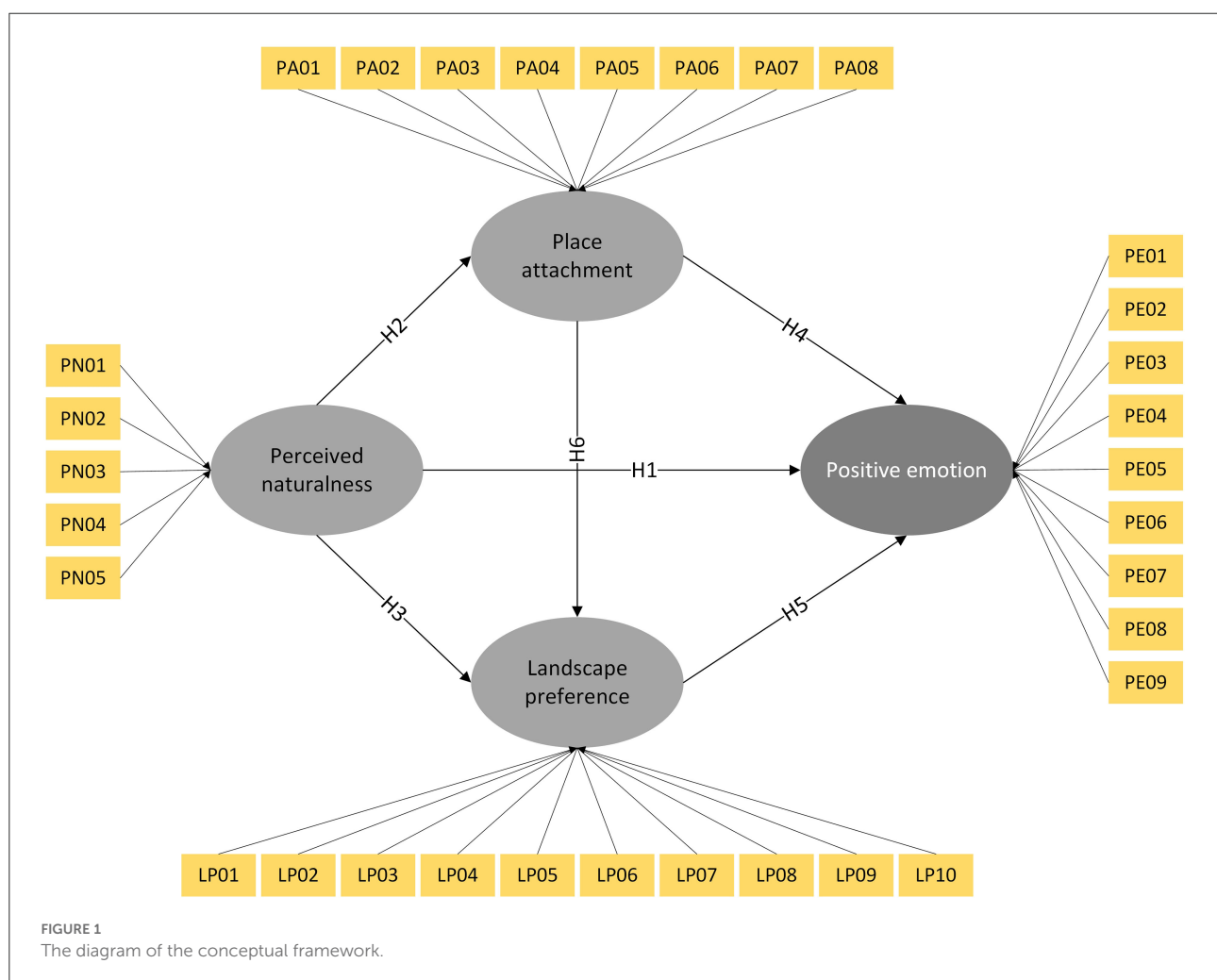


TABLE 1 Latent variables and the corresponding exogenous variables.

Construct	Code	Measuring questions (Indictors)
Perceived naturalness (PN)	PN01	I think the campus green spaces have many wild plants and animals.
	PN02	I can feel the strong natural voice in the campus green spaces.
	PN03	The campus green spaces make me feel friendly.
	PN04	I feel safe and calm in the campus green spaces.
	PN05	I feel the campus green spaces are wild.
Positive emotion (PE)	PE01	I feel active.
	PE02	I feel enthusiastic.
	PE03	I feel cheerful.
	PE04	I feel joyful.
	PE05	I feel excited.
	PE06	I feel proud.
	PE07	I feel inspired.
	PE08	I feel strong.
	PE09	I feel grateful.
Place attachment (PA)	PA01	The campus green spaces are comfortable and allow me to do the things I want.
	PA02	There is no other place like the campus green spaces.
	PA03	I can get more satisfaction in the campus green spaces than in other places.
	PA04	What I do on the campus green spaces is more important than what I do elsewhere.
	PA05	The campus green spaces allow me to see what I am interested in.
	PA06	I feel that the campus green spaces are part of my life.
	PA07	I have a strong identification with the campus green spaces.
	PA08	The campus green spaces are special, and I have good feelings about them.
Landscape preference (LP)	LP01	I think the various parts of the campus green spaces form a whole.
	LP02	The various parts of the campus green spaces form a beautiful landscape.
	LP03	I think the campus green spaces contain a multitude of elements and features.
	LP04	I think there are many intricate elements in the campus green spaces.

(Continued)

TABLE 1 Continued

Construct	Code	Measuring questions (Indictors)
	LP05	I think the campus green spaces contain many functions.
	LP06	I can clearly understand the campus green spaces.
	LP07	I think the campus green spaces have clear markers.
	LP08	The campus green spaces make me want to investigate more.
	LP09	The campus green spaces are circuitous and intrigue me.
	LP10	The campus green spaces are far-reaching and mysterious.

preference matrix (49), landscape preference was evaluated by four dimensions, including (1) coherence measured by LP01 and LP02, (2) legibility measured by LP03 to LP05, (3) complexity measured by LP06 and LP07, and (4) mystery measured by LP08 to LP10.

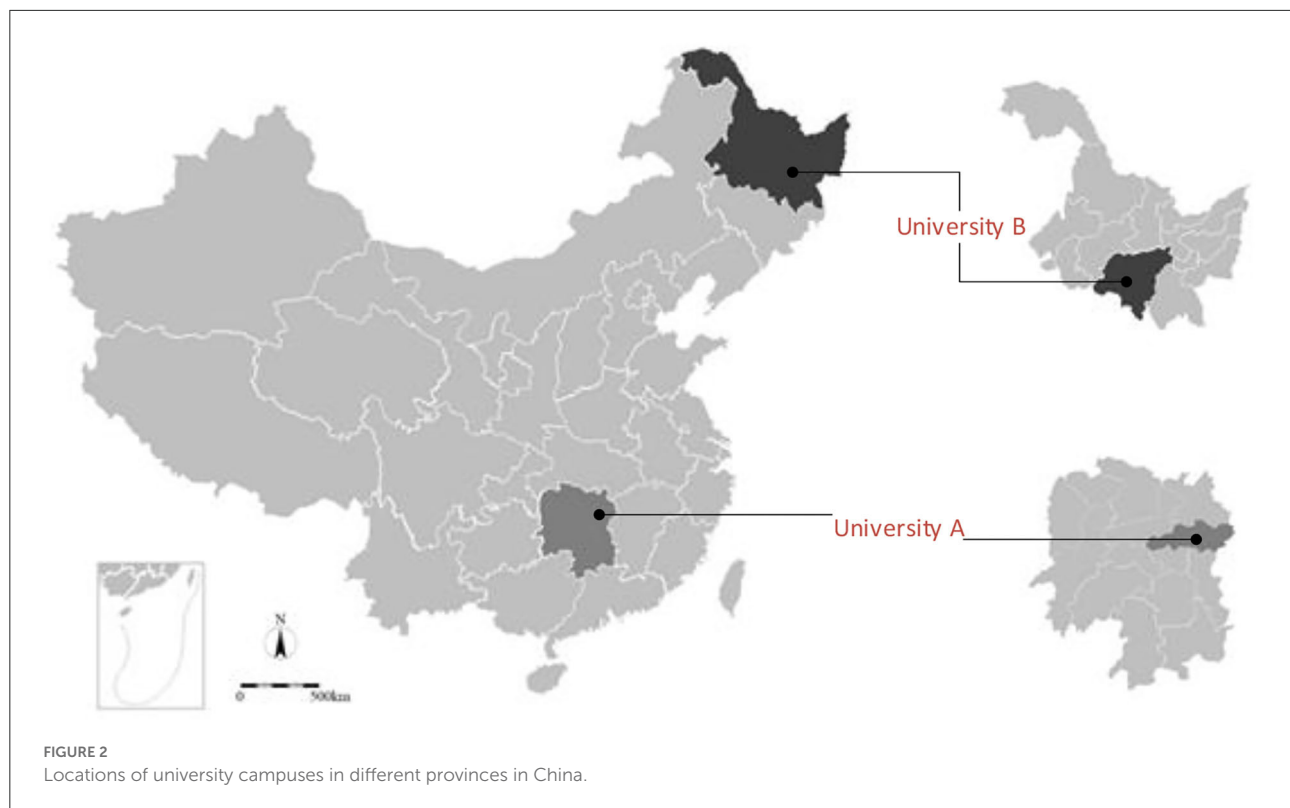
## Methodology

### Study locations

The field surveys were conducted on two campuses, namely campus of university A (UA) in Changsha of Hunan Province and the campus of university B (UB) in Harbin of Heilongjiang Province, in China. According to the Köppen climate classification, Changsha is classified as Cfa and characterized by mild temperate climate and fully humid climate with hot summers, while Harbin is classified as Dwa and characterized by snow, dry winters, and hot summers (61). The locations of the studied universities are shown in Figure 2. UA started to reopen in September 2020 when the outdoor activity limits for COVID-19 pandemic control were phased out. Due to sporadic outbreaks in Heilongjiang Province at that time, UB implemented a stricter lockdown after students returned for the fall semester compared to UA. The characteristics of the two universities are listed in Table 2.

On the campus of UA, the green space is scattered and includes lawns, trees, and a river. There are many geese in the river. The outdoor activity area is crowded. Minor noises are caused by the green space under construction. Each green space has a unique character. The green areas in UB consist of large lawns, distinct flora, and fauna. A rich variety of plants is observed. The river flows through the campus. There are good opportunities for outdoor activities, good natural quality, and strong attraction. The scenes of the two campuses are shown in Figure 3.





## Measures and survey

A questionnaire was developed for the survey with five parts. The first part is regard to collecting information on students' socio-demographic characteristics, including gender, age, education level, and monthly living expense. The second part is used to acquire students' perceived naturalness in the form of a self-rated naturalness scale (SRNS) (17). The third part applies the Positive Affect Scale from the Positive and Negative Affect Scale (PANAS) (in Chinese), as a snippet of the full scale, for obtaining students' positive emotions when exposed to the CGSs (60). The fourth part directs at evaluating students' place attachment in their university based on the Place Attachment Scale (PAS) (45). The final section measures students' landscape preference based on the environmental preference matrix (49). Except for the first part, all questions are answered by respondents using a Likert-type scale from 1 to 5 (1-strongly disagree, 2-somewhat disagree, 3-neither disagree nor agree, 4-somewhat agree, 5-strongly agree). The screenshots of the questionnaire forms are shown in Figure 4.

From February to April 2021, students were randomly invited to join the surveys in the two selected universities. All participants voluntarily took part in our surveys, and the collected questionnaire forms are anonymous for privacy issues. Before answering the questionnaire, respondents were informed of the purpose of the questionnaire and asked to recall their

TABLE 2 Characteristics of the universities in this study.

	UA	UB
Location	Changsha, Hunan Province	Harbin, Heilongjiang Province
Number of students	Approx. 59000	Approx. 26000
The overall area	317 ha	136 ha

emotional states during their routine activities in the CGSs over the past 2 weeks. Finally, of the 539 possible eligible questionnaires, 474 completed questionnaires passed the validity check (UA: 253, UB: 221; effective response rate: 87.94%).

## Structural equation modeling

Structural equation modeling (SEM) is a popular method for data analysis that has been widely used in many fields, such as psychology, sociology, and education. Unlike other modeling approaches, SEM integrates a measurement model and structural model, which can directly respond to the relationship between latent and observed variables, as well as the relationship between latent variables (62).

UA



UB



FIGURE 3  
Scenes of the studied university campuses.

The equation of the measured model is as follows:

$$X = \Lambda_x \xi + \delta \quad (1)$$

$$Y = \Lambda_y \eta + \varepsilon \quad (2)$$

where  $X$  denotes the vector consisting of measured variables of the  $i$ th independent latent variables,  $Y$  denotes the vector of measured variables of dependent latent variable;  $\Lambda_{xi}$  and  $\Lambda_y$  are matrices of factor loadings for  $X$  and  $Y$ , respectively;  $\delta$  and  $\varepsilon$  are measurement errors of independent and dependent latent variables, respectively; and  $\xi$  is a vector of latent independent variables and  $\eta$  is a vector of latent dependent variables. The variances and covariances among the measurement errors of measured independent variables in  $X$  are contained in  $\Omega_\delta$ , and the variances and covariances among the measurement errors for the measured dependent variables are included in  $\Omega_\varepsilon$ .

The regression equation of the structural model is as follows:

$$\eta = B\eta + \Gamma\xi + \zeta, \quad (3)$$

where  $B$  is the regression coefficient matrix regarding the latent dependent variables;  $\Gamma$  is the regression coefficient matrix

relating latent independent variables; and  $\zeta$  is the vector of the error term in the structural model equation that contains the equation prediction errors. The variances and covariances among the latent independent variables are included in a matrix  $\Phi$ , and the variances and covariances among latent dependent prediction errors are contained in a matrix  $\Psi$ .

To estimate the SEM model, it is assumed in this study that the outcomes were continuous when the random variables follow a normal distribution. Maximum likelihood (ML) was used to figure out the estimation of the model regarding all parameters simultaneously. ML yields an estimate that seeks to maximize the likelihood that the measured data are consistent with the implied model, which is given as (63):

$$F_{ML} = \log |\Sigma(\hat{\theta})| + tr(S\Sigma^{-1}(\hat{\theta})) - \log |S| - (p + q) \quad (4)$$

where  $\Sigma(\hat{\theta})$  is the matrix that the theoretical model implies composing of the abovementioned matrices of estimated parameters (denoted by  $\hat{\theta}$ ), including  $\Lambda_{xi}$ ,  $\Lambda_y$ ,  $\Omega_\delta$ ,  $\Omega_\varepsilon$ ,  $B$ ,  $\Gamma$ ,  $\Phi$ , and  $\Psi$ ;  $tr$  is the trace of the matrix;  $S$  is the covariance matrix



FIGURE 4  
Questionnaire form sample in Chinese and English.

observed in the data;  $p$  is the number of indicators for exogenous latent variables in the model; and  $q$  is the number of indicators for the endogenous latent variables in the model. The loadings and coefficients are obtained when the difference between the covariance matrix elements of measured data and the covariance matrix elements implied by the model is minimized.

## Results

### Descriptive statistics

The sociodemographic characteristics of respondents are shown in Table 3. The number of male students who joined the survey at UA was little higher than the number of female students, while the opposite occurred at UB. The students in the age group of 22-year-old and below made up the majority of respondents, followed by those aged 23–26 years old. In terms of educational attainment, the largest proportions of respondents are undergraduates, which are 69.17% in UA and 81.00% in

UB. Regarding monthly expenditure, students surveyed at both universities mainly spend 1,000–2,000 CNY per month, which account for 65.22% of respondents at UA and 72.40% of respondents at UB. According to the statistical yearbook 2019, the per capita disposable income of urban residents in Changsha is 55,211 CNY (64), while in Harbin, it is 40,007 CNY (65).

### SEM estimation results

The Tucker–Lewis index (TLI) is widely used to model linear mean and covariance structures. The value of The TLI also ranges between 0 and 1, with results  $\geq 0.9$ , indicating an acceptable fit to the model (66). The comparative fit index (CFI) reflects the difference between the hypothetical model and the independent model. The value of CFI lies between 0 and 1, where a value  $\geq 0.9$  indicates that the model is acceptable (67). Root Mean Square Error of Approximation (RMSEA) refers to the square root of the asymptotic residual sum of squares. Previous

**TABLE 3** Descriptive statistics on demographic characteristics of the participants.

Factor	Category	UA	UB
Sex	Men	136 (53.75%)	99 (44.80%)
	Women	117 (46.25%)	122 (55.20%)
Age (years)	≤ 22	176 (69.57%)	137 (61.99%)
	23–26	63 (24.90%)	82 (37.10%)
	≥ 26	14 (5.53%)	2 (0.91%)
Education	Undergraduate	175 (69.17%)	179 (81.00%)
	Master	73 (28.85%)	41 (18.55%)
	Doctor	5 (1.98%)	1 (0.45%)
Monthly expense (CNY)	≤ 1000	26 (10.28%)	13 (5.88%)
	1000–2000	165 (65.22%)	160 (72.40%)
	≥ 2000	62 (24.50%)	48 (21.72%)

**TABLE 4** Model fit indexes.

	TLI	CFI	RMSEA
UA	0.911	0.918	0.072
UB	0.900	0.910	0.075

studies showed that an RMSEA of  $< 0.05$  indicates a satisfactory model fit, however, if it is  $< 0.08$ , then it indicates an acceptable model fit (68). As shown in Table 4, the model fit indices for both universities meet the desired criteria. The values of TLI and CFI in the estimation of models for the two universities are  $> 0.9$ , and the values of RMSEA for the models of both universities are less than the acceptable value of 0.08. These indicate that both the models have good fits.

As shown in Table 5, the standardized factor loadings between latent variables and all corresponding observed variables are  $> 0.6$ . Regarding the structural models, Table 6 shows the estimated results that differ across the two universities. The positive effect of students' perceived naturalness on their positive emotions is significant in two universities. The higher the perceived naturalness that students may have, the more positive emotional states they will reach. Besides the direct influences on positive emotion, in the model of UB, the indirect effect through landscape preference and the joint indirect effect through place attachment and landscape preference are positively significant. However, the indirect effects are not significant when it comes to the model in UA. These are particularly useful for confirming our hypothesis that there are differences in the underlying mechanisms of the relationship between students' perceived naturalness and emotions in different social and environmental contexts. At the same time, these results highlight the necessity of expanding the functionality of the CGSs, which contributes to creating a green environment suitable for restoration and addressing the

different psychological needs of students during the COVID-19 pandemic.

The direct mediate effect of place attachment is not verified in the models of both universities. This result is inconsistent with recent research, which concluded that place attachment was beneficial to students' positive emotions and mental health (69). One of the possible explanations for this inconformity is that university students' place attachment is likely to link with their past experiences (25). Place attachment is dynamic based on personal experience (70). When people visit an environment, past experiences and memories may be evoked regarding the local landscape elements in their hometowns, which are not aligned with the current environment (24, 71). The irrelevance of the environment to past experiences can decrease people's place attachment (72). Due to the influence of the social context and cultural circumstances on the landscape character of the campus, the CGSs may not meet the environmental needs of students from other regions, which may affect their place attachment to the campus. Another possible explanation is the restriction of the freedom to enjoy the CGSs as a result of the closure of public spaces and the restriction of the distance during the COVID-19 pandemic (73). When students return to the CGSs, their emotional states are getting more positive soon; however, their place attachments are not established immediately. The mediate effects of landscape preference and place attachment have been verified in UB, which indicates that the relationship between students' perceived naturalness of the CGSs, and their positive emotion can be sequentially mediated by place attachment and landscape preference. A campus that is well-designed and meets students' needs for outdoor activities and landscape preferences will have a positive effect on their emotional and psychological recovery (44, 52, 74).

Compared to UB, the joint mediating role of place attachment and landscape preference was not validated at UA. This is mainly due to the absence of a link between students' landscape preferences and positive emotions. People's landscape preferences are heterogeneous and dynamic and can be influenced by temporal, spatial, and personal factors (48). As for UA, the disorder and confusion of the green spaces were caused by the construction on the campus. The campus under construction will generate noise, dust, and visual experiences unrelated to the natural environment (75). Mounting evidence showed that disorder and confusion are determined by the artificial structures in the environment, which can affect students' landscape preferences and positive emotions (4, 52). In addition, the lockdown of universities during the COVID-19 epidemic can also affect students' landscape preferences (76). UA has now gradually reopened with the effective control of the epidemic, but strict social distancing measures are still in place for students (4). Our survey was conducted approximately 5 months after the reopening of UA. This allowed students to spend more time around the campuses and led to increasing familiarity with the CGSs. This familiarity can hinder students'

TABLE 5 Results of the measurement model.

Latent variable	Indicator	UA		UB	
		Estimate	<i>p</i> -value	Estimate	<i>p</i> -Value
Perceived naturalness	PN01	0.616	0.000	0.661	0.000
	PN02	0.627	0.000	0.707	0.000
	PN03	0.817	0.000	0.896	0.000
	PN04	0.795	0.000	0.904	0.000
	PN05	0.832	0.000	0.861	0.000
Positive emotion	PE01	0.836	0.000	0.816	0.000
	PE02	0.845	0.000	0.795	0.000
	PE03	0.883	0.000	0.838	0.000
	PE04	0.898	0.000	0.872	0.000
	PE05	0.874	0.000	0.858	0.000
	PE06	0.830	0.000	0.908	0.000
	PE07	0.805	0.000	0.795	0.000
	PE08	0.752	0.000	0.753	0.000
	PE09	0.826	0.000	0.772	0.000
Place attachment	PA01	0.802	0.000	0.720	0.000
	PA02	0.718	0.000	0.658	0.000
	PA03	0.771	0.000	0.731	0.000
	PA04	0.634	0.000	0.653	0.000
	PA05	0.830	0.000	0.834	0.000
	PA06	0.807	0.000	0.817	0.000
	PA07	0.878	0.000	0.906	0.000
	PA08	0.806	0.000	0.774	0.000
Landscape preference	LP01	0.843	0.000	0.804	0.000
	LP02	0.845	0.000	0.812	0.000
	LP03	0.844	0.000	0.791	0.000
	LP04	0.789	0.000	0.706	0.000
	LP05	0.791	0.000	0.685	0.000
	LP06	0.708	0.000	0.735	0.000
	LP07	0.645	0.000	0.692	0.000
	LP08	0.843	0.000	0.763	0.000
	LP09	0.780	0.000	0.735	0.000
	LP10	0.689	0.000	0.611	0.000

TABLE 6 Results of the structural model.

Hypothesis	UA		UB	
	Coefficient	<i>p</i> -Value	Coefficient	<i>p</i> -Value
H1	0.215	0.047	0.247	0.011
H2	0.827	0.000	0.703	0.000
H3	0.166	0.022	0.295	0.000
H4	0.317	0.080	0.151	0.251
H5	0.791	0.000	0.648	0.000
H6	0.235	0.180	0.294	0.045



perception of the mystery of the CGSs (4). As a part of students' landscape preference, mystery promises to provide interesting new information through the environment (77). This also implies that the absence of a sense of mystery in the CGSs may have a negative impact on students' landscape preferences; however, it does not influence their positive emotions.

## Discussion and conclusion

This study aimed at understanding the importance of perceived naturalness in university campus green spaces for improving students' positive emotions, especially after the controlling regulations of the COVID-19 pandemic. The questionnaire-based surveys have been undertaken in two universities in Heilongjiang and Hunan Provinces to collect data on students' positive emotions, perceived naturalness, place attachment, and landscape preference regarding CGSs in different social and environmental contexts.

A comparison of SEM results of the sample groups from the two different universities indicates that perceived naturalness, place attachment, and landscape preference influence positive emotion in different manners. The findings suggest that students' perceived naturalness of the CGSs can directly influence their positive emotions. Meanwhile, students' place attachment and landscape preference can be facilitated by the perceived naturalness of the CGSs, ultimately leading to more positive emotions.

With the improvement of campus environments of Chinese universities in the last two decades, students can experience a more natural and better-designed campus environment than in other urban spaces (78). Nevertheless, more attention is needed to maintain the emotional and psychological well-being of students, especially under the situation of the COVID-19 pandemic. As for the practical implications, this study provides psychological insights into the administration and planning of the university campus. Natural elements, such as plants, lawns, and water bodies, which are expected to make the CGSs more responsive to the needs of students in various social and environmental contexts, are essential for the emotional recovery of students during the COVID-19 pandemic. Campus administrators and planners can take further steps to foster a sense of identity, such as increasing the connectivity, safety, and fun of the CGSs, based on students' common needs during the COVID-19 pandemic. Diverse management and planning measures should be adopted for the CGSs in different periods of the lockdown. Moreover, those students who have severe mental health problems due to the COVID-19 pandemic may have higher rates of infection and mortality (79). In addition to the emotional restoration of the CGSs, there is a need to address the root causes of students' psychological problems through vaccinations and other methods (80). This study effectively establishes the causal

relationships between the study variables through students' subjective perceptions, but this approach is prone to perception bias and recall bias. For example, this study only investigated the results of naturalness through perception and evaluation, thus lacking objective indicators of the CGSs for students' perceived naturalness. Technically, the results emerging from field surveys and simultaneous measurements could provide more useful information on how people perceive the naturalness and what environmental variables affect place attachments, as well as the direct effects of environmental variables on students' emotions. As subjective attributes, perceived naturalness, place attachment, and landscape preference all change in response to environmental information and personal states, which may involve individual core values and cognitive transfer processes (81). Therefore, future research is required to employ more complex conceptual frameworks, such as the mind sponge mechanism, to investigate the relationship between environmental variables and subjective perceptions. In this study, data were collected from two universities because of the limitation of human resources and budget. Future studies could extend the number of study locations to avoid sampling bias.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by Academic Ethics Committee of School of Architecture and Art, Central South University. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

SL, YJ, JL, and ZL carried out investigation and made data curation. SL, YJ, JL, and YP made formal analysis. SL and YJ wrote the original draft preparation. YP, WL, and TF reviewed, revised, and edited the manuscript. All authors contributed to the article and approved the submitted version.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated

organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

- Sarkodie SA, Owusu PA. Global assessment of environment, health and economic impact of the novel coronavirus (COVID-19). *Environ Dev Sustain.* (2021) 23:5005–15. doi: 10.1007/s10668-020-00801-2
- Moreno C, Wykes T, Galderisi S, Nordentoft M, Crossley N, Jones N, et al. How mental health care should change as a consequence of the COVID-19 pandemic. *Lancet Psychiatry.* (2020) 7:813–24. doi: 10.1016/S2215-0366(20)30307-2
- Li B, Peng Y, He H, Wang M, Feng T. Built environment and early infection of COVID-19 in urban districts: a case study of Huangzhou. *Sustain Cities Soc.* (2021) 66:1–10. doi: 10.1016/j.scs.2020.102685
- Sun SY, Chen YY, Mu S, Jiang B, Lin YW, Gao T, Qiu L. The psychological restorative effects of campus environments on college students in the context of the COVID-19 pandemic: a case study at Northwest A&F University, Shaanxi, China. *Int J Environ Res Public Health.* (2021) 18:168731. doi: 10.3390/ijerph18168731
- Cao WJ, Fang ZW, Hou GQ, Han M, Xu XR, Dong JX, et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* (2020) 287:112934. doi: 10.1016/j.psychres.2020.112934
- Ma Z, Zhao J, Li Y, Chen D, Wang T, Zhang Z, et al. Mental health problems and correlates among 746 217 college students during the coronavirus disease 2019 outbreak in China. *Epidemiol Psychiatr Sci.* (2020) 29:931. doi: 10.1017/S2045796020000931
- Malik S, Perveen A. Mindfulness and anxiety among university students: moderating role of cognitive emotion regulation. *Curr. Psychol.* (2021) doi: 10.1007/s12144-021-01906-1
- Franzoi IG, Sauta MD, Granieri A. State and trait anxiety among university students: a moderated mediation model of negative affectivity, alexithymia, and housing conditions. *Front. Psychol.* (2020) 11:1255. doi: 10.3389/fpsyg.2020.01255
- Schmid PC, Mast MS. Mood effects on emotion recognition. *Motiv Emot.* (2010) 34:288–92. doi: 10.1007/s11031-010-9170-0
- Cloitre M, Khan C, Mackintosh MA, Garvert DW, Henn-Haase CM, Falvey EC, et al. Emotion Regulation Mediates the Relationship Between ACES and Physical and Mental Health. *Psychol Trauma Theory Res Pract Policy.* (2019) 11:82–9. doi: 10.1037/tra0000374
- Oriol X, Amutio A, Mendoza M, Da Costa S, Miranda R. Emotional creativity as predictor of intrinsic motivation and academic engagement in university students: the mediating role of positive emotions. *Front Psychol.* (2016) 7:01243. doi: 10.3389/fpsyg.2016.01243
- Ewing L, Hamza CA, Willoughby T. Stressful experiences, emotion dysregulation, and nonsuicidal self-injury among university students. *J Youth Adolesc.* (2019) 48:1379–89. doi: 10.1007/s10964-019-01025-y
- McRae K, Gross JJ. Emotion regulation introduction. *Emotion.* (2020) 20:1–9. doi: 10.1037/emo0000703
- Ulrich R. Biophilia, biophobia, and natural landscapes the biophilia. *Hypothesis.* (1993) 7:73–37.
- Hipp JA, Gulwadi GB, Alves S, Sequeira S. The relationship between perceived greenness and perceived restorativeness of University Campuses and student-reported quality of life. *Environ Behav.* (2016) 48:1292–08. doi: 10.1177/0013916515598200
- Luis S, Dias R, Lima, ML. Greener schoolyards, greener futures? greener schoolyards buffer decreased contact with nature and are linked to connectedness to nature. *Front Psychol.* (2020) 11:567882. doi: 10.3389/fpsyg.2020.567882
- Liu Q, Zhang Y, Lin Y, You D, Zhang W, Huang Q, et al. The relationship between self-rated naturalness of university green space and students' restoration and health. *Urban Urban Green.* (2018) 34:259–68. doi: 10.1016/j.ufug.2018.07.008
- van den Bogerd N, Dijkstra SC, Koole SL, Seidell JC, de Vries R, Maas, J. Nature in the indoor and outdoor study environment and secondary and tertiary education students' well-being, academic outcomes, and possible mediating pathways: a systematic review with recommendations for science and practice. *Health Place.* (2020) 66:102403. doi: 10.1016/j.healthplace.2020.102403
- Gulwadi GB, Mishchenko ED, Hallowell G, Alves S, Kennedy M. The restorative potential of a university campus: Objective greenness and student perceptions in Turkey and the United States. *Landsc Urban Plan.* (2019) 187:36–46. doi: 10.1016/j.landurbplan.2019.03.003
- Wang Y, Kotze DJ, Vierikko K, Niemela J. What makes urban greenspace unique - Relationships between citizens' perceptions on unique urban nature, biodiversity and environmental factors. *Urban Green.* (2019) 42:1–9. doi: 10.1016/j.ufug.2019.04.005
- Chen CX, Luo WJ, Kang N, Li HW, Yang XH, Xia Y. Serial mediation of environmental preference and place attachment in the relationship between perceived street walkability and mood of the elderly. *Int J Environ Res Public Health.* (2020) 17:134620. doi: 10.3390/ijerph17134620
- Scannell L, Gifford R. Place attachment enhances psychological need satisfaction. *Environ Behav.* (2017) 49:359–89. doi: 10.1177/0013916516637648
- Giuliani MV, Feldman R. Place attachment in a developmental and cultural context. *J Environ Psychol.* (1993) 13:267–74. doi: 10.1016/S0272-4944(05)80179-3
- Walker AJ, Ryan, RL. Place attachment and landscape preservation in rural New England: a maine case study. *Landsc Urban Plan.* (2008) 86:141–52. doi: 10.1016/j.landurbplan.2008.02.001
- Ratcliffe E, Korpela, KM. Memory and place attachment as predictors of imagined restorative perceptions of favourite places. *J Environ Psychol.* (2016) 48:120–30. doi: 10.1016/j.jenvp.2016.09.005
- Kaltenborn BP, Bjerke T. Associations between landscape preferences and place attachment: a study in Røros, Southern Norway. *Landsc Res.* (2002) 27:381–96. doi: 10.1080/0142639022000023943
- Ribeiro AI, Triguero-Mas M, Santos CJ, Gomez-Nieto A, Cole H, Anguelovski I, et al. Exposure to nature and mental health outcomes during COVID-19 lockdown A comparison between Portugal and Spain. *Environ Int.* (2021) 154:106664. doi: 10.1016/j.envint.2021.106664
- Tomaso LP, Yin J, Cedeño Laurent JG, Chen JT, Catalano PJ, Spengler JD. The relationship between nature deprivation and individual wellbeing across urban gradients under COVID-19. *Int J Environ Res Public Health.* (2021) 18:1511. doi: 10.3390/ijerph18041511
- Kleinschroth F, Kowarik I. COVID-19 crisis demonstrates the urgent need for urban greenspaces. *Front Ecol Environ.* (2020) 18:318–19. doi: 10.1002/fee.2230
- Ode A, Fry G, Tveit MS, Messenger P, Miller D. Indicators of perceived naturalness as drivers of landscape preference. *J Environ Manage.* (2009) 90:375–83. doi: 10.1016/j.jenvman.2007.10.013
- Oatley K, Johnson-Laird, PN. Cognitive approaches to emotions. *Trends Cogn Sci.* (2014) 18:134–40. doi: 10.1016/j.tics.2013.12.004
- Ha J, Kim, HJ. The restorative effects of campus landscape biodiversity: Assessing visual and auditory perceptions among university students. *Urban For Urban Green.* (2021) 64:127259. doi: 10.1016/j.ufug.2021.127259
- Malekinezhad F, Courtney P, Bin Lamit H, Vigani M. Investigating the mental health impacts of university campus green space through perceived sensory dimensions and the mediation effects of perceived restorativeness on restoration experience. *Front Public Health.* (2020) 8:578241. doi: 10.3389/fpubh.2020.578241
- Berto R. The role of nature in coping with psycho-physiological stress: a literature review on restorativeness. *Behav Sci (Basel, Switzerland).* (2014) 4:394–409. doi: 10.3390/bs4040394
- Liu JY, Peng ZK, Cai XX, Peng Y, Li J, Feng T. Students' Intention of Visiting Urban Green Spaces after the COVID-19 Lockdown in China. *Int J Environ Res Public Health.* (2021) 18:8601. doi: 10.3390/ijerph18168601
- Spano G, D'Este M, Giannico V, Elia M, Cassibba R, Laforteza R, Sanesi G. Association between indoor-outdoor green features and psychological health during the COVID-19 lockdown in Italy: a cross-sectional nationwide study. *Urban Green.* (2021) 62:127156. doi: 10.1016/j.ufug.2021.127156

37. Han SL, Liu XW. Can imported cold food cause COVID-19 recurrent outbreaks? a review. *Environ Chem Lett.* (2021) 20:119–29. doi: 10.1007/s10311-021-01312-w
38. Taylor L, Hochuli DF. Defining greenspace: multiple uses across multiple disciplines. *Landsc Urban Plan.* (2017) 158:25–38. doi: 10.1016/j.landurbplan.2016.09.024
39. Lewicka M. Place attachment, place identity, and place memory: Restoring the forgotten city past. *J Environ Psychol.* (2008) 28:209–231. doi: 10.1016/j.jenvp.2008.02.001
40. Ratcliffe E, Korpela KM. Time- and Self-Related Memories Predict Restorative Perceptions of Favorite Places Via Place Identity. *Environ Behav.* (2018) 50:690–720. doi: 10.1177/0013916517712002
41. Verbrugge L, van den Born R. The role of place attachment in public perceptions of a re-landscaping intervention in the river Waal (The Netherlands). *Landsc Urban Plan.* (2018) 177:241–50. doi: 10.1016/j.landurbplan.2018.05.011
42. Korpela KM, Hartig T, Kaiser FG, Fuhrer U. Restorative experience and self-regulation in favorite places. *Environ Behav.* (2001) 33:572–89. doi: 10.1177/00139160121973133
43. Kuwahara JH. Impacts of a place-based science curriculum on student place attachment in hawaiian and western cultural institutions at an urban high school in Hawai'i. *Int J Sci Math Educ.* (2013) 11:191–212. doi: 10.1007/s10763-012-9387-3
44. Menatti L, Subiza-Perez M, Villalpando-Flores A, Vozmediano L, San Juan, C. Place attachment and identification as predictors of expected landscape restorativeness. *J Environ Psychol.* (2019) 63:36–43. doi: 10.1016/j.jenvp.2019.03.005
45. Williams DR, Vaske, J. The measurement of place attachment: validity and generalizability of a psychometric approach. *For Sci.* (2003) 49:830–40. doi: 10.1093/forestscience/49.6.830
46. Basu M, Hashimoto S, Dasgupta R. The mediating role of place attachment between nature connectedness and human well-being: perspectives from Japan. *Sustain Sci.* (2020) 15:849–62. doi: 10.1007/s11625-019-00765-x
47. Carter J, Hollinsworth D, Raciti M, Gilbey K. Academic 'place-making': fostering attachment, belonging and identity for Indigenous students in Australian universities. *Teach High Educ.* (2018) 23:243–60. doi: 10.1080/13562517.2017.1379485
48. Zheng B, Zhang YQ, Chen JQ. Preference to home landscape: wildness or neatness? *Landsc Urban Plan.* (2011) 99:1–8. doi: 10.1016/j.landurbplan.2010.08.006
49. Kaplan S. Aesthetics, affect, and cognition: environmental preference from an evolutionary perspective. *Environ Behav.* (1987) 19:3–32. doi: 10.1177/0013916587191001
50. Zhang GC, Yang J, Wu GW, Hu, XP. Exploring the interactive influence on landscape preference from multiple visual attributes: Openness, richness, order, and depth. *Urban Green.* (2021) 65:127363. doi: 10.1016/j.ufug.2021.127363
51. Wilkie S, Clouston L. Environment preference and environment type congruence: Effects on perceived restoration potential and restoration outcomes. *Urban Green.* (2015) 14:368–76. doi: 10.1016/j.ufug.2015.03.002
52. Hami A, Abdi B. Students' landscaping preferences for open spaces for their campus environment. *Indoor Built Environ.* (2021) 30:87–98. doi: 10.1177/1420326X19887207
53. Tudorie CAM, Valles-Planells M, Gielen E, Arroyo R, Galiana, F. Towards a Greener University: perceptions of landscape services in campus open space. *Sustainability.* (2020) 12:12156047. doi: 10.3390/su12156047
54. Li KK, Zhai Y, Dou L, Liu JA. Preliminary exploration of landscape preferences based on naturalness and visual openness for college students with different moods. *Front Psychol.* (2021) 12:629650. doi: 10.3389/fpsyg.2021.629650
55. Felsten G. Where to take a study break on the college campus: an attention restoration theory perspective. *J Environ Psychol.* (2009) 29:160–67. doi: 10.1016/j.jenvp.2008.11.006
56. Gao T, Zhang T, Zhu L, Gao YA, Qiu, L. Exploring Psychophysiological restoration and individual preference in the different environments based on virtual reality. *Int J Environ Res Public Health.* (2019) 16:3102. doi: 10.3390/ijerph16173102
57. Amerio A, Brambilla A, Morganti A, Aguglia A, Bianchi D, Santi F, et al. COVID-19 lockdown: housing built environment's effects on mental health. *Int J Environ Res Public Health* 17. (2020). doi: 10.3390/ijerph17165973
58. Shaker RR. Examining sustainable landscape function across the Republic of Moldova. *Habitat Int.* (2018) 72:77–91. doi: 10.1016/j.habitatint.2016.11.002
59. Joshanloo M. Factor structure and criterion validity of original and short versions of the Negative and Positive Affect Scale (NAPAS). *Pers Individ Dif.* (2017) 105:233–7. doi: 10.1016/j.paid.2016.09.060
60. Qiu L, Zheng X, Wang Y. Revision of the positive affect and negative affect scale Chinese. *J Appl Psychol.* (2008) 14:249–54.
61. Chan D, Wu QG, Jiang GX, Dai XL. Projected shifts in koppen climate zones over China and their temporal evolution in CMIP5 multi-model simulations. *Adv Atmos Sci.* (2016) 33:283–93. doi: 10.1007/s00376-015-5077-8
62. Sandhu G, Thompson-Burdine J, Nikolian VC, Sutzko DC, Prabhu KA, Matusko N, et al. Association of faculty entrustment with resident autonomy in the operating room. *JAMA Surg.* (2018) 153:518–24. doi: 10.1001/jamasurg.2017.6117
63. Bollen KA. *Structural Equations With Latent Variables.* Wiley Series in Probability and Mathematical Statistics. Applied probability and statistics (Chapel Hill: Wiley), (1989).
64. Hunan Provincial Bureau of Statistics. *Changsha 2019 National Economic and Social Development Statistical Bulletin.* (2020). Available online at: [http://tjj.hunan.gov.cn/hntj/tjfx/tjgb/szgb/zss\\_1/202010/t20201020\\_13888450.html](http://tjj.hunan.gov.cn/hntj/tjfx/tjgb/szgb/zss_1/202010/t20201020_13888450.html) (accessed March 20, 2020).
65. Harbin Municipal Government. *Harbin 2019 National Economic and Social Development Statistical Bulletin.* (2020). Available online at: [http://www.harbin.gov.cn/art/2020/7/3/art\\_440\\_923404.html](http://www.harbin.gov.cn/art/2020/7/3/art_440_923404.html) (accessed July 3, 2020).
66. Henseler J, Ringle CM, Sarstedt, M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J Acad Mark Sci.* (2015) 43:115–35. doi: 10.1007/s11747-014-0403-8
67. Gustafsson JE, Martenson R. Structural equation modeling with AMOS: Basic concepts, applications, and programming. *Contemp Psychol Rev Books.* (2002) 47:478–80. doi: 10.1037/001198
68. Xia Y, Yang, Y. RMSEA, CFI, and TLI in structural equation modeling with ordered categorical data: The story they tell depends on the estimation methods. *Behav Res Methods.* (2019) 51:409–28. doi: 10.3758/s13428-018-1055-2
69. Scannell L, Gifford, R. The experienced psychological benefits of place attachment. *J Environ Psychol.* (2017) 51:256–69. doi: 10.1016/j.jenvp.2017.04.001
70. Cross JE. Processes of place attachment: an interactional framework. *Symb Interact.* (2015) 38:493–520. doi: 10.1002/symb.198
71. Liu QY, Wu Y, Xiao YH, Fu WC, Zhuo ZX, van den Bosch CCK, et al. More meaningful, more restorative? Linking local landscape characteristics and place attachment to restorative perceptions of urban park visitors. *Landsc Urban Plan.* (2020) 197:3763. doi: 10.1016/j.landurbplan.2020.103763
72. Liu QY, Fu WC, van den Bosch CCK, Xiao YH, Zhu ZP, You D, et al. Do Local Landscape Elements Enhance Individuals' Place Attachment to New Environments? a cross-regional comparative study in China. *Sustainability.* (2018) 10:100. doi: 10.3390/su10093100
73. Liu W, Yue XG, Tchounwou, PB. Response to the COVID-19 epidemic: the chinese experience and implications for other countries. *Int J Environ Res Public Health.* (2020) 17:2304. doi: 10.3390/ijerph17072304
74. Wilkie S, Stavridou A. Influence of environmental preference and environment type congruence on judgments of restoration potential. *Urban For Urban Green.* (2013) 12:163–70. doi: 10.1016/j.ufug.2013.01.004
75. Nikolopoulou M, Kleissl J, Linden PF, Lykoudis S. Pedestrians' perception of environmental stimuli through field surveys: Focus on particulate pollution. *Sci Total Environ.* (2011) 409:2493–502. doi: 10.1016/j.scitotenv.2011.02.002
76. Finnerty R, Marshall SA, Imbault C, Trainor LJ. Extra-Curricular activities and well-being: results from a survey of undergraduate university students during COVID-19 lockdown restrictions. *Front Psychol.* (2021) 12:647402. doi: 10.3389/fpsyg.2021.647402
77. Herzog TR, Kropscott LS. Legibility, mystery, and visual access as predictors of preference and perceived danger in forest settings without pathways. *Environ Behav.* (2004) 36:659–77. doi: 10.1177/0013916504264138
78. Mok KH, Marginson S. Massification, diversification and internationalisation of higher education in China: Critical reflections of developments in the last two decades. *Int J Educ Dev.* (2021) 84:2405. doi: 10.1016/j.ijedudev.2021.102405
79. Smith K, Lambe S, Freeman D, Cipriani A. COVID-19 vaccines, hesitancy and mental health. *Evid Based Ment Heal.* (2021) 24:47–8. doi: 10.1136/ebmental-2021-300266
80. Vuong Q-H, Le T-T, La V-P, Nguyen HTT, Ho M-T, et al. Covid-19 vaccines production and societal immunization under the serendipity-mindsponge-3D knowledge management theory and conceptual framework. *Humanit Soc Sci Commun.* (2022) 9:22. doi: 10.1057/s41599-022-01034-6
81. Vuong QH, Napier NK. Acculturation and global mindsponge: an emerging market perspective. *Int J Intercult Relations.* (2015) 49:354–67. doi: 10.1016/j.ijintrel.2015.06.003



## OPEN ACCESS

## EDITED BY

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

## REVIEWED BY

Neven Ricijas,  
University of Zagreb, Croatia  
Martina Benvenuti,  
University of Bologna, Italy  
Mohamad Noorman Masrek,  
Universiti Teknologi MARA Puncak  
Alam, Malaysia  
Dora Dodig Hundric,  
University of Zagreb, Croatia

## \*CORRESPONDENCE

Pierluigi Diotaiuti  
p.diotaiuti@unicas.it

## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Psychiatry

RECEIVED 10 March 2022

ACCEPTED 12 August 2022

PUBLISHED 06 September 2022

## CITATION

Diotaiuti P, Mancone S, Corrado S, De  
Risio A, Cavicchiolo E, Girelli L and  
Chirico A (2022) Internet addiction in  
young adults: The role of impulsivity  
and codependency.  
*Front. Psychiatry* 13:893861.  
doi: 10.3389/fpsyt.2022.893861

## COPYRIGHT

© 2022 Diotaiuti, Mancone, Corrado,  
De Risio, Cavicchiolo, Girelli and  
Chirico. This is an open-access article  
distributed under the terms of the  
[Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/)  
(CC BY). The use, distribution or  
reproduction in other forums is  
permitted, provided the original  
author(s) and the copyright owner(s)  
are credited and that the original  
publication in this journal is cited, in  
accordance with accepted academic  
practice. No use, distribution or  
reproduction is permitted which does  
not comply with these terms.

# Internet addiction in young adults: The role of impulsivity and codependency

Pierluigi Diotaiuti<sup>1\*</sup>, Stefania Mancone<sup>1</sup>, Stefano Corrado<sup>1</sup>,  
Alfredo De Risio<sup>2</sup>, Elisa Cavicchiolo<sup>3</sup>, Laura Girelli<sup>3</sup> and  
Andrea Chirico<sup>4</sup>

<sup>1</sup>Department of Human Sciences, Society and Health, University of Cassino and Southern Lazio, Cassino, Italy, <sup>2</sup>Department of Human Studies, Communication, Education, and Psychology, Libera Università Maria SS. Assunta (LUMSA), Rome, Italy, <sup>3</sup>Department of Human, Philosophical and Educational Sciences, University of Salerno, Fisciano, Italy, <sup>4</sup>Department of Psychology of Development and Socialization Processes, Sapienza University of Rome, Rome, Italy

Excessive Internet use has demonstrated comorbidity with other psychological symptoms and psychiatric disorders, as well as impairments in the management of daily life, relationships and emotional stability. Recent findings in the literature have consistently supported the relationship between impulsivity and Internet addiction. The present study hypothesized that, in addition to impulsivity, a further predictor of Internet addiction might be relational co-dependency, which is also associated in the literature with addiction phenomena, but mainly substance addiction. This paper investigates the role and predictive weight of impulsivity and codependency on Internet addiction on a sample of young adult university students ( $n = 481$ ) by using a hierarchical regression analysis. The participants were administered the UADI-2, the BIS-11 and the SFCDS. In terms of percentage distribution, 38 % of the participants were in the dependency range, while 37.7 % demonstrated Internet abuse behavior. The results confirmed the role of impulsiveness ( $\beta = 0.312$ ) and added to the literature by showing the significant role of relational codependency ( $\beta = 0.275$ ), gender ( $\beta = 0.174$ ) and age ( $\beta = 0.196$ ). Thus, male participants were more dependent, more impulsive and more co-dependent, with increasing age in the given range (18–30). The present study shed light to the presence of this issue among young adults and that, as a preventive and restraining measure, there is a need not only for targeted awareness-raising programmes but also for interventions to promote greater emotional control and a more balanced management of personal relationships.

## KEYWORDS

Internet addiction, young adults, impulsivity, motor impulsivity, attentional impulsivity, codependency

## Introduction

The Internet is one of the most widespread and accessible media for young people: chatting, role-playing, etc., are increasingly the routinary activities for them and the growing use of this media has led to the emergence of psychological problems linked to its possible maladaptive use in young people. The phenomenon of Internet abuse has been called by different names such as computer addiction, compulsive Internet use, Internet



mania, problematic or pathological Internet use, and finally Internet Addiction (IA) (1–5). Young (6), Young and Rogers (1) bring Internet Addiction Disorder to the center of the scientific debate, shifting the diagnostic reference from substance-related problems to those found in pathological gambling problems (GAP) and in fact placing Internet addiction within impulse control disorders. Individuals with Internet addiction may lose control over their Internet use, resulting in impairments in the management of daily life, relationships and emotional stability (1, 2, 4, 7).

A critical level is identified when the excessive Internet use impedes the management of the young individual's developmental activities and negative consequences come to light in an overt way (for example, decline in school performance, excessive limitation of outside activities, permanent conflicts with parents and friends, etc.) (8–11). When it happens, except the use of Internet, several other activities and interests are neglected, despite they are consciously perceived as significant, while individual continue to massively use the Internet despite the possible harmful consequences, a phenomenon known as “harmful consumption” (12, 13).

Compared with the past, currently Internet abuse is classified not as an impulse control disorder but as a (potential) addiction, i.e., the fact the tendency is to define addiction to specific online activities (as seen in section III of DSM-5 and ICD-11), rather than Internet addiction in general.

Currently, the main forms of addiction associated with the excessive use of Internet are: *Cyber-relational addiction*, characterized by an excessive tendency to establish friendship or love relationships with people met online, mainly *via* chat rooms, forums or social networks (14). In this condition, online relationships quickly become over-involving and individuals tend to neglect their relationships in presence with friends and family. *Information overload*, characterized by an obsessive search for information on the web: individuals spend increasing amounts of time searching for and organizing data on the web (15). *Cybersexual addiction*, which is characterized by compulsive use of pornography and virtual sex sites. Individuals usually download and use online pornography, engage in adult-only chats and may have compulsive masturbation (16). *Offline gaming*, characterized by a tendency to over-involve in virtual games that do not involve multi-player interaction and are not played over a network (17). *Online gaming*, in which excessive involvement and compulsive behaviors related to various online activities such as gambling, compulsive shopping, role-playing games are evident (18, 19).

Excessive Internet use has been found to be in comorbidity with other psychological symptoms and psychiatric disorders (4). Internet addiction has been found to be associated with attention deficit hyperactivity disorder (20, 21), low self-esteem (22), shyness (23), depressive

symptoms (1, 23–26), hostility (27, 28), interpersonal sensitivity (27, 29), disturbances in relationships (30, 31), obsessive-compulsive symptoms (OCS) (20, 24, 25), and impulsivity (32, 33).

Harmful Internet use, like substance abuse, triggers individuals' preoccupation with details, nervousness, irritability, aggression and impulsivity (4, 34). Previous studies have also shown that obsessive-compulsive symptoms are associated with the severity of Internet addiction (20, 24, 25). Cao et al. (32) reported that adolescents with Internet addiction show increased impulsivity and have various comorbid psychiatric disorders, which may be associated with Internet addiction. For those with behavioral inhibition issues, the Internet can serve as an area where individuals can receive short-term rewards through gaming, surfing or social networking, and be reinforced by immediate gratification (7, 35). A further study suggested that impulsivity can be considered as an endophenotype of addictive behavior (36). Impulsive individuals have problems in managing their behavior, showing recurrent failures to resist impulses to engage in a specified behavior and a feeling of lack of control while engaging in the behavior. A large body of the literature in this area concerns impulsiveness impacting the addictive tendencies (37, 38). Consistent with this, recent findings in the literature have consistently supported the relationship between impulsivity and Internet Addiction (33, 39–44).

Another construct that has been associated with addiction phenomena (predominantly substance addiction) is that of codependency. Codependency is often referred to as “relationship addiction”. It's an emotional and behavioral condition that interferes with an individual's ability to develop a healthy, mutually satisfying relationship. But over the years it's been expanded to include individuals who maintain one-sided, emotionally destructive, or abusive relationships (45–47). Researchers have identified several factors that are often linked with codependency: lack of trust in self or others; fear of being alone or abandoned; a need to control other people; chronic anger; frequent lying; poor communication skills; trouble making decisions; problems with intimacy; difficulty establishing boundaries; trouble adjusting to change; an extreme need for approval and recognition (48–50). The role of codependency among the variables associated with gambling disorder has been reported by Barrera-Algarín and Vázquez-Fernández (51). In contrast, an interesting contribution by Lu (52) recently illustrated the link between virtual community codependency and virtual community addiction: the virtual community codependency will need individuals to have a desire to derive compensation from the virtual community that cannot be achieved in the real world. If people in this community have similar needs, priorities, and goals, increasing the use of Facebook will lead to an increase in virtual community addiction. The author argues that codependency is a pattern of dysfunction in interpersonal relationships. According to the social compensation theory,



if people feel insecurity and negative social identity in real life interpersonal networks, they may spend more time using virtual communities as compensation. Lu's study (52) tested and reported a direct impact of virtual community codependency on virtual community addiction. Furthermore, the increased use of Facebook when there is a sense of the 'spirit of belonging together' can lead to increased tendency to virtual community addiction. In more general terms, Shishkov et al. (53) have first suggested a direct association between internet addiction and codependency, while, with reference to the set of patterns of thinking and behavioral characteristics of the codependent personality, Artemtseva and Malkina (54) pointed out that the codependents make cognitive errors about the consequences of their behavior in order to constantly protect themselves from uncertainty.

While the role of impulsivity has been widely analyzed in the literature of Internet Addiction, there is still a lack of studies that consider codependency as another possible factor associated to excessive Internet use. The present work had therefore the following objectives: evaluate the importance of Internet abuse and dependence in a sample of young adults, by also considering the gender of the participants; investigate the possible role of Impulsivity and codependency in explaining Internet Addiction. Other studies have confirmed for this age group the relationship between impulsivity and problems associated with various forms of addiction (55–59), and this can be even more true considering the important personal limitations in terms of mobility and relationships related to COVID-19 pandemic, which have not only solicited an increase in addictive practices (60, 61) but also a deterioration in perceived safety in relationships with others, amplifying the compensatory search for codependent relationship patterns that Internet use can offer (62–65). On the basis of the literature presented hitherto, we hypothesized that relational codependency might be in young adults, in addition to impulsivity, a further significant predictor of Internet addiction.

## Methods and materials

### Participants

Participants were recruited by forwarding an email to students enrolled at a university in central-southern Italy. This email defined the goals as well as the function of the study. Subjects were invited to enter a specific link found in the same notice, after which they filled in and posted the answers telematically and digitally. Participants were assured anonymity and also the use of information in aggregate type for research purposes. They also provided their written informed consent to participate in this study. The protocol was approved by the local university Institutional Review Board and tools administration took place in April and May 2020. A total of 1,500 emails were sent out. As far as the drop-out ratio is concerned, 86

participants dropped out after beginning to fill it in, therefore 481, including 219 (45.5 %) males and 262 females (54.5 %) with an average age of 21.79 and SD = 4.16 and age range 18–30, completed questionnaires were finally collected.

### Tools

- *Uso-Abuso e Dipendenza da Internet* [Internet use-abuse and addiction] (UADI-2), (66), assesses the psychopathological risk of Internet abuse and the psychological use that users make of the network (example items: "I happen to have flashbacks or disconnected thoughts during or after a long Internet connection"; "Sometimes I like to lie on the net"; "On the Internet I happen to look for erotic material or talk about sex"). The instrument measures the psychological and psychopathological aspects related to the use and abuse of the Internet and has been designed to be administered both off-line (by filling in the U.A.D.I. in paper form) and on-line (by filling it in *via* Internet). The instrument consists of 24 items that the person must answer on a 5-point scale ranging from 1 (Absolutely false for me) to 5 (Absolutely true for me). The UADI-2 allows scoring with reference to four dimensions: Dissociation (describes some dissociative symptoms as bizarre sensory experiences, de-personalization, de-realization, along with the tendency to alienation and estrangement-escape from reality), Impact on Real Life (contains items describing the real-life consequences i.e., any changes in habits, social relationships, mood as a result of continued Internet use), Addiction Symptoms (contains items that address some behaviors and symptoms of addiction, particularly with reference to gradually increasing linkage period, abstinence, compulsiveness, and hyperinvolvement), Identity and Sexuality (contains items describing manipulation of true personal identity online and the tendency to search for sexually oriented content). The scoring has three score ranges: up to 62, normal Internet use; 63–74, Internet abuse; over 74, Internet addiction. Cronbach's alpha for this study was 0.867.
- *Barratt Impulsiveness Scale-11* [BIS-11; (67, 68)] is a 30-item self-report questionnaire designed to assess general impulsivity taking into account the multifactorial nature of the construct. The structure of the instrument allows the assessment of six first-order factors (attention, motor, self-control, cognitive complexity, perseverance, cognitive instability) and three second-order factors: attentional impulsivity, motor impulsivity (motor and perseverance), unplanned impulsivity (self-control and cognitive complexity). Example items: "I do things without thinking"; "I act on the spur of the moment"; "I often have extraneous thoughts when thinking". The person is asked to respond regarding how often he or she generally (not referring to a specific time interval) acts and thinks similarly to the items on the scale. The total score is obtained by summing up

the first and second order factors. The items are distributed on a four-point scale (Rarely/Never = 1, Occasionally = 2, Often = 3, Almost Always/Ever = 4). In the present study, the Italian version by Fossati et al. (68) was used. Cronbach's alpha for this study was 0.835.

- *Spann-Fisher Codependency Scale* [SFCDS; (69)]. Codependency is referred as a dysfunctional pattern of relating to others with an extreme focus outside of oneself, lack of expression of feelings, and personal meaning derived from relationships with others. The tool is an unidimensional 16-item 6-point scale, ranging in score from 16 to 96 with higher scores reflecting codependency (example items: "It is hard for me to make decisions", "I don't usually let others see the "real" me", or "When someone upsets me I will hold it in for a long time, but once in a while I explode"). The mean Spann-Fischer co-dependency score is approximated with a midpoint of 52.6, a "high" score of 67.2 and a "low" score of 37.3 suggested by Fischer, Spann, and Crawford (69). The codependent person puts a lot of effort into satisfying the needs of others, constantly trying to be helpful and organizing others' lives, losing sight of and disregarding their own needs. For the purposes of this study, we obtained an Italian version of the questionnaire through back-translation procedures. We performed an exploratory factor analysis (Maximum Likelihood, promax rotation) on The Italian Spann-Fischer Codependency Scale items. Our results revealed a one-dimensional structure. A test for internal consistency and item-total correlations confirmed that excluding one poor functioning item, best preserved the reliability of the questionnaire, and we therefore decided to exclude it from the final Italian version. After this adjustment, the scale consisted of 15 items and showed good internal consistency (Cronbach's  $\alpha = 0.820$ ).

## Statistical analysis

Descriptive analyses (percentages, means, standard deviation, skewness and kurtosis, confidence intervals); *t*-test for comparison of scores with respect to gender; Pearson's bivariate correlations; testing of univariate and multivariate regression assumptions; and hierarchical regression were conducted.

## Results

Descriptively, 38.0% ( $n = 183$ ) of the sample were in the range of Internet addiction (with a mean score on the UADI-2 > 74). The 27.7% ( $n = 133$ ) of the sample were found to be in the Internet abuse range (with a mean score between 63 and 74). The remaining 34.3% ( $n = 175$ ) were in the normal range of Internet use. Significant differences emerged, however, in relation to gender. Amongst males, 45.2% ( $n = 99$ ) were addicted to the

Internet, while 30.1% ( $n = 66$ ) had Internet abuse behavior. Among females, 32.1% ( $n = 84$ ) were addicted, while 25.6% ( $n = 67$ ) abused the Internet. These differences were more specifically highlighted in Table 1 where the *t*-test comparisons between the two groups and the respective breakdowns in the range of full dependency, abuse and normal Internet use are shown.

In Table 2 below it can be seen that the level of male dependence was higher both in terms of the overall score and in relation to the subscales of Dissociation, Identity and Sexuality and Impact on Real Life, while the manifestation of Addiction Symptoms did not significantly differ between genders ( $p > 0.05$ ).

Table 3 below presents the descriptive statistics of all the variables used in the study.

Table 4 below shows the bivariate correlations between the measures used in the study. It can be seen that there were significant associations with both the Codependency scale (0.347\*\*) and the Impulsivity scale (0.349\*\*). More specifically for the latter measure, Internet Addiction reported correlations with the subscale of the Attentional Impulsiveness (0.379\*\*) and Motor Impulsiveness (0.365\*\*), while the association with the subscale of non-planning was not significant.

In order to identify predictors of Internet addiction, a hierarchical regression was performed on the variables of Codependency and Impulsivity. The preliminary verifications of the regression assumptions excluded the presence of multivariate outliers. Mardia's multivariate kurtosis index (62.33) was in fact below the critical value [ $p(p + 2) = 99$ ]; therefore, the relationship between the variables can be considered substantially linear. Low co-linearity was indicated by the low variance inflation factor (VIF) values < 2 and high tolerance values > 0.60. For verification of the assumptions on the residuals, the average between the standardized and raw residuals was equal to 0; the Durbin-Watson test had a value of 1.96 and was therefore indicative of the absence of autocorrelation.

A hierarchical multiple regression was run to determine if the addition of Codependency, Impulsivity, Age, and Gender improved the prediction of the Internet Addiction. The full model resulted statistically significant,  $R^2 = 0.289$ ,  $F(4,480) = 48.119$ ,  $p < 0.001$ ; adjusted  $R^2 = 0.283$ . The regression model included Codependency and Impulsivity at step 1, Age at step 2, Gender at step 3. The results of the hierarchical multiple linear regressions are presented in Table 5. In the regression model, with Internet Addiction as outcome variable, Codependency and Impulsivity jointly explained a 22% portion of the outcome variability. Adding Age at the second step provided a significant improvement in the explained variance, which reached 26%. By adding Gender at the third step, the explained variance further significantly increased to 29%. Standardized beta values were significant, with a positive sign for Codependency, Impulsivity, Age, and a negative sign for Gender. The order reflects the relative importance assigned to

TABLE 1 Differences in the level of Internet addiction with respect to gender of participants.

	Males	Females			
Dependence	M (SD) 86.703 (8.37)	M (SD) 82.71 (4.95)	CI 95% [1.26; 5.37]	<i>p</i> <0.005	d 0.48
Abuse	M (SD) 67.79 (3.42)	M (SD) 68.78 (3.46)	CI 95% [−2.17;0.192]	<i>p</i> >0.05	d 0.28
Normal use	M (SD) 55.48 (6.14)	M (SD) 53.42 (5.93)	CI 95% [0.092; 4.02]	<i>p</i> <0.05	d 0.34

TABLE 2 General and specific dimensions of Internet addiction with respect to gender of participants.

	Males	Females			
General addiction	M (SD) 73.00 (14.33)	M (SD) 66.74 (13.57)	CI 95% [3.75; 8.76]	<i>p</i> <0.001	d 0.45
Dissociation	M (SD) 21.21 (4.38)	M (SD) 19.16 (4.35)	CI 95% [1.27; 2.84]	<i>p</i> <0.001	d 0.46
Real life impact	M (SD) 14.18 (2.40)	M (SD) 13.61 (2.46)	CI 95% [.129; 1.00]	<i>p</i> <0.05	d 0.24
Addiction symptoms	M (SD) 23.05 (5.77)	M (SD) 22.54 (5.59)	CI 95% [−0.515; 1.52]	<i>p</i> >0.05	d 0.09
Identity and sexuality	M (SD) 14.56 (5.10)	M (SD) 11.43 (5.11)	CI 95% [2.21; 4.05]	<i>p</i> <0.001	d 0.61

each predictor. Since this study intended to give special emphasis as a predictor to codependency, agreeing with what has been argued in this regard in the recent literature cited above, this variable appears to have taken precedence in the entry over that of impulsivity, which is dominant in the less recent literature. As a third consideration, age was included, with respect to which some studies reported an inverse association with the level of addiction (70–72), while others reiterated the linear direction with increasing levels of Internet addiction (73–75). It was interesting to understand what the predictive relationship between age and problematic internet use might be in the sample of young adults considered. Finally, the gender variable was included, which according to other studies is predictive of different male and female susceptibility to problematic and pathological internet use. Thus, it was deemed that the four variables, considered in this order of entry into the predictive model, could provide a significant explanatory portion of the phenomenon under study.

## Discussion

The present study was aimed to evaluate the importance of Internet abuse and dependence in a sample of young adults and it aimed to clarify the possible role of impulsivity, codependency, gender and age in explaining Internet addiction.

Among the instruments in the Italian context to measure Internet addiction, the *UADI*, although not recent, has been preferred over others such as the *Generalized Problematic Internet Use Scale-2* [GPIUS-2, (76); Italian valid. (77)] or the classic *Internet Addiction Test* [IAT, (1); Italian valid (78)], because, in addition to having in other studies confirmed good psychometric properties (79–83), it allowed us to assess two dimensions not present in the other instruments mentioned above, and which we considered significant for their possible association with the impulsivity and codependency variables, namely dissociation experiences and identity manipulations on the web. First of all, the results showed a substantial percentage of young people in the addiction phase (one third of the total sample). Moreover, another third of the sample demonstrated Internet abuse behavior. This clearly indicates that there was an issue of control over the use of the Internet among the young adults involved. Nevertheless, we recognize that there might be an overestimation, especially referred to the classification of “abuse” of the Internet. This can be due to the fact that the instrument was originally carried out in 2005 when the average use of the Internet and social networks was still limited. Over the years, we have seen a significant increase in the use of the Internet, especially among young people, due to a natural expansion of connectivity possibilities and as a normal evolution of a behavior of consultation and search for information. Moreover, the use of messaging for

TABLE 3 Descriptive statistics of the variables.

	Skewness	(SE)	Kurtosis	(SE)	Mean	(SD)
Age	0.757	0.111	−0.932	0.222	21.79	4.16
General Internet addiction	0.123	0.111	−0.560	0.222	69.59	14.26
Dissociation	−0.020	0.111	−0.411	0.222	20.09	4.48
Real life impact	−0.026	0.111	0.495	0.222	13.87	2.45
Addiction symptoms	−0.272	0.111	−0.362	0.222	22.77	5.67
Identity and sexuality	0.083	0.111	−0.891	0.222	12.85	5.33
Codependency	−0.275	0.111	0.495	0.222	51.36	10.88
Total impulsivity	−0.410	0.111	−0.242	0.222	68.03	10.47
Motor impulsivity	−0.150	0.111	−0.726	0.222	22.87	5.18
Attentional impulsivity	−0.183	0.111	−0.343	0.222	18.04	3.23
Non planning	−0.122	0.111	0.630	0.222	27.12	4.34

SE, Standard Error; SD, Standard Deviation.

TABLE 4 Bivariate correlations.

	1	2	3	4	5	6	7	8	9	10
General Internet addiction (UADI-2)	1									
Dissociation (UADI-2)	0.861**	1								
Real life impact (UADI-2)	0.387**	0.288**	1							
Addiction symptoms (UADI-2)	0.832**	0.615**	0.038	1						
Identity and sexuality (UADI-2)	0.887**	0.676**	0.293**	0.628**	1					
Codependency (SFCDS)	0.347**	0.230**	0.017	0.394**	0.306**	1				
Total impulsivity (BIS-11)	0.349**	0.320**	0.248**	0.157**	0.382**	0.138**	1			
Motor impulsivity (BIS-11)	0.365**	0.335**	0.233**	0.190**	0.384**	0.168**	0.878**	1		
Attentional impulsivity (BIS-11)	0.379**	0.312**	0.198**	0.218**	0.428**	0.182**	0.805**	0.647**	1	
Non planning (BIS-11)	0.124**	0.140**	0.174**	−0.010	0.144**	−0.003	0.765**	0.443**	0.425**	1
Age	0.173**	0.092*	0.089*	0.136**	0.225**	0.232**	−0.110**	−0.077	−0.022	−0.169**

N = 481.

\*\* Correlation is significant at the 0.01 level (2-tailed). \* Correlation is significant at the 0.05 level (2-tailed).

For Age Spearman's correlation has been used. Pearson's for the other variables.

interactions with friends and acquaintances has also highly increased. Another aspect that should definitely be considered is that the UADI does not differentiate between different forms of addiction (smartphone, social media, cybersex, game addiction), while it measures a general prevalence of addiction. In light of current developments, we believe there is a need to provide adequate distinctions between different types of addiction and to differentiate areas affected by possible problems. Considering that the administrations took place after the period of greatest impact of the COVID-19 pandemic in Italy (84) which, as we know, imposed a prolonged isolation and reduction in direct contacts, it is probable that these percentages are affected by the impact of social isolation (85, 86) and that this has contributed to a compensatory search on the Internet. The results are, however, similar to the findings of the study by Salarvand et al. (87), also conducted with university students.

Consulting the existing literature related to the period of COVID-19 lockdown (the same period in which we conducted our survey), has shown that the rates of general addiction increased as compared to the pre-COVID period. For example, the study of Burkauskas et al. (88) has shown that Internet Gaming Disorder (IGD) has increased 1.6 times (compared to the pre-COVID period) while the prevalence of the Problematic Internet Use (PIU) has increased 1.5 times. The same increase (1.6 times) during the COVID-19 pandemic of PIU has been also remarked by (89) in both adults and young people. This increase is particularly critical among young people as pointed out by several studies. For example, Zhao et al. (90) estimated the PIU prevalence rate in a sample of university students to be 28.4%, while a Swiss study by Mohler-Kuo et al. (91) estimated the PIU prevalence rate to be 21.3% for young adults.

TABLE 5 Results of hierarchical linear regression analyses.

Independent variable	Outcome variable		
	Internet addiction		
	Adjust R <sup>2</sup>	ΔR <sup>2</sup>	β
<i>Step 1</i>	0.220***	0.223***	
Codependency			0.310***
Impulsivity			0.318***
<i>Step 2</i>	0.255***	0.037***	
Codependency			0.265***
Impulsivity			0.342***
Age			0.197***
<i>Step 3</i>	0.283***	0.029***	
Codependency			0.275***
Impulsivity			0.312***
Age			0.196***
Gender			−0.174***

N = 481; β = standardized beta value.

\*\*\*p ≤ 0.001.

Of particular interest, however, is the recent meta-analysis by Meng et al. (92), which includes 504 studies from 64 countries conducted before November 2021 and from which the importance of the varying incidence of specific modes of Internet addiction can be clearly understood. The study reports prevalence estimates of 26.99% (95% CI, 22.73–31.73) for smartphone addiction, 17.42% (95% CI, 12.42–23.89) for social media addiction, 14.22% (95% CI, 12.90–15.65) for Internet addiction, 8.23% (95% CI, 5.75–11.66) for cybersex addiction, and 6.04% (95% CI, 4.80–7.57) for game addiction.

Underlying the differences in prevalence estimates among the studies should certainly be noted the incidence of the instrument used. In our case, the results reported using the UADI-2 suffer from a lack of classificatory articulation and a normative update that may be reflected in some overestimation of problematic incidence.

However, in the enforced form of preventive isolation, a vicious circle is created that pushes people to seek comfort, entertainment, distraction and relief on the Internet, putting aside the real discomforts, which in this way are not resolved and addressed (93). In other words, the Internet acts as a deterrent and an escape route for people who experience difficulties in socializing in real life. Due to character traits such as shyness or situations of social isolation, the use of new technologies and social networks seem to become a privileged source of intense and satisfying emotions and sensations, albeit originating from entirely virtual dimensions, so that the Internet can represent a means of escaping from everyday reality and taking refuge in an illusory and gratifying world, in which the virtual element makes it possible to overcome the difficulties and inhibitions that can characterize real interactions, thus

triggering pathological mechanisms that severely affect the social relationships, the financial situation and the mental health of the people involved (92).

Internet addictions are more frequent in people with a basic emotional fragility. They are triggered in people who are already experiencing psychological difficulties such as depression, obsessive-compulsive disorders and anxiety disorders (94). The immoderate and improper use of mobile phones and the Internet not only can cause huge gaps between people, but can also lead them to withdraw into themselves, to develop relational insecurities or a fear of rejection, to feel inadequate and in need of support, even if this is external and for its own sake. It should not be forgotten that among these forms of addiction, there is also the so-called ludopathy, i.e., addiction to games and gambling, to which mobile devices also contribute on a large scale (95, 96).

Our results underline the male prevalence of Internet addiction, in line with other studies carried out during the same period (97, 98). Regarding gender differences, the literature indicates that men are generally attracted to sex sites and online games. Women are more likely to spend time flirting in chat rooms. Men prefer visual stimuli and focused on sexual experiences, while women are more focused on relationships and interactions (99–102). These features are congruent with the findings regarding gender comparisons of the UADI-2 addiction scale components. The significantly higher score on the dissociation scale for males is associated with increased gaming [see also (103–105)], whereas the score on the identity and sexuality scale is more likely to relate to behavior related to searching the Internet for sexually oriented content or masking one's identity in chat rooms or role-playing games [see also (106, 107)]. While no gender differences were found with regard to the manifestation of specific addiction-related symptoms, the negative impact on real life (work, study, social relationships, general wellbeing) was greater for males.

The analysis of the bivariate correlations clearly confirmed both the association with impulsiveness and that with codependency. The subsequent hierarchical regression also confirmed the hypothesis of the present study. In terms of the weights of the regression coefficients, impulsivity remains the main predictor (β = 0.312), as indicated by most of the above literature, but it is flanked by co-dependency, which shows a regressive weight just below the former (β = 0.275).

To the best of our knowledge, the only study that explicitly relates codependency to Internet addiction is that of Shishkov et al. (53). Their contribution shows that higher levels of Internet addiction were associated with an increase in codependency. Although the authors do not carry out a regression analysis, but limit themselves to correlation associations, they comment on the results, pointing out that the prerequisites for Internet addiction as well as for codependency are in the family.

In contrast to the study of Shishkov et al., in which both Internet addiction and codependency were greater in younger



individuals, our results show the opposite trend: within the 18–30 age group, it is the older participants who are more dependent, both on the Internet and in terms of relationships. This result is particularly relevant as it raises interesting questions about the potential extension of addiction problems into the fully adult age group.

Some confirmation with respect to the age trend involved in such issues comes from studies that have recently focused on the Internet addiction of workers and professionals (108–111). Other studies also point out the association between Internet addiction (in both adults and young adults) with depression (43, 112–114), hyperactivity and attention deficit (115–119).

The prevalence of Internet addiction in the adults leads us to consider the growing incidence of attention disorders such as ADHD in this age group. Although ADHD is a disorder that begins in childhood, if it is not recognized and properly treated, it can develop into adult ADHD. Although hyperactivity often tends to diminish over time, emotional restlessness and instability in interpersonal relations sometimes persist, together with difficulty in organizing oneself and managing several tasks in parallel (120–123); attention difficulties persist, manifesting themselves as difficulties in tasks such as keeping appointments and meeting deadlines. These consequences negatively affect different aspects of the adult's life, often leading to financial and work difficulties, interpersonal and relationship problems (124, 125). The significant association and predictive estimation, which emerged in our study, of motor and attentional impulsiveness with Internet addiction, suggests that at the basis of this addiction there may also be problems of attention and impulse management that can be traced back to adult ADHD.

As regards codependency, this predictor usually includes personal relationship problems, also within the family context. We found only one study that explicitly considered family functioning, attentional impulsivity and Internet addiction in a sample of young adults in a single explanatory model (43). In this model, attentional impulsivity is proposed as a mediator of the relationship between family functioning and Internet addiction. Although our study does not test this mediation, it has shed light to the role of these predictors in explaining Internet addiction.

## Practical implications of the study

Once some of the possible significant predictors have been identified, it seems appropriate to identify the containment interventions to be put in place. In this regard, the review by Xu et al. (126) on psychological interventions on Internet addiction suggests the formation of targeted and personalized intervention programmes. For impulsivity, which has been proposed as a potential indicator and treatment target of Internet addiction (127, 128), The Reality Therapy approach is suggested to assist individuals in controlling their behavior

and making alternative Internet-related choices (129). Reality therapy is based on choice theory, which holds that people are in charge of their lives and what they do, feel, and think (126, 130). It focuses on goal-directed choices and self-control, which are very important aspects for young people (131, 132) directly by assisting individuals in reflecting on their behaviors, evaluating their options, and planning to choose more effective options (130, 133). Reality therapy may help people with addictions and impulsivity issues improve their self-control and reduce problem behaviors. Despite the fact that there have been very few studies of Internet addiction intervention using reality therapy alone, this method has been linked to improved self-esteem. Similar effects have been observed in studies of reality therapy for substance abuse (134, 135). Although more research is needed, preliminary findings suggest that reality therapy may play a role in the treatment of Internet addiction (130). Because good family functioning was linked to a lower risk of experiencing Internet addiction, family factors may be important targets for Internet addiction interventions (136). Family therapy is not a specific process, but rather a set of interventions aimed at improving family functions and relationships rather than directly addressing addictive behaviors. The therapies are designed to improve communication and relationships while shifting psychological needs fulfillment away from the internet and toward interactions and building relationships with family members (137, 138). Shek et al. (139, 140) used a combination of motivational interviewing and family-based therapy. Participants reported less Internet addiction and improved family functioning.

Since our study reveals the predictive role of codependency, and this is certainly associated with problems of poor relationship functioning, it can be assumed that both family therapy and other interventions or compound approaches may help. Mindfulness-oriented recovery enhancement (MORE), for example, combines mindfulness training with cognitive restructuring (the process of learning to identify and modify maladaptive thoughts through methods such as logical disputation) (141). Some studies have looked into combining two different psychosocial treatments. According to Yao et al. (142), combining reality therapy and mindfulness meditation had a significant effect on Internet gaming disorder.

Given that an inverse relationship between internet addiction and information literacy has emerged in several studies (143–145), further preventive and restraining interventions could include ad hoc media and information literacy enhancement programs, which have been found to be effective in addressing other youth issues such as various addictions (146–148), doping consumption in sports (149, 150), eating disorders (151–153), cyberbullying (154, 155), youth aggressiveness and deviant behaviours (156, 157).

With regard to the above-mentioned interventions, it should be noted that since most of them are conducted with small groups of adolescents, it remains open to question the extent of their effectiveness with a different target group such as young adults and adults. For example, both adult co-dependency and adult hyperactivity problems would require further experimentation, taking into account the different contexts and the actual limitations/opportunities of the current living conditions. Further research and implementation of targeted and customized programmes will certainly be necessary.

## Limitations of the study

Our findings should be interpreted while acknowledging some limitations. First, the sample size for this study was small and the statistical power can be affected. This limitation was due to the difficulty of getting more students involved in the study during the COVID-19 emergency, but we believe that future studies could benefit from a larger sample size and selecting participants from other parts of the country. Second, the participants in our sample were all university students. This choice was made bearing in mind the results of recent meta-analyses conducted in different countries that have shown a high prevalence of Internet addiction in this population [e.g., (87, 158, 159)] and have raised the urgency to orientate policy strategies to this emerging issue for young adults. However future research will be needed to replicate these findings in other groups. Third, it should be considered that the UADI-2 instrument does not differentiate between different forms of addiction (smartphone, social media, cybersex, game addiction) and the measure is indicative of a general prevalence, which in light of current developments, would instead need a specific distinction to adequately and differentially define the areas affected by possible problematicness. Furthermore, results reported may reflect some overestimation of problematic incidence due to this lack of classificatory articulation and normative update since the moment of validation of the instrument UADI-2 carried out in 2005. In addition, future studies could include more variables (such as socio-economic status, including clinical data as depression, anxiety, feeling of loneliness, interpersonal issues, maladaptive cognitions) and more covariates variables. Finally, it was a cross-sectional study, therefore, causalities could not be entirely clarified.

## Conclusion

This study investigates the role and predictive weight of impulsivity and codependency on Internet addiction on a sample of young adult university students by using a

hierarchical regression analysis. The results confirmed that both impulsivity and codependency play a role in problems related to Internet use, moreover they showed the relative importance of gender and age. The study demonstrated that maladaptive and addicted use of the Internet is a critical issue also among young adults, and it suggests that preventive and restraint measures are needed. These can include not only targeted awareness programs, but also interventions aimed at encouraging a greater emotional and attentional control and a more balanced management of personal relationships among young people.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board of the University of Cassino and Southern Lazio. The participants provided their written informed consent to participate in this study.

## Author contributions

PD, SM, and SC designed the study and drafted the manuscript. PD, SM, SC, and ADR analyzed the data and discussed the results. EC, LG, and AC revised the manuscript. All authors contributed to the article and approved the submitted version.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

- Young KS, Rogers RC. The relationship between depression and Internet addiction. *Cyberpsychol Behav.* (1998) 1:25–8. doi: 10.1089/cpb.1998.1.25
- Davis RA. A cognitive-behavioral model of pathological Internet use. *Comput Human Behav.* (2001) 17:187–95. doi: 10.1016/S0747-5632(00)00041-8
- Meerkerk GJ, Van Den Eijnden RJ, Vermulst AA, Garretsen HF. The compulsive internet use scale (CIUS): some psychometric properties. *Cyberpsychology & behavior.* (2009) 12:1–6. doi: 10.1089/cpb.2008.0181
- Ko CH, Yen JY, Yen CF, Chen CS, Chen CC. The association between Internet addiction and psychiatric disorder: a review of the literature. *Eur Psychiat.* (2012) 27:1–8. doi: 10.1016/j.eurpsy.2010.04.011
- Shapira NA, Lessig MC, Goldsmith TD, Szabo ST, Lazortiz M, Gold MS, et al. (2003). Problematic internet use: proposed classification and diagnostic criteria. *Depress. Anxiety.* 17:207–16. doi: 10.1002/da.10094
- Young KS. Internet addiction: the emergence of a new clinical disorder. *Cyberpsychol Behav Soc Netw.* (1996) 3:237–44. doi: 10.1089/cpb.1998.1.237
- Anderson EL, Steen E, Stavropoulos V. Internet use and problematic internet use: A systematic review of longitudinal research trends in adolescence and emergent adulthood. *Int J Adolesc Youth.* (2017) 22:430–54. doi: 10.1080/02673843.2016.1227716
- Prem Singh JG, Prajina PV. A study on the impact of internet addiction among adolescents. *Int J Scientific Res.* (2013) 2:499–501. doi: 10.15373/22778179/AUG2013/164
- Missaoui SG, Brahim T, Bouriga W, Abdelaziz AB. Prevalence and consequences of internet addiction in a cohort of tunisian adolescents: a pilot study. *J Child Adolesc Behav.* (2015) 3:257. doi: 10.4172/2375-4494.100257
- Baturay MH, Toker S. Internet addiction among college students: some causes and effects. *Educ Inf Technol.* (2019) 24:2863–85. doi: 10.1007/s10639-019-09894-3
- Mohamed G, Bernouss R. A cross-sectional study on Internet addiction among Moroccan high school students, its prevalence and association with poor scholastic performance. *Int J Adolesc Youth.* (2020) 25:479–90. doi: 10.1080/02673843.2019.1674165
- Tokunaga RS. A meta-analysis of the relationships between psychosocial problems and internet habits: synthesizing internet addiction, problematic internet use, and deficient self-regulation research. *Commun Monogr.* (2017) 84:423–46. doi: 10.1080/03637751.2017.1332419
- Tripathi A. Impact of internet addiction on mental health: an integrative therapy is needed. *Integr Med Int.* (2017) 4:215–22. doi: 10.1159/000491997
- Shaw M, Black DW. Internet addiction. *CNS Drugs.* (2008) 22:353–65. doi: 10.2165/00023210-200822050-00001
- AlHeneidi HH, Smith AP. Exploring the influence of information overload, internet addiction, and social network addiction, on students' well-being and academic outcomes. In: *International Symposium on Human Mental Workload: Models and Applications*. Cham: Springer. (2021) p. 116–135. doi: 10.1007/978-3-030-91408-0\_8
- Agastya IGN, Siste K, Nasrun MWS, Kusumadewi I. Cybersex addiction: an overview of the development and treatment of a newly emerging disorder. *Med J Indonesia.* (2020) 29:233a–41. doi: 10.13181/mji.rev.203464
- Bodi G, Maintenant C, Pennequin V. The role of maladaptive cognitions in gaming disorder: differences between online and offline gaming types. *Addict Behav.* (2021) 112:106595. doi: 10.1016/j.addbeh.2020.106595
- Müller A, Laskowski NM, Wegmann E, Steins-Loeber S, Brand M. Problematic online buying-shopping: is it time to considering the concept of an online subtype of compulsive buying-shopping disorder or a specific internet-use disorder?. *Curr Addict Rep.* (2021) 8:494–9. doi: 10.1007/s40429-021-00395-3
- Rosendo-Rios V, Trott S, Shukla P. Systematic literature review online gaming addiction among children and young adults: a framework and research agenda. *Addict Behav.* (2022) 107238. doi: 10.1016/j.addbeh.2022.107238
- Carli V, Durkee T, Wasserman D, Hadlaczky G, Despalins R, Kramarz E, et al. The association between pathological internet use and comorbid psychopathology: a systematic review. *Psychopathology.* (2013) 46:1–13. doi: 10.1159/000379791
- Chen YL, Chen SH, Gau SS. ADHD and autistic traits, family function, parenting style, and social adjustment for Internet addiction among children and adolescents in Taiwan: a longitudinal study. *Res Dev Disabil.* (2015) 39:20–31. doi: 10.1016/j.ridd.2014.12.025
- Kim HK, Davis KE. Toward a comprehensive theory of problematic Internet use: Evaluating the role of self-esteem, anxiety, flow, and the self-rated importance of Internet activities. *Computers in Human.* (2009) 25:490–500. doi: 10.1016/j.chb.2008.11.001
- Treuer T, Fábán Z, Füredi J. Internet addiction associated with features of impulse control disorder: is it a real psychiatric disorder?. *J Affect Dis.* (2001) 66:283. doi: 10.1016/S0165-0327(00)00261-5
- Ha JH, Kim SY, Bae SC, Bae S, Kim H, Sim M, et al. Depression and internet addiction in adolescents. *Psychopathology.* (2007) 40:424–30. doi: 10.1159/000107426
- Jang KS, Hwang SY, Choi JY. Internet addiction and psychiatric symptoms among Korean adolescents. *J School Health.* (2008) 78:165–71. doi: 10.1111/j.1746-1561.2007.00279.x
- Diotaiuti P, Girelli L, Mancone S, Corrado S, Valente G, Cavicchiolo E. impulsivity and depressive brooding in internet addiction: A study with a sample of italian adolescents during covid-19 lockdown. *Front Psychiatry.* (2022) 13:941313. doi: 10.3389/fpsy.2022.941313
- Ko CH, Yen JY, Yen CF, Lin HC, Yang MJ. Factors predictive for incidence and remission of internet addiction in young adolescents: a prospective study. *CyberPsychol Beh.* (2007) 10:545–51. doi: 10.1089/cpb.2007.9992
- Yen JY, Ko CH, Yen CF, Wu HY, Yang MJ. The comorbid psychiatric symptoms of Internet addiction: attention deficit and hyperactivity disorder (ADHD), depression, social phobia, and hostility. *J. Adolesc Health.* (2007) 41:93–8. doi: 10.1016/j.jadohealth.2007.02.002
- Diotaiuti P, Valente G, Mancone S, Grambone A, Chirico A. (2021). Metric goodness and measurement invariance of the italian brief version of interpersonal reactivity index: A study with young adults. *Front Psychol.* (2021) 12:773363. doi: 10.3389/fpsyg.2021.773363
- Milani L, Osualdella D, Di Blasio P. Interpersonal relationships, coping strategies and problematic internet use in adolescence: an italian study. *Stud Health Technol Inform.* (2009) 144:69–71. doi: 10.3389/conf.neuro.14.2009.06.068
- Milani L, La Torre G, Fiore M, Grumi S, Gentile DA, Ferrante M, et al. Internet gaming addiction in adolescence: risk factors and maladjustment correlates. *Int J Ment Health Addict.* (2018) 16:888–904. doi: 10.1007/s11469-017-9750-2
- Cao F, Su L, Liu T, Gao X. The relationship between impulsivity and Internet addiction in a sample of Chinese adolescents. *Eur Psychiat.* (2007) 22:466–71. doi: 10.1016/j.eurpsy.2007.05.004
- Mazhari S. The prevalence of problematic internet use and the related factors in medical students, Kerman, Iran. *Addict Health Summer-Autumn.* (2012) 4:87–94.
- Kayış AR, Satici SA, Yılmaz MF, Simşek D, Ceyhan E, Bakioglu F. Big five-personality trait and internet addiction: a meta-analytic review. *Comput Hum Behav.* (2016) 63:35–40. doi: 10.1016/j.chb.2016.05.012
- Petrucelli F, Diotaiuti P, Verrastro V, Petrucelli I, Carenti ML, De Berardis D, et al. Obsessive-compulsive aspects and pathological gambling in an Italian sample. *BioMed Res Int.* (2014) 2014:167438. doi: 10.1155/2014/167438
- Verdejo-García A, Lawrence AJ, Clark L. Impulsivity as a vulnerability marker for substance-use disorders: review of findings from high-risk research, problem gamblers and genetic association studies. *Neurosci Biobehav Rev.* (2008) 32:777–810. doi: 10.1016/j.neubiorev.2007.11.003
- Zhang Y, Liu Z, Zhao Y. Impulsivity, social support and depression are associated with latent profiles of internet addiction among male college freshmen. *Front Psychiatry.* (2021) 12:642914. doi: 10.3389/fpsy.2021.642914
- Rømer Thomsen K, Callesen MB, Hesse M, Kvamme TL, Pedersen MM, Pedersen MU, et al. Impulsivity traits and addiction-related behaviors in youth. *J Behav Addict.* (2018) 7:317–30. doi: 10.1556/2006.7.2018.22
- Lee HW, Choi JS, Shin YC, Lee JY, Jung HY, Kwon JS. Impulsivity in internet addiction: a comparison with pathological gambling. *Cyberpsychol Behav Soc Netw.* (2012) 15:373–7. doi: 10.1089/cyber.2012.0063
- Zhang Y, Mei S, Li L, Chai J, Li J, Du H. The relationship between impulsivity and internet addiction in chinese college students: a moderated mediation analysis of meaning in life and self-esteem. *PLoS ONE.* (2015) 10:e0131597. doi: 10.1371/journal.pone.0131597
- Yüçens B, Üzer A. The relationship between internet addiction, social anxiety, impulsivity, self-esteem, and depression in a sample of Turkish undergraduate medical students. *Psychiatry Res.* (2018) 267:313–8. doi: 10.1016/j.psychres.2018.06.033

42. Li Q, Dai W, Zhong Y, Wang L, Dai B, Liu X. The mediating role of coping styles on impulsivity, behavioral inhibition/approach system, and internet addiction in adolescents from a gender perspective. *Front Psychol.* (2019) 10:2402. doi: 10.3389/fpsy.2019.02402
43. Marzilli E, Cerniglia L, Ballarotto G, Cimino S. Internet addiction among young adult university students: the complex interplay between family functioning, impulsivity, depression, and anxiety. *Int J Environ Res Public Health.* (2020) 17:8231. doi: 10.3390/ijerph17218231
44. Khanbabaie S, Abdollahi MH, Shahgholian M. The predictive role of working memory and impulsivity in internet addiction, an investigation about the mediating role of time perception. *Pers Individ Dif.* (2022) 185:111280. doi: 10.1016/j.paid.2021.111280
45. Karaşar B. Codependency: An evaluation in terms of depression, need for social approval and self-love/self-efficacy. *Kastamonu Eğitim Dergisi.* (2021) 29:117–26. doi: 10.24106/kefdergi.738845
46. Orbon MC, Basaria D, Dewi FIR, Gumarao MS, Mergal VC, Heng PH. Codependency among family members as predicted by family functioning and personality type. In: *International Conference on Economics, Business, Social, and Humanities (ICEBSH 2021)*. Atlantis Press. (2021) p. 1388–1393. doi: 10.2991/assehr.k.210805.218
47. Berdichevsky AA, Padun MA, Gagarina MA, Arkhipova MV. Emotional regulation in individuals, standing in codependent relationship. *Clin Psychol.* (2021) 10:185–204. doi: 10.17759/cpse.2021100409
48. Aimaganbetova OH, Sagnayeva TZ, Bimaganbetova ZT, Adilova ET, Kasym L. Study of independence as social-psychological factor influencing on the personal features of the co-dependent person. *Bull. KazNU. Psychol. Sociol. Ser.* (2018) 2:146–153. <https://bulletin-psysoz.kaznu.kz/index.php/1-psy/article/view/868> doi: 10.26577/JPPS-2018-2-660
49. Rozhnova TM, Kostyuk SV, Malygin VL, Enikolopov SN, Nikolenko VN. The phenomenon of codependency: psychological and medical genetic aspects. *Neurol Neuropsychiatr Psychosomat.* (2020) 12:53–9. doi: 10.14412/2074-2711-2020-5-53-59
50. Bacon I, McKay E, Reynolds F, McIntyre A. The lived experience of codependency: An interpretative phenomenological analysis. *Int J Ment Health Addict.* (2020) 18:754–71. doi: 10.1007/s11469-018-9983-8
51. Barrera-Algarín E, Vázquez-Fernández MJ. The rise of online sports betting, its fallout, and the onset of a new profile in gambling disorder: young people. *J Addict Dis.* (2021) 39:363–72. doi: 10.1080/10550887.2021.1886567
52. Lu LC, Tsai CT. The effect of virtual community codependency on virtual community addiction: exploring the mediation effects. In: *2018 Global Marketing Conference at Tokyo (pp. 1169–1173)*. Available online at: <http://db.koreascholar.com/article.aspx?code=351682> doi: 10.15444/GMC2018.09.08.02
53. Shishkov VV, Kokurenkova PA, Sokolov AR, Ulyanova MY, Ilyichev AB, Pozdnyak VV, et al. Correlation of internet addiction with codependency and temperament. In: *Medical Scientific Bulletin of Central Chernozemye (Naučno-medicinskij vestnik Central'nogo Chernozem'ya)*. (2021) p. 45–51. Available online at: <https://new.vestniksurgey.com/index.php/1990-472X/article/view/6786>
54. Artemtseva NG, Malkina MA. Cognitive mistakes of codependents as a way to protect against uncertainty. *Vestnik Of Samara State Technical University Psychological And Pedagogical Sciences.* (2022) 19:153–66. doi: 10.17673/vsgtu-pps.2022.1.11
55. Schreiber LR, Grant JE, Odlaug BL. Emotion regulation and impulsivity in young adults. *J Psychiatr Res.* (2012) 46:651–8. doi: 10.1016/j.jpsychires.2012.02.005
56. Ziada KE, Becker D, Bakhiet SF, Dutton E, Essa YAS. Impulsivity among young adults: Differences between and within Western and Arab populations in the BIS-11. *Curr Psychol.* (2020) 39:464–73. doi: 10.1007/s12144-018-0032-3
57. Di Carlo F, Pettorruso M, Alessi MC, Picutti E, Collecchio R, Migliara G, et al. Characterizing the building blocks of Problematic Use of the Internet (PUI): The role of obsessional impulses and impulsivity traits among Italian young adults. *Compr Psychiatry.* (2021) 106:152225. doi: 10.1016/j.comppsy.2021.152225
58. O'Donnell BE, Skosnik PD, Hetrick WP, Fridberg DJ. Decision making and impulsivity in young adult cannabis users. *Front Psychol.* (2021) 12:2594. doi: 10.3389/fpsy.2021.679904
59. Salvarli SI, Griffiths MD. The association between internet gaming disorder and impulsivity: A systematic review of literature. *Int J Ment Health Addict.* (2022) 20:92–118. doi: 10.1007/s11469-019-00126-w
60. Servidio R, Bartolo MG, Palermi AL, Costabile A. Fear of COVID-19, depression, anxiety, and their association with Internet addiction disorder in a sample of Italian students. *J Affect Dis Rep.* (2021) 4:100097. doi: 10.1016/j.jadr.2021.100097
61. Sinclair DL, Vanderplasschen W, Savahl S, Florence M, Best D, Sussman S. Substitute addictions in the context of the COVID-19 pandemic. *J Behav Addict.* (2021) 9:1098–102. doi: 10.1556/2006.2020.00091
62. Abbott A, Askelson N, Scherer AM, Afifi RA. Critical reflections on COVID-19 communication efforts targeting adolescents and young adults. *J Adolescent Health.* (2020) 67:159–60. doi: 10.1016/j.jadohealth.2020.05.013
63. Alivernini F, Manganelli S, Girelli L, Cozzolino M, Lucidi F, Cavicchiolo E. Physical distancing behavior: the role of emotions, personality, motivations, and moral decision-making. *J Pediatr Psychol.* (2021) 46:15–26. doi: 10.1093/jpepsy/jsaa122
64. Cavicchiolo E, Manganelli S, Girelli L, Cozzolino M, Lucidi F, Alivernini F. Adolescents at a distance: the importance of socio-cognitive factors in preventive behavior during the COVID-19 pandemic. *Eur J Health Psychol.* (2021) 28:161–70. doi: 10.1027/2512-8442/a000083
65. Diotaiuti P, Valente G, Mancone S, Falese L, Bellizzi F, Anastasi D, et al. Perception of risk, self-efficacy and social trust during the diffusion of Covid-19 in Italy. *Int. J. Environ. Res. Public Health.* (2021) 18:3421–7. doi: 10.3390/ijerph18073427
66. Baiocco R, Manca M, Del Miglio C, Cerruti R, Couyomdjian A. Uso e abuso di Internet in adolescenza: quale relazione con i disturbi psicosomatici? Internet use and abuse in adolescence: what relationship with psychosomatic disorders? *Psicotech.* (2005) 2:47–60. doi: 10.1400/69127
67. Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *J Clin Psychol.* (1995) 51:768–74. doi: 10.1002/1097-4679(199511)51:6<768::AID-JCLP2270510607>3.0.CO;2-1
68. Fossati A, Di Ceglie A, Acquarini E, Barratt ES. Psychometric properties of an Italian version of the Barratt Impulsiveness Scale-11 (BIS-11) in nonclinical subjects. *J Clin Psychol.* (2001) 57:815–28. doi: 10.1002/jclp.1051
69. Fischer JL, Spann L, Crawford DW. Measuring codependency. *Alcohol Treat Q.* (1991) 8:87–100. doi: 10.1300/J020V08N01\_06
70. Rosenthal SR, Cha Y, Clark MA. The internet addiction test in a young adult US population. *Cyberpsychol Behav Soc Netw.* (2018) 21:661–6. doi: 10.1089/cyber.2018.0143
71. Wolniewicz CA, Tiamiyu MF, Weeks JW, Elhai JD. Problematic smartphone use and relations with negative affect, fear of missing out, and fear of negative and positive evaluation. *Psychiatry Res.* (2018) 262:618–23. doi: 10.1016/j.psychres.2017.09.058
72. Andrade ALM, Scatena A, Bedendo A, Enumo SRF, Dellazzana-Zanon LL, Prebianchi HB, et al. Findings on the relationship between Internet addiction and psychological symptoms in Brazilian adults. *Int J Psychol.* (2020) 55:941–50. doi: 10.1002/ijop.12670
73. Ioannidis K, Treder MS, Chamberlain SR, Kiraly F, Redden SA, Stein DJ, et al. Problematic internet use as an age-related multifaceted problem: Evidence from a two-site survey. *Addict Behav.* (2018) 81:157–66. doi: 10.1016/j.addbeh.2018.02.017
74. Menon S, Narayanan L, Kahwaji AT. Internet addiction: A research study of college students in India. *J Econ Bus.* (2018) 1:100–6. doi: 10.31014/aior.1992.01.01.9
75. Lin MP. Prevalence of internet addiction during the COVID-19 outbreak and its risk factors among junior high school students in Taiwan. *Int J Environ Res Public Health.* (2020) 17:8547. doi: 10.3390/ijerph17228547
76. Caplan SE. Theory and measurement of generalized problematic Internet use: A two-step approach. *Comput Human Behav.* (2010) 26:1089–97. doi: 10.1016/j.chb.2010.03.012
77. Fioravanti G, Primi C, Casale S. Psychometric evaluation of the generalized problematic internet use scale 2 in an Italian sample. *Cyberpsychol Behav Soc Netw.* (2013) 16:761–6. doi: 10.1089/cyber.2012.0429
78. Fioravanti G, Casale S. Evaluation of the psychometric properties of the Italian Internet Addiction Test. *Cyberpsychol Behav Soc Netw.* (2015) 18:120–8. doi: 10.1089/cyber.2014.0493
79. D'Elia F, Callea A. UADI: uno studio sulla dipendenza da internet. *Int J Educ Psychol.* (2010) 4:107–15.
80. Gnisci A, Perugini M, Pedone R, Di Conza A. Construct validation of the use, abuse and dependence on the Internet inventory. *Comput Human Behav.* (2011) 27:240–7. doi: 10.1016/j.chb.2010.08.002
81. Di Lorenzo M, Lancini M, Suttora C, Zanella TE. La dipendenza da internet in adolescenza tra normalità e psicopatologia: uno studio italiano. *Psichiatria e psicoterapia.* (2013) 101–35.
82. Masi G, Berloff S, Muratori P, Paciello M, Rossi M, Milone A. Internet addiction disorder in referred adolescents: a clinical study on comorbidity. *Addict Res Theory.* (2021) 29:205–11. doi: 10.1080/16066359.2020.1772242



83. Sechi C, Loi G, Cabras C. Addictive internet behaviors: The role of trait emotional intelligence, self-esteem, age, and gender. *Scand J Psychol.* (2021) 62:409–17. doi: 10.1111/sjop.12698
84. Bruno, G., Panzeri, A., Granziol, U., Alivernini, F., Chirico, A., Galli, F., et al. (2020). The Italian COVID-19 psychological research consortium (it c19prc): general overview and replication of the UK study. *J Clin Med.* 10(1). doi: 10.3390/jcm10010052
85. Alivernini F, Manganelli S. The classmates social isolation questionnaire (CSIQ): an initial validation. *Eur J Developmental Psychol.* (2016) 13:264–74. doi: 10.1080/17405629.2016.1152174
86. Cavicchiolo E, Lucidi F, Diotaiuti P, Chirico A, Galli F, Manganelli S, et al. Adolescents' characteristics and peer relationships in class: a population study. *Int J Environ Res Public Health.* (2022) 19:8907. doi: 10.3390/ijerph19158907
87. Salarvand SN, Albatineh A, Dalvand S, Baghban Karimi E, Ghanei Gheshlagh R. Prevalence of internet addiction among Iranian university students: a systematic review and meta-analysis. *Cyberpsychol Behav Soc Netw.* (2022) 25:213–22. doi: 10.1089/cyber.2021.0120
88. Burkauskas J, Geacate-Stonciene J, Demetrovics Z, Griffiths MD, Király O. Prevalence of problematic internet use during the COVID-19 pandemic. *Curr Opin Behav Sci.* (2022) 101179. doi: 10.1016/j.cobeha.2022.101179
89. Oka T, Hamamura T, Miyake Y, Kobayashi N, Honjo M, Kawato M, et al. Prevalence and risk factors of internet gaming disorder and problematic internet use before and during the COVID-19 pandemic: a large online survey of Japanese adults. *J Psychiatr Res.* (2021) 142:218–25. doi: 10.1016/j.jpsychires.2021.07.054
90. Zhao Y, Jiang Z, Guo S, Wu P, Lu Q, Xu Y, et al. Association of symptoms of attention deficit and hyperactivity with problematic internet use among university students in Wuhan, China during the COVID-19 pandemic. *J Affect Disord.* (2021) 286:220–7. doi: 10.1016/j.jad.2021.02.078
91. Mohler-Kuo M, Dzemali S, Foster S, Werlen L, Walitza S. Stress and mental health among children/adolescents, their parents, and young adults during the first COVID-19 lockdown in Switzerland. *Int J Environ Res Public Health.* (2021) 18:4668. doi: 10.3390/ijerph18094668
92. Meng SQ, Cheng JL, Li YY, Yang XQ, Zheng JW, Chang XW, et al. Global prevalence of digital addiction in general population: a systematic review and meta-analysis. *Clin Psychol Rev.* (2022) 102128. doi: 10.1016/j.cpr.2022.102128
93. Giallonardo V, Sampogna G, Del Vecchio V, Luciano M, Albert U, Carmassi C, et al. The impact of quarantine and physical distancing following COVID-19 on mental health: study protocol of a multicentric Italian population trial. *Front Psychiatry.* (2020) 11:533. doi: 10.3389/fpsy.2020.00533
94. Guzik AG, Candelari A, Wiese AD, Schneider SC, Goodman WK, Storch EA. Obsessive-compulsive disorder during the COVID-19 pandemic: a systematic review. *Curr Psychiatry Rep.* (2021) 23:71. doi: 10.1007/s11920-021-01284-2
95. Månsson V, Wall H, Berman AH, Jayaram-Lindström N, Rosendahl I. A Longitudinal study of gambling behaviors during the COVID-19 pandemic in Sweden. *Front Psychiatry.* (2021) 12:708037. doi: 10.3389/fpsyg.2021.708037
96. Salerno L, Pallanti S. COVID-19 Related Distress in Gambling Disorder. *Front Psychiatry.* (2021) 12:620661. doi: 10.3389/fpsy.2021.620661
97. Kumari R, Langer B, Gupta R, Gupta RK, Mir MT, Shafi B, et al. Prevalence and determinants of Internet addiction among the students of professional colleges in the Jammu region. *Fam Med Prim Care Rev.* (2022) 11:325–9. doi: 10.4103/fmnc.fmnc\_991\_21
98. Parajuli BR. Increased internet addiction during COVID-19 pandemics. *Life Res.* (2022) 5:1. doi: 10.53388/life2021-0829-635
99. Dufour M, Brunelle N, Tremblay J, Leclerc D, Cousineau MM, Khazaal Y, et al. Gender difference in internet use and internet problems among Quebec high school students. *Can J Psychiatry.* (2016) 61:663–8. doi: 10.1177/0706743716640755
100. Su W, Han X, Yu H, Wu Y, Potenza MN. Do men become addicted to internet gaming and women to social media? A meta-analysis examining gender-related differences in specific internet addiction. *Comput Human Behav.* (2020) 113:106480. doi: 10.1016/j.chb.2020.106480
101. Hassan T, Alam MM, Wahab A, Hawlader MD. Prevalence and associated factors of internet addiction among young adults in Bangladesh. *J Egypt Public Health Assoc.* (2020) 95:1–8. doi: 10.1186/s42506-019-0032-7
102. Tian Y, Zuo T, Sun Q, Sun L, Cao S, Qin N. The association between generalized and specific problematic internet use and its gender differences across different educational levels. *Front Psychol.* (2021) 12. doi: 10.3389/fpsyg.2021.634581
103. Guglielmucci F, Monti M, Franzoi IG, Santoro G, Granieri A, Billieux J, et al. Dissociation in problematic gaming: a systematic review. *Curr Addict Rep.* (2019) 6:1–14. doi: 10.1007/s40429-019-0237-z
104. Gundogdu U, Eroglu M. The relationship between dissociation symptoms, sleep disturbances, problematic internet use and online gaming in adolescents. *Psychol Health Med.* (2021) 1–12. doi: 10.1080/13548506.2021.1984542
105. Schimmenti A, Musetti A, Costanzo A, Terrone G, Maganuco NR, Aglieri Rinella C, et al. The unfabulous four: Maladaptive personality functioning, insecure attachment, dissociative experiences, and problematic internet use among young adults. *Int J Ment Health Addict.* (2021) 19:447–61. doi: 10.1007/s11469-019-00079-0
106. Awan HA, Aamir A, Diwan MN, Ullah I, Pereira-Sanchez V, Ramalho R, et al. Internet and pornography use during the COVID-19 pandemic: presumed impact and what can be done. *Front Psychiatry.* (2021) 12:220. doi: 10.3389/fpsy.2021.623508
107. Karamanoli E, Tantaros S, Pavlopoulos V. Internet use in emerging adulthood: associations with life satisfaction, identity development, and attachment style. *Psychology.* (2020) 25:93–108. doi: 10.12681/psy\_hps.25589
108. Vanea MO. Intensive/excessive use of internet and risks of internet addiction among specialized workers-gender and online activities differences. *Procedia-Social and Behavioral Sciences.* (2011) 30:757–64. doi: 10.1016/j.sbspro.2011.10.148
109. Shin SE, Kim NS, Jang EY. Comparison of problematic internet and alcohol use and attachment styles among industrial workers in Korea. *Cyberpsychol Behav Soc Netw.* (2011) 14:665–72. doi: 10.1089/cyber.2010.0470
110. Shrivastava A, Sharma MK, Marimuthu P. Internet addiction at workplace and its implication for workers life style: exploration from Southern India. *Asian J Psychiatr.* (2018) 32:151–5. doi: 10.1016/j.ajp.2017.11.014
111. Pohl M, Feher G, Kapus K, Feher A, Nagy GD, Kiss J, et al. The association of internet addiction with burnout, depression, insomnia, and quality of life among hungarian high school teachers. *Int J Environ Res Public Health.* (2022) 19:438. doi: 10.3390/ijerph19010438
112. Ostovar S, Allahyar N, Aminpoor H, Moafian F, Nor MBM, Griffiths MD. Internet addiction and its psychosocial risks (depression, anxiety, stress and loneliness) among Iranian adolescents and young adults: A structural equation model in a cross-sectional study. *Int J Ment Health Addict.* (2016) 14:257–67. doi: 10.1007/s11469-015-9628-0
113. Dieris-Hirche J, Böttel L, Bielefeld M, Steinbüchel T, Kehyayan A, Dieris B, et al. Media use and Internet addiction in adult depression: a case-control study. *Comput Human Behav.* (2017) 68:96–103. doi: 10.1016/j.chb.2016.11.016
114. Przepiorka A, Blachnio A, Cudo A. The role of depression, personality, and future time perspective in internet addiction in adolescents and emerging adults. *Psychiatry Res.* (2019) 272:340–8. doi: 10.1016/j.psychres.2018.12.086
115. Wang BQ, Yao NQ, Zhou X, Liu J, Lv ZT. The association between attention deficit/hyperactivity disorder and internet addiction: a systematic review and meta-analysis. *BMC Psychiatry.* (2017) 17:1–12. doi: 10.1186/s12888-017-1408-x
116. Mutluer BT, Orum TY, Sertcelik S. Incidence of Internet addiction in adult attention deficit hyperactivity disorder. *Eur Psychiat.* (2017) 41:S396–7. doi: 10.1016/j.eurpsy.2017.02.457
117. Panagiotidi M, Overton P. The relationship between internet addiction, attention deficit hyperactivity symptoms and online activities in adults. *Compr Psychiatry.* (2018) 87:7–11. doi: 10.1016/j.comppsy.2018.08.004
118. Evren B, Evren C, Dalbudak E, Topcu M, Kutlu N. The impact of depression, anxiety, neuroticism, and severity of Internet addiction symptoms on the relationship between probable ADHD and severity of insomnia among young adults. *Psychiatry Res.* (2019) 271:726–31. doi: 10.1016/j.psychres.2018.12.010
119. Kandre DD, Patel AV, Mehta PI. Analytical study of adult attention deficit hyperactivity disorder symptoms and internet addiction among medical students. *Neuropsychiatry & Neuropsychology/Neuropsychiatry i Neuropsychologia.* (2020) 15. doi: 10.5114/nan.2020.97398
120. Song P, Zha M, Yang Q, Zhang Y, Li X, Rudan I. The prevalence of adult attention-deficit hyperactivity disorder: A global systematic review and meta-analysis. *J Glob Health.* (2021) 11:04009. doi: 10.7189/jogh.11.04009
121. Barkley RA, Brown TE. Unrecognized attention-deficit/hyperactivity disorder in adults presenting with other psychiatric disorders. *CNS Spectr.* (2008) 13:977–84. doi: 10.1017/S1092852900014036
122. Volkow ND, Swanson JM. Adult attention deficit–hyperactivity disorder. *New England Journal of Medicine.* (2013) 369:1935–44. doi: 10.1056/NEJMcp1212625
123. Anbarasan D, Kitchin M, Adler LA. Screening for adult ADHD. *Curr Psychiatry Rep.* (2020) 22:1–5. doi: 10.1007/s11920-020-01194-9
124. Adler LA, Faraone SV, Spencer TJ, Berglund P, Alperin S, Kessler RC. The structure of adult ADHD. *Int J Methods Psychiatr Res.* (2017) 26:e1555. doi: 10.1002/mpr.1555



125. Katzman MA, Bilkey TS, Chokka PR, Fallu A, Klassen LJ. Adult ADHD and comorbid disorders: clinical implications of a dimensional approach. *BMC Psychiatry*. (2017) 17:1–15. doi: 10.1186/s12888-017-1463-3
126. Xu LX, Wu LL, Geng XM, Wang ZL, Guo XY, Song KR, et al. A review of psychological interventions for internet addiction. *Psychiatry Res*. (2021) 302:114016. doi: 10.1016/j.psychres.2021.114016
127. Irvine MA, Worbe Y, Bolton S, Harrison NA, Bullmore ET, Voon V. Impaired decisional impulsivity in pathological videogamers. *PLoS ONE*. (2013) 8:e75914. doi: 10.1371/journal.pone.0075914
128. Dong G, Potenza MN. A cognitive-behavioral model of Internet gaming disorder: Theoretical underpinnings and clinical implications. *J Psychiatr Res*. (2014) 58:7–11. doi: 10.1016/j.jpsychires.2014.07.005
129. Wubbolding RE. Evolution of Psychotherapy: A Conference of Inner Control. *Int J Reality Ther*. (2006) 26:35–7.
130. Kim JU. The effect of a R/T group counseling program on the Internet addiction level and self-esteem of Internet addiction university students. *Int J Realty Therap*. (2008) 27:4–12.
131. Alivernini F, Lucidi F, Manganelli S. Assessment of academic motivation: A mixed methods study. *Int J Mult Res Approaches*. (2008) 2:71–82. doi: 10.5172/mra.455.2.1.71
132. Alivernini F, Manganelli S, Lucidi F. Personal and Classroom Achievement Goals: Their Structures and Relationships. *J Psychoeduc Assess*. (2018) 36:354–65. doi: 10.1177/0734282916679758
133. Kim JU. A reality therapy group counseling program as an Internet addiction recovery method for college students in Korea. *Int J Reality Therapy*. (2007) 26:3–9.
134. Jahromi MK, Mosallanejad L. The impact of reality therapy on metacognition, stress and hope in addicts. *Glob J Health Sci*. (2014) 6:281. doi: 10.5539/gjhs.v6n6p281
135. Law FM, Guo GJ. The impact of reality therapy on self-efficacy for substance-involved female offenders in Taiwan. *Int J Offender Ther Comp Criminol*. (2015) 59:631–53. doi: 10.1177/0306624X13518385
136. Yu L, Shek DTL. Internet addiction in Hong Kong adolescents: a three-year longitudinal study. *J Pediatr Adolesc Gynecol*. (2013) 26:S10–7. doi: 10.1016/j.jpjag.2013.03.010
137. Han DH, Kim SM, Lee YS, Renshaw PF. The effect of family therapy on the changes in the severity of on-line game play and brain activity in adolescents with on-line game addiction. *Psychiatry Res*. (2012) 202:126–31. doi: 10.1016/j.psychres.2012.02.011
138. Liu QX, Fang XY, Yan N, Zhou ZK, Yuan XJ, Lan J, et al. Multi-family group therapy for adolescent Internet addiction: exploring the underlying mechanisms. *Addict Behav*. (2015) 42:1–8. doi: 10.1016/j.addbeh.2014.10.021
139. Shek DT, Tang VM, Lo CY. Evaluation of an Internet addiction treatment program for Chinese adolescents in Hong Kong. *Adolescence*. (2009) 44.
140. Diotaiuti P, Valente G, Mancone S, Grambone A. Psychometric properties and a preliminary validation study of the Italian brief version of the communication styles inventory (CSI-B/I). *Front Psychol*. (2020) 11:1421. doi: 10.3389/fpsyg.2020.01421
141. Li W, Garland EL, Howard MO. Therapeutic mechanisms of Mindfulness-Oriented Recovery Enhancement for internet gaming disorder: Reducing craving and addictive behavior by targeting cognitive processes. *J Addict Dis*. (2018) 37:5–13. doi: 10.1080/10550887.2018.1442617
142. Yao YW, Chen PR, Chiang-shan RL, Hare TA, Li S, Zhang JT, et al. Combined reality therapy and mindfulness meditation decrease intertemporal decisional impulsivity in young adults with Internet gaming disorder. *Comput Hum Behav*. (2017) 68:210–6. doi: 10.1016/j.chb.2016.11.038
143. Langarizadeh M, Naghipour M, Tabatabaei SM, Mirzaei A, Vaghar ME. Prediction of internet addiction based on information literacy among students of Iran University of Medical Sciences. *Electron Phys*. (2018) 10:6333. doi: 10.19082/6333
144. Deonisius RF, Lestari I, Sarkadi S. The effect of digital literacy to internet addiction. *J Educ*. (2019) 5:71–5. doi: 10.29210/120192333
145. García LC, Gómez MC. Approaches and guidelines for creating educational projects based on Internet addiction: Presentation of a new approach linked to digital competence. In: *Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality*. (2020). p. 605–10. doi: 10.1145/3434780.3436657
146. Jormand H, Bashirian S, Barati M, Rezapur-Shahkolai F, Babamiri M. Exploration of media literacy about substance abuse among students: a qualitative study. *Turkish J Addict*. (2020) 7:234–40. doi: 10.5152/ADDICTA.2020.20073
147. Barati M, Bashirian S, Jormand H, Babamiri M, Rezapur-Shahkolai F. Can substance abuse media literacy increase prediction of drug use in students?. *BMC Psychol*. (2022) 10:1–15. doi: 10.1186/s40359-022-00860-2
148. Dai HD, Ratnapradipa K, Michaud TL, King KM, Guenzel N, Tamrakar N, et al. Vaping media literacy, harm perception, and susceptibility of e-cigarette use among youth. *Am J Prevent Med*. (2022). doi: 10.1016/j.amepre.2022.05.012 [Epub ahead of print].
149. Lucidi F, Mallia L, Alivernini F, Chirico A, Manganelli S, Galli F, et al. The effectiveness of a new school-based media literacy intervention on adolescents' doping attitudes and supplements use. *Front Psychol*. (2017) 8:749. doi: 10.3389/fpsyg.2017.00749
150. Mallia L, Chirico A, Zelli A, Galli F, Palombi T, Bortoli L, et al. The implementation and evaluation of a media literacy intervention about PAES use in sport science students. *Front Psychol*. (2020) 11:368. doi: 10.3389/fpsyg.2020.00368
151. McLean SA, Wertheim EH, Masters J, Paxton SJ. A pilot evaluation of a social media literacy intervention to reduce risk factors for eating disorders. *Int J Eat Disord*. (2017) 50:847–51. doi: 10.1002/eat.22708
152. Diotaiuti P, Girelli L, Mancone S, Valente G, Bellizzi F, Misiti F, et al. Psychometric properties and measurement invariance across gender of the Italian version of the tempest self-regulation questionnaire for eating adapted for young adults. *Front Psychol*. (2022) 13:941784. doi: 10.3389/fpsyg.2022.941784
153. Paxton SJ, McLean SA, Rodgers RF. "My critical filter buffers your app filter": Social media literacy as a protective factor for body image. *Body Image*. (2022) 40:158–64. doi: 10.1016/j.bodyim.2021.12.009
154. Kapucu MS, Özcan H, Özyer KK. (2021). The relationship between secondary school students' digital literacy levels, social media usage purposes and cyberbullying threat level. *Int J Modern Educ Stud*. (2021) 5:537–66. doi: 10.51383/ijonmes.2021.136
155. Cheng ACS. Adolescent co-researchers design media literacy lessons to address cyberbullying through design thinking: encouraging passive bystanders to protect cyber-victims. In: *Research Anthology on Combating Cyber-Aggression and Online Negativity*. IGI Global. (2022). p. 285–311. doi: 10.4018/978-1-6684-5594-4.ch017
156. Xie X, Gai X, Zhou Y. A meta-analysis of media literacy interventions for deviant behaviors. *Comput. Educ*. (2019) 139:146–56. doi: 10.1016/j.compedu.2019.05.008
157. Moorhouse EA, Brooks H. Critical media literacy approaches to violence prevention: A research note. *J Media Liter Educ*. (2020) 12:84–99. doi: 10.23860/JMLE-2020-12-1-7
158. Joseph J, Varghese A, Vr V, Dhandapani M, Grover S, Sharma S, et al. Prevalence of internet addiction among college students in the Indian setting: a systematic review and meta-analysis. *General Psychiat*. (2021) 34:e100496. doi: 10.1136/gpsych-2021-100496
159. Shao YJ, Zheng T, Wang YQ, Liu L, Chen Y, Yao YS. Internet addiction detection rate among college students in the People's Republic of China: a meta-analysis. *Child Adolesc Psychiatry Ment Health*. (2018) 12:25. doi: 10.1186/s13034-018-0231-6



## OPEN ACCESS

## EDITED BY

Wing Fai Yeung,  
Hong Kong Polytechnic University,  
Hong Kong SAR, China

## REVIEWED BY

Nazanin Alavi,  
Queen's University, Canada  
Magnus Mfoafo-M'Carthy,  
Wilfrid Laurier University, Canada

## \*CORRESPONDENCE

Vincent I. O. Agyapong  
vn602367@dal.ca

## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

RECEIVED 05 March 2022

ACCEPTED 30 September 2022

PUBLISHED 28 October 2022

## CITATION

Agyapong B, Shalaby R, Wei Y and  
Agyapong VIO (2022) Can  
ResilienceNHope, an evidence-based  
text and email messaging innovative  
suite of programs help to close the  
psychological treatment and mental  
health literacy gaps in college  
students?

*Front. Public Health* 10:890131.

doi: 10.3389/fpubh.2022.890131

## COPYRIGHT

© 2022 Agyapong, Shalaby, Wei and  
Agyapong. This is an open-access  
article distributed under the terms of  
the [Creative Commons Attribution  
License \(CC BY\)](#). The use, distribution  
or reproduction in other forums is  
permitted, provided the original  
author(s) and the copyright owner(s)  
are credited and that the original  
publication in this journal is cited, in  
accordance with accepted academic  
practice. No use, distribution or  
reproduction is permitted which does  
not comply with these terms.

# Can ResilienceNHope, an evidence-based text and email messaging innovative suite of programs help to close the psychological treatment and mental health literacy gaps in college students?

Belinda Agyapong<sup>1,2</sup>, Reham Shalaby<sup>1</sup>, Yifeng Wei<sup>1</sup> and  
Vincent I. O. Agyapong<sup>1,2,3\*</sup>

<sup>1</sup>Department of Psychiatry, University of Alberta, Edmonton, AB, Canada, <sup>2</sup>Global Psychological eHealth Foundation, Edmonton, AB, Canada, <sup>3</sup>Department of Psychiatry, Faculty of Medicine, Dalhousie University, Halifax, NS, Canada

There is a high prevalence of stress, anxiety, depression, and substance use disorders in college students globally. Financial stressors, course workload, peer pressure, and other personal, family, and societal stressors contribute to the high incidence of mental disorders among college students. Despite the high prevalence of mental disorders in college students, barriers such as lack of mental health literacy, stigma of mental health, inadequate numbers of mental health counselors and clinical psychologists supporting students in colleges in both low- and high-income countries, and financial and geographical barriers often hinder college students from accessing the needed mental supports. There is increasing evidence on the effectiveness and feasibility of mobile technology in health promotion and closing psychological treatment gaps. College students are well adapted to the use of mobile technology, particularly text and email messaging daily, which presents a unique opportunity for an innovative way to offer support for their mental health. In this article, we provide a perspective on the ResilienceNHope program, an evidence-based text and email messaging innovation, to close the psychological treatment gap and improve the mental health literacy of college students.

## KEYWORDS

resilience, hope, mental health, anxiety, depression, stress, text messaging

## Introduction

Higher education students experience many challenges leading to increased vulnerability and hence a high incidence of mental health issues. The education and learning of 67.6% of students are impacted worldwide due to the COVID-19 pandemic (1). Globally, many studies have confirmed the high prevalence of mental health issues

among college or university students. A cross-sectional study among university students found that 27.5% had moderate and 9.7% had severe or extremely severe depression; 34% had moderate and 29% had severe or extremely severe anxiety; and 18.6% had moderate and 5.1% had severe or extremely severe stress (2). Another study showed that the prevalence of depressive symptoms was 32.6% (3), while anxiety and depressive symptoms were associated with lower grades (4). In another cross-sectional study of university students, more than half of the participants were affected by depression (51.3%), anxiety (66.9%), and stress (53%) (5). Results of another study reported that 34.6% had depressive symptomatology, 37.2% showed anxiety symptoms, and 47.1% had stress symptoms (6).

The ongoing pandemic and online learning has exacerbated the mental health burden of the university student. Approximately one-third of college students experienced varying degrees of depression, anxiety, and stress symptoms with online learning during the COVID-19 pandemic (7). One study reported that isolation measures to curb the COVID-19 pandemic including online learning, mostly home-based learning, had a huge health impact with the potential to affect long-term diet and physical activity in both sexes with approximately 30% fewer students achieving adequate levels of activity, compared with the previous 2 years (8). The lack of campus time and face-to-face learning contact can also result in learners feeling isolated (9) and has significantly disrupted the lives of students (1). One study reported that students experienced increased stress and anxiety as well as difficulties concentrating during online learning (10). Acute stress, anxiety, and depressive symptoms have been prevalent among students during the COVID-19 epidemic (11). One study found the prevalence of depression, anxiety, and stress were 31.9, 32.9, and 14.6%, respectively (7). Another study reported the prevalence of moderately severe to severe depression and anxiety were 34.3% and 20.1%, respectively (12).

The stressors experienced by university students in Canada are not different from those experienced by students in other countries. A cross-sectional survey in Canada reported 39.5% symptoms of moderate to severe depression, 23.8% of moderate-severe anxiety, and 80.3% of moderate-severe levels of perceived stress (13). In addition, over the academic year, 14% of students reported suicidal thoughts and 1.6% suicide attempts (4). Moderate to severe levels of anxiety and depressive symptoms persist among university students, especially in the first year and the use of drugs seems to increase these risks (14). A longitudinal study of students on entry showed clinically significant depressive symptoms (28%) and anxiety symptoms (33%) which increased to 36 and 39%, respectively, by the end of the first year (4).

The high prevalence of toxic stress, anxiety, depression, and substance use disorders can be attributed but not limited

to factors such as financial stressors, course workload, peer pressure, and other personal, family, and societal stressors (15). A survey of university students reported lack of money, time management, coursework assessment items, lack of sleep, and course marks as having a major impact on their mental health (16). The prevalence of anxiety seems to be much higher than either depression or stress (2), which can be explained by the uncertainties of life coupled with course workload. Depressive symptoms are significantly related to grade point average and examinations or tests (3, 13). Anxiety about examination generally results in depression, excessive worry, and stress about the evaluation of tests and results (17). Anxiety can also be a result of socioeconomic factors or family factors (13). Financial stressors also contribute immensely to the mental health burden and a cross-sectional survey suggest that there are significantly higher stress scores among students whose family had low incomes (2).

The risk of alcohol or drug use among university students is also due to the substantial changes occurring in their lives, including social factors, peer, teachers, or parent's pressure (18). A cross-sectional study of university students in Nigeria showed that nearly 4.2% were dependent on alcohol, while 14.1% had "low-risk use" for other psychoactive substances (19). In another study conducted in Switzerland, a slightly higher percentage (20%) of university students reported increased alcohol consumption and 26% engaged in binge drinking (20).

In contrast to the wide availability of psychotropic medications for the treatment of mental disorders (21), psychological treatment services are usually limited or completely unavailable. Barriers to access alongside inadequate resources have contributed to the limitations in providing or making these services available to patients with mental illness, thus creating a therapeutic gap.

Mounting evidence report the global lack of mental health professionals, including therapists, particularly in remote areas and rural communities in addition to the costly and resource-intensive nature of the conventional supportive services (21–25). Besides, there are other personal beliefs and culture-based factors such as the stigma or discrimination barriers emerging from the social or professional circles surrounding the patients that may limit the accessibility to these services and may further contribute to enlarging the therapeutic gap (21–25).

A large body of literature, therefore, has suggested that remotely delivered services could be comparable to face-to-face services and effective in addressing mental health conditions (23, 26). These services have been recently adopted in the healthcare system allowing for the use of technology and the internet to either communicate with a healthcare provider or instead to deliver the health services and information

TABLE 1 Description of the ResilienceNHope suite of programs.

Program	Organization/date launched	Province/country	Program description
Text4Mood (35)	Alberta Health Services, 2016	Alberta	Address stigma, long waitlists, and geographical barriers to access to counseling services for anxiety and depression. The program was recognized by the Mental Health Innovations Networks which is headquartered at the Department of Mental Health and Substance Abuse of the World Health Organization. Over 25,000 As at the end of February 2022,
Text4Support (36)	Alberta Health Services, January 2018 Scheduled for launch by Nova Scotia Health Authority and Dalhousie University as part of a clinical trial in July 2022	Alberta and Nova Scotia	Provides mental health diagnosis specific supportive text messages to addiction and mental health patients who are receiving formal face-to-face mental health services. Programs under Text4Support include Depression Program, Anxiety Program, Bipolar Program, Psychosis Program, Addiction Program, Trauma Program, Personality Disorders Program, Eating Disorders Program, and an Obsessive-Compulsive Disorders Program.
Text4Hope (37)	Alberta Health Services, March 2021	Alberta and British Columbia, Canada	Provide support for individuals experiencing stress, anxiety, and depression because of the COVID-19 pandemic. Available in English, French, Punjabi, Mandarin and Arabic, Text4Hope has had over 55,000 subscribers as at the end of February 2022
Text4Hope Addiction Support (38).	Alberta Health Services, March 2021	Alberta, Canada	To provide addiction related supportive text messages for individuals dealing with addiction problems during the COVID pandemic
Text4Hope Cancer Care (39).	Alberta Health Services, March 2021	Alberta, Canada	to provide psychological support for patients undergoing cancer treatments during the COVID pandemic
Text4PTSI (40).	University of Alberta, June 2021	Alberta, Canada	Provide psychological support for first responders experiencing post-traumatic stress injury symptoms
MoreGoodDays (41)	Alberta Kickstand, June 2020	Alberta, Canada	Provide psychological support for the youth and young adults. Messages are crafted by young people and reviewed by a clinical team.
Positive Mental Health Program (33)	Global Psychological eHealth Foundation. Scheduled for launch as a global program in December 2022	Worldwide	School/college and workplace based mental health literacy and supportive email and voice messaging program
Wellness4Teachers (42)	Global Psychological eHealth Foundation. Scheduled to be launched in September 2022	Alberta and Nova Scotia Canada	Provide psychological support for teachers experiencing symptoms of burnout, stress, anxiety and depression
ResilienceNHope4Ukraine (43)	Global Psychological eHealth Foundation, March 2022	Canada	Provide psychological support for Canadian experiencing symptoms of stress, anxiety and depression and PTSD because of the war in Ukraine. The program is available in English, French, Ukrainian and Russian languages.

via mobile devices such as smartphones using SMS, MSS, mobile, or web applications (27–30). The provision of easily accessible interventions that require the patients to use an app or internet program with no human interaction was compared against therapist involvement in an intervention (27, 31). Phone chat or texting was the preferred mode of communication among adolescents with their physicians, compared to face-to-face (32). Adolescents usually report more convenience with reduced anxiety and effective communication. Therefore, the growing spread of such wireless services in the healthcare system has become more reasonable among young adults.

## ResilienceNHope

ResilienceNHope (33) is an evidence-informed e-mental health application which delivers one-way (non-interactive) psychological interventions which incorporate cognitive behavioral therapy based on daily supportive messages (mobile text or email), weekly mental health literacy information, online mental health self-assessments, and other mental health resources to help address part of the mental health literacy and the mental health treatment gap for individuals and communities globally. Subscribers are informed of the non-interactive nature of the supportive messaging program through the welcome and introductory messages they receive on subscribing to the program. They are also offered the phone number of the mental health crisis service for their province or region to call if they are in crisis, such as if they experience suicidal ideation. In addition to the English programs, ResilienceNHope mobile text-based program include Arabic, French, Punjabi, Mandarin, Ukrainian, and Russian languages (34) and can easily be adapted to other languages. Both the email and text message programs aim to support regional and national health authorities and institutions seeking to implement evidence-based, cost-effective, and easily scalable population-level e-mental health programs. The current suite of programs includes Text4Mood, Text4Support, Text4Hope, Text4HopeAddiction Support, Text4Hope Cancer Care, Text4PTSI, MoreGoodDays, Positive Mental Health, ResilienceNHope4Ukraine, and Wellness4Teachers as described in Table 1.

## Scientific evidence in support of the efficacy and effectiveness of ResilienceNHope messaging programs

ResilienceNHope text-based messaging programs have provided evidence as cost-effective and easily scalable programs

designed to provide psychological support for individuals with various mental health conditions, including alcohol abuse, Major Depressive Disorder (MDD), Generalized Anxiety Disorder (GAD), perceived stress, Post Traumatic Stress Disorder (PTSD), sleep disorder symptoms, suicidal ideations and thoughts of self-harm, and comorbid conditions. Besides the reported effectiveness, the service has achieved expansive reachability along with the reported satisfaction among the subscribers. The text-based programs have further facilitated surveillance of mental health conditions among subscribers who are mostly mental health and addiction patients and the general public who provide serial online surveys which include questions accessing the presence of mental health symptoms.

In the following section, we will highlight the utility of the ResilienceNHope text-based programs, evidence of their effectiveness, and the potential applicability of the programs to help close the mental health treatment gap among college students.

## Drug/alcohol abuse

- A randomized controlled trial (RCT) (44) was conducted involving 59 patients with alcohol use disorders (AUD) who completed a residential addiction treatment program in Grande Prairie, Alberta, Canada. Patients in the intervention group ( $n = 29$ ) received daily automated unidirectional, non-interactive supportive text messages crafted based on addiction counseling principles and sent through an online program to the patients' cell phones for 3 months following discharge. Patients in the control group ( $n = 30$ ) received a text message thanking them for participating in the study. A trend was observed in the intervention group to have more than double the mean number of days to their first drink after discharge from the residential treatment program, compared to the control group (60 vs. 26 days respectively, mean difference: 34.97; 95% CI:  $-5.87-75.81$ ). Small to moderate effects were found for Cumulative Abstinence Duration (CAD) and units of alcohol per drinking day. Small to negligible effects were found for health utilization. On subgroup analyses, the participants who received text messages, among those who did not attend follow-up outpatient counseling, showed a longer CAD. Additionally, patients with alcohol use disorder who received text messages had a trend toward recording larger cumulative alcohol abstinence in days.
- In another study (45), the authors examined the PTSD symptoms and its mental health associates in the residents of a Canadian community of Fort McMurray, 6 months after enduring a wildfire that forced over 90,000 residents



to evacuate after the fire consumed about 2,400 homes and over 200,000 ha of forest. The authors found that the respondents who presented with likely PTSD after the wildfire were significantly more likely to self-report increased drug abuse (8.1 vs. 2.1,  $p = 0.02$ ), but not increased alcohol use (16.4 vs. 11.4%,  $p = 0.3$ ), compared with respondents who did not have likely PTSD.

- In an ongoing research work (38), the authors have implemented a program of daily supportive text messaging (Text4Hope-Addiction Support) to reduce drug or alcohol cravings as well as anxiety and depression, typically associated with alcohol and substance use disorders. The authors evaluated the prevalence of cravings, anxiety, and depressive symptoms; demographic correlates of the same; and the outcomes of the Text4Hope-Addiction Support intervention in mitigating cravings, anxiety, and depressive symptoms during the COVID-19 pandemic. Preliminary unpublished data reveal a significant reduction in craving intensity, craving frequency, and length of time craving drugs, after receiving a 3-month daily supportive text message (Text4Hope-Addiction support), as reported on the Brief Substance Craving Scale ( $n = 67$ ).

## Major depressive disorder

- In an RCT involving 73 patients diagnosed with MDD, patients in the intervention group ( $n = 35$ ) received twice-daily supportive text messages for 3 months as part of their outpatient treatment, while the control group ( $n = 38$ ) received a single thank-you message every fortnight (46). Patients in the intervention group (20.8; SD = 11.7) had a significant greater reduction (25%) in their depressive symptom on BDI scores compared to patients in the control group (24.9; SD = 11.5),  $F(1, 60) = 4.83$ ,  $p = 0.03$ ,  $\eta^2 = 0.07$ , with a medium effect size Cohen's  $d = 0.67$  (47). Furthermore, after adjusting for baseline scores, a significant difference remained in the 3-month mean self-rated VAS scores (EQ-5D-5 L scale) between the intervention and control groups, 65.7 (SD = 15.3) vs. 57.4 (SD = 22.9),  $F(1, 60) = 4.16$ ,  $p = 0.05$ ,  $\eta^2 = 0.065$ . The mean difference in change means self-rated VAS scores were also statistically significant with an effect size (Cohen's  $d$ ) of 0.51.
- Early in the COVID-19 pandemic, Text4Hope, a service that used supportive SMS text messaging as an evidence-based, with prior research supporting good outcomes and high user satisfaction to reduce distress related to the COVID-19 crisis, initially among Canadians (37).
- After 3 months, there was a significant reduction (10.3%) in likely depressive symptoms on the Patient Health Questionnaire-9 scale score from baseline (9.32; SD =

6.23) to 3 months (8.36; SD = 6.62) ( $t(301) = 3.16$ ,  $p = 0.002$ ) (48).

- Similarly, subscribers of Text4Hope who had been enrolled for 6 weeks (Intervention Group) had a significantly lower prevalence of depression compared to new subscribers during the same time period (Control Group) (36.8 vs. 52.1%, respectively) (49). After controlling for demographic variables, subscribers in the intervention group remained less likely to self-report symptoms of MDD (OR = 0.50; 95% CI = 0.47–0.73), compared to the subscribers in the control group.

## Comorbid MDD and AUD

- In an RCT, patients with AUD and comorbid depression ( $n = 95$ ) were recruited after completing a 30-day rehabilitation program. The intervention group ( $n = 47$ ) received twice-daily supportive text messages over 6 months while control participants ( $n = 48$ ) had treatment as usual for 6 months, with an added 6-month post-treatment follow-up for both groups. At 3 months, depression ( $P = 0.02$ ) and perceived stress scores ( $P < 0.01$ ) were significantly reduced in the intervention group relative to control participants with small to medium effect. A significantly greater reduction in units per drinking day ( $U = 494$ ,  $P = 0.03$ ,  $r = -0.3$ ) from baseline to 6-month treatment point was reported in the intervention group, compared to the control group with a medium effect size ( $P = 0.03$ ). There were no differences in drinking or mood measures at 6-month post-treatment follow-up (50). This may highlight the value of the continuity and sustainability of texting-based programs to ensure improved mental health.
- Another RCT aimed to explore the effects of supportive text messages on mood and abstinence outcomes for patients with depression and co-morbid AUD. The participants ( $n = 54$ ) with a DSM-IV diagnosis of unipolar depression and AUD who completed an in-patient dual diagnosis treatment program were randomized to receive twice-daily supportive text messages ( $n = 26$ ) or a fortnightly thank you text message ( $n = 28$ ) for 3 months. At 3 months (51), there was a statistically significant difference in depression symptoms as measured on BDI-II scale scores between the intervention and control groups; after adjusting for the baseline scores, with a mean difference of  $-7.9$  (95% CI:  $-13.06$  to  $-2.76$ , Cohen's  $d = 0.85$ ). Additionally, there was a trend for a greater CAD in the text message group than the control group: 88.3 (SD = 6.2) vs. 79.3 (SD = 24.1),  $t = 1.78$ ,  $df = 48$ ,  $p = 0.08$ .

At 6 months, which was 3 months after the cessation of the texts, the results of the same study showed unlike at 3 months,

there was no statistically significant difference in BDI-II scores or CAD between the text message group and the control group. However, patients in the intervention group had significantly higher days to first drink compared to those in the control group: 119.9 (47.7) vs. 62.4 (44.9),  $t = 2.99$ ,  $df = 22$ ,  $p = 0.01$  (52).

## Generalized anxiety disorder (GAD)

- The positive impact of the daily supportive texting service, Text4Hope, on anxiety symptoms, was reported at the mid-point and end of the program as follows: there was a significant reduction ( $-18.7\%$ ,  $p < .001$ ) in the Generalized Anxiety Disorder-7 (GAD-7) scale's measured mean anxiety symptom score from baseline (mean = 9.62, SD = 5.6) to 6 weeks (mean = 7.82, SD = 5.2) after receiving daily supportive messages, with a small effect size (Cohen  $d$ : 0.4) (53). Furthermore, the prevalence of likely generalized anxiety disorder (GAD) among subscribers was significantly reduced at 6 weeks compared to the baseline figures (45.8 vs. 32.3%, respectively).

Similar results were obtained at 3 months with a 22.7% reduction in the GAD-7 score from baseline (mean = 9.07, SD = 6.02) to 3 months (mean = 7.01, SD = 5.84) (48).

- The effectiveness of Text4Hope in combating mental health symptoms was evaluated in a comparative study, by comparing psychiatric parameters between two subscriber groups. The first group was the Text4Hope subscribers who received daily texts for 6 weeks (intervention group), while the second group was the new Text4Hope subscribers who were yet to receive messages (control group). The results revealed that the intervention group had a significantly lower prevalence of anxiety compared to the Control Group (31.4 vs. 46.5%, respectively) (49). Furthermore, the subscribers belonging to the intervention group remained less likely to self-report symptoms of likely GAD (OR = 0.55; 95% CI = 0.44–0.68), after controlling for demographic variables.

## Stress

Similar to the examined GAD symptoms, stress symptoms were examined through the Text4Hope initiative, as follows:

- There was a significant reduction in stress symptoms as measured by the Perceived Stress Scale (PSS-10) ( $-18.7\%$ ,  $p < 0.001$ ) from baseline (mean = 20.35, SD = 6.7) to 6

weeks (mean = 19.51, SD = 7.0) (53), and when compared to 3 months, there was a 5.7% reduction in the PSS-10 score from baseline (mean = 20.21, SD = 7.23) to 3 months (mean = 19.07, SD = 7.74) (48). Likewise, stress prevalence among subscribers was significantly reduced at 6 weeks (5.4%) and 3 months (6.9%), compared to baseline data.

- In the aforementioned comparative study, the intervention group had a significantly lower prevalence of moderate or high stress compared to the Control Group (78.8 vs. 88.0, respectively), and the subscribers belonging to the intervention group remained less likely to self-report symptoms of stress (OR = 0.56; 95% CI = 0.41–0.75), after controlling for demographic variables (49).

## Suicidal thoughts

In the same comparative study, which was run to evaluate the effectiveness of Text4Hope, 6 months after launching the service, the subscribers in the intervention group showed a significantly lower prevalence of suicidal thoughts and self-harm ideas, compared to the control group (subscribers who were yet to receive supportive text messages) (16.9 vs. 26.6%, respectively) (49). Furthermore, intervention group subscribers remained less likely to self-report symptoms of suicidal thoughts and self-harm (OR = 0.59; 95% CI = 0.45–0.77), after controlling for demographic variables (49).

## Sleep symptoms

In the same comparative study, the intervention group had a lower prevalence of disturbed sleep compared to the control group (76.9 vs. 85.1%, respectively), although this was not statistically significant after Bonferroni correction ( $p = 0.02$ , which is larger than the adjusted  $p = 0.01$ ) (49).

## Other evidence in supporting text messaging or email applications

Text messages are a current platform that incorporates technology into the healthcare system, spanning a wide range of health conditions and playing different roles. Text messages are used as a reminder of medical appointments (54) or to encourage adherence to prescribed medications (55). Supportive texting programs, such as Text2quit and Quit4baby, have been provided to people in the field of addiction and smoking, particularly during their vulnerability, achieving considerable success. Text4baby was provided to pregnant women and new mothers aiming to improve their health beliefs and

attitudes (56, 57) and Text2quit was provided to adults and pregnant women to quit smoking (58, 59). Favorable response to these programs have been reported praising the content and the skills taught that helped them with positive ideas on quitting, to the extent that they may recommend it to a friend.

In the field of addiction and drug use, several studies examined the effect of text messages with reported efficacy and feasibility for such programs in combating drug and alcohol-related problems in young people. For example, Mason, Ola et al. (60), in their meta-analysis, aimed to examine the effectiveness of text message interventions for tobacco and alcohol cessation within adolescent and young adult populations. A total of 14 RCT studies were examined, and the authors reported an overall effect size of 0.25, concluding while the effect sizes varied among the studies, approximately one in three people in the treatment groups reduced their tobacco or alcohol use, compared to people in control groups. This indicated that text interventions have a positive effect on reducing substance use behaviors among the young population, and the prevention of SUD and smoking could be enhanced *via* texting services.

In another systematic review, Hutton, Prichard et al. (61) examined 15 articles regarding the effect of mobile-based health interventions (mHealth), such as social networking sites, SMS, and mobile phone applications on reducing harmful alcohol-related behaviors. Their target population was young people aged between 12 and 26 years, without known alcohol addiction or alcohol dependency. The authors reported that the service was effective in reducing alcohol consumption in 50% of their studies, with above 70% in text messages-based studies. Furthermore, the authors reported that young people liked personalized messaging that helped in an effective way to convey supportive services; and concluded that the use of mHealth, particularly text messaging, was found to be an affordable, acceptable, and effective way to deliver messages to reduce alcohol consumption in young people. With respect to the text-based and online services in the field of psychosis and schizophrenia, several studies reported positive results related to the efficacy, better engagement, and feasibility of these interventions. For example, in a recent systematic review run by D'Arcey, Collaton et al. (62), the authors concluded that text messages were generally safe, feasible, easy to use, and wellperceived as reported by more than half of the study participants. Additionally, the authors reported that text messages can leverage patients' engagement in terms of improving clinic attendance, better adherence to medications, and therapeutic alliance.

In another systematic review examining both the online and mobile-based interventions, Alvarez-Jimenez, Alcazar-Corcoles et al. (29) indicated that both interventions may show promise in improving positive psychotic symptoms among patients

with schizophrenia-spectrum disorders. The authors reported that such interventions, particularly mobile-based, may help to monitor early relapse signs that may reduce hospital admissions. Additionally, they noticed that tailored text-based interventions were found to be associated with improved symptomatology in terms of reduced hallucination severity and improved sociability but not functional outcomes.

Similarly, several studies examined texting services in addressing depression and mental health conditions or symptoms either alone or in association with anxiety and suicidal symptoms.

In a systematic review by Cox, Allida et al. (24), the authors aimed to examine text messaging interventions in people with depressive symptoms. The review included seven trials in their review with 1,918 participants. The authors concluded that there is a significant effect of text messages in reducing depressive symptom scores, however, due to the substantial heterogeneity (high inconsistency in results), the effect was described as borderline. Considering depression as a primary outcome in this review, the sensitivity analysis reported a statistically significant reduction in depressive symptoms with a low heterogeneity in the intervention group compared to the control group at the end of treatment (SMD,  $-0.30$ ; 95% CI,  $-0.53$  to  $-0.08$ ;  $I^2 = 23\%$ ). Similar results were obtained while considering trials using standard depression rating scales. The review also concluded that the effectiveness of text messages in reducing depressive symptoms was achieved when two or more messages were sent per week, while a lower number may not produce a significant effect.

In another scoping review, Dwyer, de Almeida Neto et al. (63) reported on text messages in adjunction with other e-mental health as counseling services. The authors concluded that there is converging evidence that text-based counseling services and interventions are effective in treating a variety of mental health conditions, such as depression, suicidal ideation, or anxiety, particularly when patients with depression are comfortable with online communication. With respect to text-based counseling, it was found to be effective in treating depression and psychological distress, and the communications analyzed using computational linguistic techniques can be applied to identify individuals at risk of serious mental health or suicide (63).

To examine the use of text messaging-based interventions and identify technological and clinical design features of these interventions in the young population, MacDougall, Jerrott et al. (32) in their scoping review examined the literature for text-based services in mental health among children and adolescents. The authors included 31 studies providing data related to the nature, frequency, and targeted assessments of text-based services in the field of mental health. The authors observed that patients' engagement was the main outcome measure in the majority of the studies. Regarding the frequency of the interventions, it seems that a smaller number and

less frequency of text messages were provided to the younger population compared to the adults, where the authors reported that text messages were usually delivered in less than 12 weeks with a range between one to three messages per week. With respect to the clinical condition, the two main targeted mental health conditions were substance use or problem drinking (35% of the studies) and depression in adolescents (32% of the studies). Most studies reported the use of bidirectional messaging system (65% of the studies), with limited data on the cost or policy implications.

## Feasibility for implementing ResilienceNHope messaging programs among college students

ResilienceNHope service has the potential to expand along the young population, including college students. The evidence based on the outcomes of the service has flagged out the high risk in the young population of experiencing mental health symptoms, such as, anxiety, Post-traumatic stress disorder (PTSD), and passive death wish and thoughts of self-harm, particularly during the COVID-19 pandemic (64–66). Izu et al. (67) compared the prevalence and the severity of different mental health conditions among Text4Hope subscribers, based on their age groups. The authors reported that 11% of the total survey respondents ( $n = 8,267$ ) were identified as 25-year-olds or less. The mean scores on the Perceived Stress Scale 10 (68), the Generalized Anxiety Disorder 7-item (69), and the Patient Health Questionnaire-9 scale (70) were highest among this young population and lowest among those aged >60 years (25.4 vs. 16.65, 12.23 vs. 6.35, 13.05 vs. 6.65, respectively). The authors proposed some explanations, such as the younger adults may be exposed to more information about the pandemic *via* social media or their loss of social connections with friends which may render them more vulnerable to mental distress. Such alarms lead to the development of MoreGoodDays program, one of the ResilienceNHope suite of a free daily text messaging service provided by Kickstand for the youth in Alberta (41). The service provides adolescents and young adults with a 1-year daily supportive text message. Although anyone can register for MoreGoodDays, the service is primarily aimed to support the young populations and promote their mental health and wellbeing. According to the latest reports, more than one half of MoreGoodDays subscribers are college students (138/263, 52.5%). The preliminary feedback is promising, the end users among adolescents and young adults usually report their acceptance and satisfaction and further seek service extension after 1 year. This led to the provision of a second version of the service that has enabled those who are interested to re-register to the service more than one time.

The feasibility, accessibility, and reachability domains of ResilienceNHope programs was achieved among young adults.

This was clearly reflected in the considerable representation of young people in the Text4Hope service. Given that the service was provided to everyone in Alberta, regardless of their age, at 1 year, there were 1,199 subscribers who identified as 25 years or less (11%), and 600, 5.7%, were students. Furthermore, the unpublished data for 1-year Text4Hope service showed that the subscribers who were  $\leq 25$  years achieved a better improvement (higher reduction) in the mean scores of likely stresses ( $-2.11$  vs.  $-1.30$ ) and likely GAD ( $-2.40$  Vs.  $-2.11$ ) as compared to those above 25 years, respectively, albeit the results were not statistically significant. Similarly, just less than a quarter of Text4Support, self-subscribers were young adults (18–24y) (36). Taken from these text-based services seem to be acceptable, accessible, and effective in young populations.

## Likely acceptability of ResilienceNHope messaging programs among college students: Subjective mental wellbeing and user satisfaction

Besides the reported clinical effectiveness of ResilienceNHope programs, the service has achieved an expansive acceptability and satisfaction among subscribers. To examine the perception and feedback of patients with AUD and comorbid depression about the usefulness of supportive text messages, a randomized trial was designed with participants who have a DSM-IV diagnosis of AUD and depression ( $n = 26$ ), and who completed an in-patient dual diagnosis treatment program were provided with twice-daily supportive text messages delivered to their mobile phones for 3 months (71). At 3 months, 18 (75%) patients reported that the text messages always or often reminded them to remain abstinent from alcohol. Twenty (83%) patients reported that the intervention had played a useful role in helping to improve their mental health, in particular, in serving as a motivation for recovery and in preventing relapse.

Subscribers of Text4Mood program (text-based program that delivers daily supportive text messages to subscribers was launched in 2016) ( $n = 894$ ) reported that daily supportive messages made them feel more hopeful about managing issues in their lives (82 %,  $n = 588$ ), in charge of managing depression and anxiety (77 %,  $n = 552$ ), coping with stress (77 %,  $n = 552$ ), and feel connected to a support system (75 %,  $n = 542$ ). Most subscribers also reported that Text4Mood improved their overall mental wellbeing (83 %,  $n = 598$ ), made them feel like they could bounce back if they made a mistake (77 %,  $n = 554$ ), and 52% ( $n = 461$ ) reported that the daily messages helped them elevate their mood. Furthermore, most subscribers felt the daily messages were positive (98%), supportive (95%), on topic (88.5%), and to the point (87%) (72). Similar results

were obtained from Text4Hope service (the mental health service provided by health authorities in Alberta, Canada, to support the mental wellbeing and distress associated with the COVID-19 pandemic) (37). More than 70% of the subscribers agreed that Text4Hope helped them cope with stress (1334/1731, 77.1%) and anxiety (1309/1728, 75.8%), feel connected to a support system (1400/1729, 81%), manage COVID-19-related issues (1279/1728, 74%), and improve mental wellbeing (1308/1731, 75.6%). Similarly, subscribers agreed that messages were positive, affirmative, and succinct. Messages were always or often read by 97.9% (1681/1716) of respondents, and more than one in five (401/1716, 23.4%) reported that they always or often returned to messages. Most subscribers (1471/1666, 88.3%) read the messages and either reflected upon them or took a positive action (73). Furthermore, the subscribers were asked about their acceptance of technology-based services in supporting their health. Most subscribers welcomed almost all technology-based services as part of their health care (mental or physical), during crisis, or emergency situations (73).

## Conclusion

College students are confronted by multiple stressors and are therefore vulnerable to experiencing psychological disorders such as anxiety, depression, and substance use disorders. This notwithstanding, barriers such as stigma, lack of counseling services, long waitlists, and geographical barriers to access may hinder many college students from accessing psychological support. There is abundant evidence on the cost-effectiveness, scalability, and acceptability of e-mental health interventions, particularly supportive text and email interventions to address psychological distress and improve resilience and mental health literacy in youth and young adults. ResilienceNHope suite of text and email messaging programs has robust research evidence of effectiveness to reduce psychological treatment gaps at the population level, and may be effective in providing psychological support for college students globally. There is currently no other e-mental health program which specifically addresses youth mental health extensively and comprehensively and integrates mental health promotion, prevention, and intervention in one package, using youth-friendly delivery format. The components

of ResilienceNHope have been evaluated to be effective and it is time to combine them into a more accessible package for further advanced evaluation among college students who experience significant transitions into early adulthood.

## Author contributions

BA and RS drafted the initial manuscript. All authors reviewed and revised the manuscript and approved the final version for submission.

## Funding

The ResilienceNHope research programs are funded by the Alberta Mental Health Foundation and the Royal Bank of Canada Foundation.

## Conflict of interest

VIOA is the founder and Principal Investigator of the ResilienceNHope messaging programs. VIOA is the Board Chair of the Global Psychological eHealth Foundation a not-for profit organization. BA is the President and Chief Executive Officer of the Global Psychological eHealth Foundation. VIOA and BA have no financial conflicts of interests in relation to this article.

The remaining authors declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

- Shah K, Mann S, Singh R, Bangar R, Kulkarni R. Impact of COVID-19 on the mental health of children and adolescents. *Cureus*. (2020) 12:e10051. doi: 10.7759/cureus.10051
- Shamsuddin K, Fadzil F, Ismail WS, Shah SA, Omar K, Muhammad NA, et al. Correlates of depression, anxiety and stress among Malaysian university students. *Asian J Psychiatr*. (2013) 6:318–23. doi: 10.1016/j.ajp.2013.01.014
- Chen CJ, Chen YC, Sung HC, Hsieh TC, Lee MS, Chang CY. The prevalence and related factors of depressive symptoms among junior college nursing students: a cross-sectional study. *J Psychiatr Ment Health Nurs*. (2015) 22:590–8. doi: 10.1111/jpm.12252
- Duffy A, Keown-Stoneman C, Goodday S, Horrocks J, Lowe M, King N, et al. Predictors of mental health and academic outcomes in first-year university students: identifying prevention and early-intervention targets. *BJPsych Open*. (2020) 6:e46. doi: 10.1192/bjo.2020.24
- Iqbal S, Gupta S, Venkatarao E. Stress, anxiety and depression among medical undergraduate students and their socio-demographic correlates. *Indian J Med Res*. (2015) 141:354–7. doi: 10.4103/0971-5916.156571



6. Moutinho IL, Maddalena NC, Roland RK, Lucchetti AL, Tibirica SH, Ezequiel OD, et al. Depression, stress and anxiety in medical students: a cross-sectional comparison between students from different semesters. *Rev Assoc Med Bras*. (2017) 63:21–8. doi: 10.1590/1806-9282.63.01.21
7. Chang W-w, Shi L-x, Zhang L, Jin Y-l, Yu J-g. The mental health status and associated factors among medical students engaged in online learning at home during the pandemic: a cross-sectional study from China. *Front Psychiatry*. (2021) 12:755503. doi: 10.3389/fpsy.2021.755503
8. Gallo LA, Gallo TE, Young SL, Moritz KM, Akison LK. The impact of isolation measures due to COVID-19 on energy intake and physical activity levels in Australian university students. *Nutrients*. (2020) 12:1865. doi: 10.1101/2020.05.10.20076414
9. Crow J, Murray JA. Online distance learning in biomedical sciences: community, belonging and presence. *Adv Exp Med Biol*. (2020) 1235:165–78. doi: 10.1007/978-3-030-37639-0\_10
10. Lemay DJ, Bazelaïs P, Doleck T. Transition to online learning during the COVID-19 pandemic. *Comput Hum Behav Rep*. (2021) 4:100130. doi: 10.1016/j.chbr.2021.100130
11. Li Y, Zhao J, Ma Z, McReynolds LS, Lin D, Chen Z, et al. Mental health among college students during the COVID-19 pandemic in China: a 2-wave longitudinal survey. *J Affect Disord*. (2021) 281:597–604. doi: 10.1016/j.jad.2020.11.109
12. Hajduk M, Dancik D, Januska J, Strakova A, Turcek M, Heretik A, et al. Depression and anxiety among college students in Slovakia—comparison of the year 2018 and during COVID-19 pandemic. *Bratisl Lek Listy*. (2022) 123:44–9. doi: 10.4149/BLL\_2022\_007
13. Othman N, Ahmad F, El Morr C, Ritvo P. Perceived impact of contextual determinants on depression, anxiety and stress: a survey with university students. *Int J Ment Health Syst*. (2019) 13:17. doi: 10.1186/s13033-019-0275-x
14. Adams KL, Saunders KE, Keown-Stoneman CDG, Duffy AC. Mental health trajectories in undergraduate students over the first year of university: a longitudinal cohort study. *BMJ Open*. (2021) 11:e047393. doi: 10.1136/bmjopen-2020-047393
15. Auerbach RP, Mortier P, Bruffaerts R, Alonso J, Benjet C, Cuijpers P, et al. WHO World mental health surveys international college student project: prevalence and distribution of mental disorders. *J Abnorm Psychol*. (2018) 127:623–38. doi: 10.1037/abn0000362
16. Rubin M. Explaining the association between subjective social status and mental health among university students using an impact ratings approach. *SN Soc Sci*. (2021) 1:20. doi: 10.1007/s43545-020-00031-3
17. Rehman F, Saeed I, Khan NF, Shahzad H, Janjuas AR, Ajanal Z. Measuring the level of examination anxiety among students in a private medical college in Lahore. *P J M H S*. (2018) 12:1084–7.
18. Maccombs-Hunter S, Bhat, CS. Exploring psychological distress and impulsivity as predictors of undergraduate problematic alcohol use. *J Addict Offender Couns*. (2022) 43:111–24. doi: 10.1002/jaoc.12111
19. James BO, Thomas IF, Omoaregba JO, Okogbenin EO, Okonoda KM, Ibrahim AW, et al. Psychosocial correlates of perceived stress among undergraduate medical students in Nigeria. *Int J Med Educ*. (2017) 8:382–8. doi: 10.5116/ijme.59c6.3075
20. Zysset A, Volken T, Amendola S, von Wyl A, Dratva J. Change in alcohol consumption and binge drinking in university students during the early COVID-19 pandemic. *Front Public Health*. (2022) 10:854350. doi: 10.3389/fpubh.2022.854350
21. WHO. The World Health Report. *Mental Disorders Affect One in Four People*. (2001). Available online at: <https://www.who.int/news/item/28-09-2001-the-world-health-report-2001-mental-disorders-affect-one-in-four-people> (accessed December 6, 2021).
22. Statistics Canada. *Health Fact Sheets, Mental Health Care Needs*. (2018). Available online at: <https://www150.statcan.gc.ca/n1/pub/82-625-x/2019001/article/00011-eng.htm> (accessed June 17, 2020).
23. Moroz N, Moroz I, D'Angelo MS. Mental health services in Canada: barriers and cost-effective solutions to increase access. *Healthc Manag Forum*. (2020) 33:282–7. doi: 10.1177/0840470420933911
24. Cox KL, Allida SM, Hackett ML. Text messages to reduce depressive symptoms: Do they work and what makes them effective? A systematic review. *Health Educ J*. (2021) 80:253–71. doi: 10.1177/0017896920959368
25. Solutions S. *Top 5 Barriers to Mental Healthcare Access*. (2021) 6:2021. Available online at: <https://www.socialsolutions.com/blog/barriers-to-mental-healthcare-access/> (accessed December).
26. Rodriguez-Pulido F, Castillo G, Hamrioui S, Martin LD, Vazquez-Beltran P, de la Torre-Diez I, et al. Treatment of depression in primary care with computerized psychological therapies: systematic reviews. *J Med Syst*. (2020) 44:67. doi: 10.1007/s10916-020-1543-7
27. Jimenez-Molina A, Franco P, Martinez V, Martinez P, Rojas G, Araya R. Internet-based interventions for the prevention and treatment of mental disorders in Latin America: a scoping review. *Front Psychiatry*. (2019) 10:664. doi: 10.3389/fpsy.2019.00664
28. SAMHSA. Substance Abuse and Mental Health Services Administration (SAMHSA). *Telehealth for the Treatment of Serious Mental Illness and Substance Use Disorders*. (2021). Available online at: [https://store.samhsa.gov/sites/default/files/SAMHSA\\_Digital\\_Download/PEP21-06-02-001.pdf](https://store.samhsa.gov/sites/default/files/SAMHSA_Digital_Download/PEP21-06-02-001.pdf) (accessed December 6, 2021).
29. Alvarez-Jimenez M, Alcazar-Corcoles MA, Gonzalez-Blanch C, Bendall S, McGorry PD, Gleeson JF. Online social media and mobile technologies for psychosis treatment: a systematic review on novel user-led interventions. *Schizophr Res*. (2014) 156:96–106. doi: 10.1016/j.schres.2014.03.021
30. Gliddon E, Barnes S, Murray G, Michalak E. Online and mobile technologies for self-management in bipolar disorder: a systematic review. *Psychiatr Rehabil J*. (2017) 40:309–19. doi: 10.1037/prj0000270
31. Kumar V, Sattar Y, Bseiso A, Khan S, Rutkowsky IH. The effectiveness of internet-based cognitive behavioral therapy in treatment of psychiatric disorders. *Cureus*. (2017) 9:e1626-e. doi: 10.7759/cureus.1626
32. MacDougall S, Jerrott S, Clark S, Campbell LA, Murphy A, Wozney L. Text message interventions in adolescent mental health and addiction services: scoping review. *JMIR Mental Health*. (2021) 8:e16508-e. doi: 10.2196/16508
33. Resiliencenhope Suite of Supportive Text Messaging Programs Reduce Stress, Anxiety and Depression (2021). Available online at: <https://www.youtube.com/watch?v=KmaPyjCNtio> (accessed February 1, 2022).
34. AHS Expands Text4Hope in Multiple Languages. Available online at: <https://www.albertahealthservices.ca/news/Page16337.aspx#:~:text=EDMONTON%20%E2%80%93%20Alberta%20Health%20Services%20AHS.with%20mental%20health%20related%20issues> (accessed February 1, 2022).
35. Text4Mood. Available online at: <https://www.mhinnovation.net/innovations/text4mood> (accessed February 1, 2022).
36. Noble JM, Vuong W, Surood S, Urchuk L, Greenshaw AJ, Agyapong VIO. Text4Support mobile-based programming for individuals accessing addictions and mental health services-retroactive program analysis at baseline, 12 weeks, and 6 months. *Front Psychiatry*. (2021) 12:640795. doi: 10.3389/fpsy.2021.640795
37. Agyapong VIO, Hrabok M, Vuong W, Gusnowski A, Shalaby R, Mrklas K, et al. Closing the psychological treatment gap during the COVID-19 pandemic with a supportive text messaging program: protocol for implementation and evaluation. *JMIR Res Protoc*. (2020) 9:e19292. doi: 10.2196/19292
38. Agyapong VIO, Hrabok M, Vuong W, Gusnowski A, Shalaby R, Surood S, et al. implementation and evaluation of a text message-based addiction counseling program (Text4Hope-addiction support): protocol for a questionnaire study. *JMIR Res Protoc*. (2020) 9:e22047. doi: 10.2196/22047
39. Agyapong VIO, Hrabok M, Shalaby R, Mrklas K, Vuong W, Gusnowski A, et al. Closing the COVID-19 psychological treatment gap for cancer patients in Alberta: protocol for the implementation and evaluation of Text4Hope-cancer care. *JMIR Res Protoc*. (2020) 9:e20240. doi: 10.2196/20240
40. Obuobi-Donkor G, Eboreime E, Bond J, Phung N, Eyben S, Hayward J, et al. An E-mental health solution to prevent and manage posttraumatic stress injuries among first responders in Alberta: protocol for the implementation and evaluation of text messaging services (Text4PTSI and Text4Wellbeing). *JMIR Res Protoc*. (2022) 11:e30680. doi: 10.2196/30680
41. More Good Days. Available online at: <https://mykickstand.ca/online-care#more-good-days> (accessed February 1, 2022).
42. Agyapong B, Wei Y, da Luz Dias R, Agyapong VIO. Burnout and associated psychological problems among teachers and the impact of the wellness4teachers supportive text messaging program: protocol for a cross-sectional and program evaluation study. *JMIR Res Protoc*. (2022) 11:e37934. doi: 10.2196/37934
43. Mental Health Foundation. *Hope4Ukraine: a Text-Based Mental Health Resource for Canadians*. Edmonton: Mental Health Foundation (2022).
44. Agyapong VIO, Juhas M, Mrklas K, Hrabok M, Omeje J, Gladue I, et al. Randomized controlled pilot trial of supportive text messaging for alcohol use disorder patients. *J Subst Abuse Treat*. (2018) 94:74–80. doi: 10.1016/j.jsat.2018.08.014
45. Agyapong VIO, Juhas M, Omeje J, Denga E, Nwaka B, Akinjise I, et al. Prevalence rates and correlates of likely post-traumatic stress disorder in residents of fort McMurray 6 months after a wildfire. *Int J Ment Health Addict*. (2019) 19:632–50. doi: 10.26226/morressier.5a6ef3efd462b80290b58682

46. Agyapong VIO, Mrklas K, Suen VYM, Rose MS, Jahn M, Gladue I, et al. Supportive text messages to reduce mood symptoms and problem drinking in patients with primary depression or alcohol use disorder: protocol for an implementation research study. *JMIR Res Protoc.* (2015) 4:e55-e. doi: 10.2196/resprot.4371
47. Agyapong VIO, Juhas M, Ohinmaa A, Omeje J, Mrklas K, Suen VYM, et al. Randomized controlled pilot trial of supportive text messages for patients with depression. *BMC Psychiatry.* (2017) 17:286. doi: 10.1186/s12888-017-1448-2
48. Agyapong VIO, Hrabok M, Shalaby R, Vuong W, Noble JM, Gusnowski A, et al. Text4Hope: receiving daily supportive text messages for 3 months during the COVID-19 pandemic reduces stress, anxiety, and depression. *Disaster Med Public Health Prep.* (2021) 16:1326–30. doi: 10.1017/dmp.2021.27
49. Agyapong VIO, Shalaby R, Hrabok M, Vuong W, Noble JM, Gusnowski A, et al. Mental health outreach via supportive text messages during the COVID-19 pandemic: improved mental health and reduced suicidal ideation after six weeks in subscribers of text4hope compared to a control population. *Int J Environ Res Public Health.* (2021) 18:2157. doi: 10.3390/ijerph18042157
50. O'Reilly H, Hagerty A, O'Donnell S, Farrell A, Hartnett D, Murphy E, et al. Alcohol use disorder and comorbid depression: a randomized controlled trial investigating the effectiveness of supportive text messages in aiding recovery. *Alcohol Alcohol.* (2019) 54:551–8. doi: 10.1093/alcac/agz060
51. Agyapong VI, Ahern S, McLoughlin DM, Farren CK. Supportive text messaging for depression and comorbid alcohol use disorder: single-blind randomised trial. *J Affect Disord.* (2012) 141:168–76. doi: 10.1016/j.jad.2012.02.040
52. Agyapong VI, McLoughlin DM, Farren CK. Six-months outcomes of a randomised trial of supportive text messaging for depression and comorbid alcohol use disorder. *J Affect Disord.* (2013) 151:100–4. doi: 10.1016/j.jad.2013.05.058
53. Agyapong VIO, Hrabok M, Vuong W, Shalaby R, Noble JM, Gusnowski A, et al. Changes in stress, anxiety, and depression levels of subscribers to a daily supportive text message program (Text4Hope) during the COVID-19 pandemic: cross-sectional survey study. *JMIR Mental Health.* (2020) 7:e22423. doi: 10.2196/22423
54. Gurrol-Urganci I, de Jongh T, Vodopivec-Jamsek V, Atun R, Car J. Mobile phone messaging reminders for attendance at healthcare appointments. *Cochrane Database Syst Rev.* (2013) 2013:CD007458. doi: 10.1002/14651858.CD007458.pub3
55. Välimäki M, Hätönen H, Adams CE. Mobilenet: mobile telephone text messages to encourage adherence to medication and to follow up with people with psychosis: methods and protocol for a multicenter randomized controlled two-armed trial. *JMIR Res Protoc.* (2012) 1:e8. doi: 10.2196/resprot.2136comparative study, the intervention
56. Evans WD, Wallace Bihm J, Szekely D, Nielsen P, Murray E, Abrams L, et al. Initial outcomes from a 4-week follow-up study of the Text4baby program in the military women's population: randomized controlled trial. *J Med Internet Res.* (2014) 16:e131. doi: 10.2196/jmir.3297
57. Abrams LC, Lee Westmaas J, Bontemps-Jones J, Ramani R, Mellerson J, A. content analysis of popular smartphone apps for smoking cessation. *Am J Prev Med.* (2013) 45:732–6. doi: 10.1016/j.amepre.2013.07.008
58. Abrams LC, Boal AL, Simmens SJ, Mendel JA, Windsor RA. A randomized trial of Text2Quit: a text messaging program for smoking cessation. *Am J Prev Med.* (2014) 47:242–50. doi: 10.1016/j.amepre.2014.04.010
59. Abrams LC, Johnson PR, Heminger CL, Van Alstyne JM, Leavitt LE, Schindler-Ruwisch JM, et al. Quit4baby: results from a pilot test of a mobile smoking cessation program for pregnant women. *JMIR Mhealth Uhealth.* (2015) 3:e10. doi: 10.2196/mhealth.3846
60. Mason M, Ola B, Zaharakis N, Zhang J. Text messaging interventions for adolescent and young adult substance use: a meta-analysis. *Prevent. Sci.* (2015) 16:181–8. doi: 10.1007/s11121-014-0498-7
61. Hutton A, Prichard I, Whitehead D, Thomas S, Rubin M, Sloand E, et al. mHealth interventions to reduce alcohol use in young people: a systematic review of the literature. *Compr Child Adolesc Nurs.* (2020) 43:171–202. doi: 10.1080/24694193.2019.1616008
62. D'Arcey J, Collaton J, Kozloff N, Voineskos AN, Kidd SA, Foussias G. The use of text messaging to improve clinical engagement for individuals with psychosis: systematic review. *JMIR Mental Health.* (2020) 7:e16993. doi: 10.2196/16993
63. Dwyer A, de Almeida Neto A, Estival D, Li W, Lam-Cassettari C, Antoniou M. Suitability of text-based communications for the delivery of psychological therapeutic services to rural and remote communities: scoping review. *JMIR Mental Health.* (2021) 8:e19478-e. doi: 10.2196/19478
64. Hrabok M, Nwachukwu I, Gusnowski A, Shalaby R, Vuong W, Surood S, et al. Mental health outreach via supportive text messages during the COVID-19 Pandemic: One-week Prevalence and Correlates of Anxiety symptoms. *Can J Psychiatry.* (2021) 66:59–61. doi: 10.1177/0706743720969384
65. Shalaby R, Adu MK, Andreychuk T, Eboreime E, Gusnowski A, Vuong W, et al. Prevalence, demographic, and clinical correlates of likely PTSD in subscribers of Text4Hope during the COVID-19 pandemic. *Int J Environ Res Public Health.* (2021) 18:6227. doi: 10.3390/ijerph18126227
66. Sapara A, Shalaby R, Osiogo F, Hrabok M, Gusnowski A, Vuong W, et al. COVID-19 pandemic: demographic and clinical correlates of passive death wish and thoughts of self-harm among Canadians. *J Ment Health.* (2021) 30:170–8. doi: 10.1080/09638237.2021.1875417
67. Nwachukwu I, Nkire N, Shalaby R, Hrabok M, Vuong W, Gusnowski A, et al. COVID-19 pandemic: age-related differences in measures of stress, anxiety and depression in Canada. *Int J Environ Res Public Health.* (2020) 17:6366. doi: 10.3390/ijerph17176366
68. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* (1983) 24:385–96. doi: 10.2307/2136404
69. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med.* (2006) 166:1092–7. doi: 10.1001/archinte.166.10.1092
70. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* (2001) 16:606–13. doi: 10.1046/j.1525-1497.2001.016009606.x
71. Agyapong VI, Milnes J, McLoughlin DM, Farren CK. Perception of patients with alcohol use disorder and comorbid depression about the usefulness of supportive text messages. *Technol Health Care.* (2013) 21:31–9. doi: 10.3233/THC-120707
72. Agyapong VI, Mrklas K, Juhas M, Omeje J, Ohinmaa A, Dursun SM, et al. Cross-sectional survey evaluating Text4Mood: mobile health program to reduce psychological treatment gap in mental healthcare in Alberta through daily supportive text messages. *BMC Psychiatry.* (2016) 16:378. doi: 10.1186/s12888-016-1104-2
73. Shalaby R, Vuong W, Hrabok M, Gusnowski A, Mrklas K, Li D, et al. Gender differences in satisfaction with a text messaging program (Text4Hope) and anticipated receptivity to technology-based health support during the COVID-19 pandemic: cross-sectional survey study. *JMIR Mhealth Uhealth.* (2021) 9:e24184. doi: 10.2196/24184

# Frontiers in Public Health

Explores and addresses today's fast-moving healthcare challenges One of the most cited journals in its field, which promotes discussion around inter-sectoral public health challenges spanning health promotion to climate change, transportation, environmental change and even species diversity.

## Discover the latest Research Topics

[See more →](#)

### Frontiers

Avenue du Tribunal-Fédéral 34  
1005 Lausanne, Switzerland  
[frontiersin.org](https://frontiersin.org)

### Contact us

+41 (0)21 510 17 00  
[frontiersin.org/about/contact](https://frontiersin.org/about/contact)



### Frontiers in Public Health

