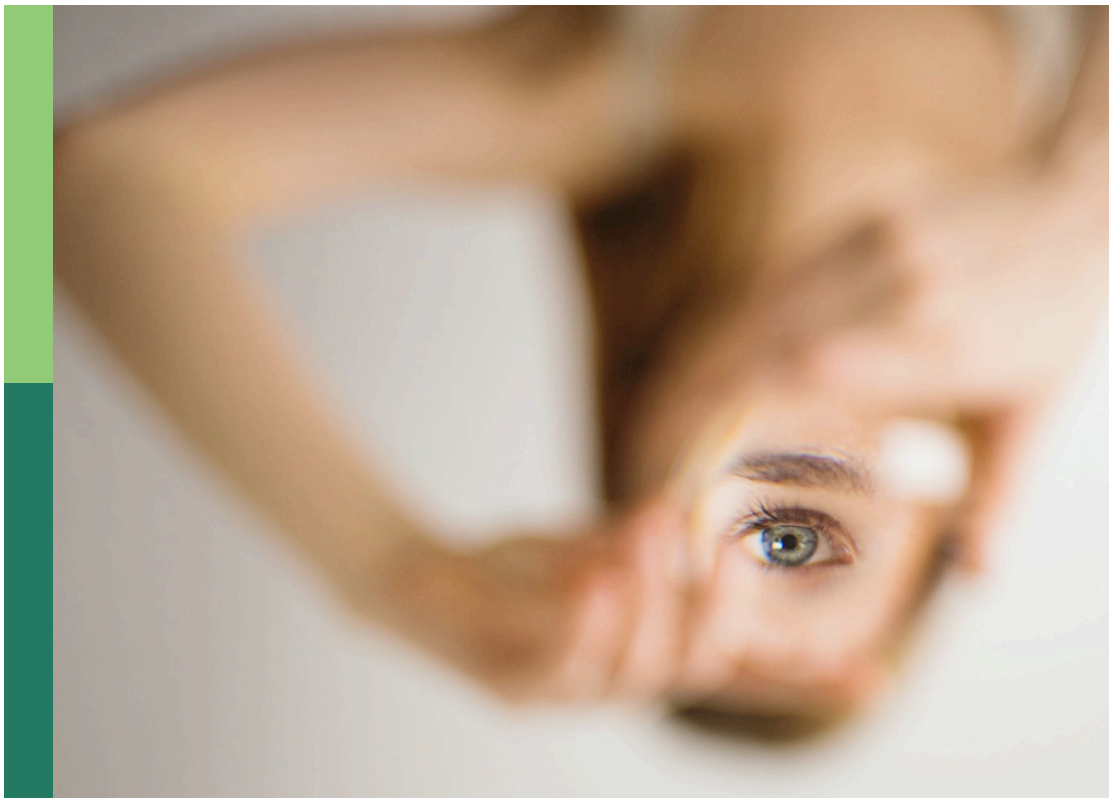
frontiers | Research Topics

Addiction and social behaviors in the post-pandemic world

Edited by
Iina Savolainen, Nicholas Kerry and Anu Sirola

Published in
Frontiers in Psychology



ISSN 1664-8714
ISBN 978-2-8325-5596-5
DOI 10.3389/978-2-8325-5596-5

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

Addiction and social behaviors in the post-pandemic world

Topic editors

Iina Savolainen — Tampere University, Finland

Nicholas Kerry — University of Pennsylvania, United States

Anu Sirola — University of Jyväskylä, Finland

Citation

Savolainen, I., Kerry, N., Sirola, A., eds. (2024). *Addiction and social behaviors in the post-pandemic world*. Lausanne: Frontiers Media SA.

doi: 10.3389/978-2-8325-5596-5

Table of contents

frontiers | Frontiers in Psychology

TYPE Editorial
PUBLISHED 02 May 2024
DOI 10.3389/fpsyg.2024.1414233

OPEN ACCESS

EDITED AND REVIEWED BY
Gerald Matthews,
George Mason University, United States

*CORRESPONDENCE
Iina Savolainen
✉ iina.savolainen@tuni.fi

RECEIVED 08 April 2024
ACCEPTED 15 April 2024
PUBLISHED 02 May 2024

CITATION
Savolainen I, Kerry N and Sirola A (2024) Editorial: Addiction and social behaviors in the post-pandemic world.
Front. Psychol. 15:1414233.
doi: 10.3389/fpsyg.2024.1414233

Editorial: Addiction and social behaviors in the post-pandemic world

Iina Savolainen[1]*, Nicholas Kerry[2] and Anu Sirola[3]

[1]Faculty of Social Sciences, Tampere University, Tampere, Finland, [2]Positive Psychology Center, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Social Sciences and Philosophy, University of Jyväskylä, Jyväskylä, Finland

KEYWORDS

addiction, alcohol use and abuse, social behavior, behavioral change, COVID-19, post-pandemic

Editorial on the Research Topic
Addiction and social behaviors in the post-pandemic world

Since its onset in early 2020, the COVID-19 pandemic profoundly challenged the fabric of our daily lives, our wellbeing, and the nature of our social interactions (Vindegaard and Benros, 2020; Alizadeh et al., 2023). Initially, many responded to the pandemic by retreating into quarantine, an experience marked by social isolation and withdrawal from conventional daily interactions. As we moved into the post-pandemic phase, our society had undergone significant changes, with altered social conventions now rooted in our everyday reality.

The pandemic notably impacted health-related behaviors and those with addictive potential (Avena et al., 2021). Changes in our social interactions and entertainment during the pandemic manifested in activities such as online gaming, social media use, and broader internet consumption. While these behaviors served to maintain connections during times of isolation, there existed a risk that they would become permanent patterns, persisting even after returning to regular activities and social engagements (Zvolensky et al., 2020). This context underscored the need for research addressed in our Research Topic "*Addiction and social behaviors in the post-pandemic world.*" This collection of research on diverse populations offers insights into the nuanced ways in which the pandemic has influenced, and continues to influence, addictive and social behaviors, providing a crucial understanding of the challenges and opportunities that lie ahead.

Reilly et al.'s investigation into the pandemic experiences of US veterans established that a significant portion of veterans experienced anxiety about COVID-19, leading to an increase in the consumption of alcohol, sedatives, inhalants, tobacco, and cannabis. Even after adjusting for pre-existing problematic substance use, the negative consequences of the pandemic and self-reported feelings of loneliness due to COVID-19 were associated with worsened physical and mental health during the pandemic. Similarly, Akeman et al. found a deterioration in mental health among students during the pandemic, with symptoms worsening as the pandemic persisted. Those employing active coping strategies were less prone to symptom exacerbation, while increased alcohol consumption prior to the pandemic correlated with heightened symptoms. Additionally, Chen et al. investigated college students in the post-pandemic period, examining psychological distress, metacognitions regarding smartphone usage, and problematic smartphone usage.

Their work highlighted psychological distress as a significant predictor of problematic smartphone usage and identified variations in the underlying mechanisms linking diverse forms of psychological distress to problematic smartphone usage, providing insights into prevention and intervention strategies targeting problematic smartphone usage among this population.

Online use patterns, such as social media use, changed during the pandemic (Marciano et al., 2022). Social media thrives on content creation and sharing, and Da-yong and Zhan established that individuals' personality traits play a significant role in shaping their motivations to share content, particularly in the realm of short video sharing. Highly conscientious users are inclined to share short videos for altruistic reasons rather than for image management or emotional expression, and they actively manage their online time. Conversely, extraversion and neuroticism have a robust positive influence on motivations related to image management, altruism, emotional expression, leisure, and conformity. These results provide important insight into future investigations on excessive time spent on social media and the spread of content and (mis)information. Breckwoldt et al. assessed the frequency and duration of video gaming amidst the COVID-19 pandemic among athletes, noting a significant surge in video gaming activity during the initial lockdown period, which they suggest was beneficial in helping athletes adapt to the prevailing circumstances. Kim et al. utilized a 3-year longitudinal dataset involving adolescents and examined the impact of gaming duration on psychological variables such as loneliness, depression, self-esteem, and life satisfaction. Their findings also underscored the role of social capital as a moderator, with higher levels of social capital in gaming cohorts enhancing self-esteem and life satisfaction. These results emphasize the importance of gaming in promoting coping mechanisms and social capital, particularly in situations where social interaction relies on virtual platforms. Despite the benefits of internet gaming, further research is needed to understand whether its risk of becoming an addictive behavior could outweigh these benefits (Von der Heiden et al., 2019).

The study by Bottel et al. contributed to existing knowledge of how to effectively measure problematic online activities by differentiating internet use disorder (IUD) from internet gaming disorder (IGD). By adapting the DSM-5 criteria for IGD as questions for IUD, the authors were able to detect which criteria were most significant in predicting IUD. "Loss of control", "continued overuse", and "mood regulation" were frequently endorsed criteria by participants who were categorized as heavy internet users, but "jeopardizing" emerged as the strongest predictor of IUD, followed by "loss of interest" and "continued overuse." The findings provide support for potential adjustments to the DSM-5 criteria for IUD to enhance the accuracy of diagnosis of internet use disorders.

Taking a practical approach to addressing wellbeing during the post-pandemic era, Dash et al. assessed the impact of adolescent-provider connectedness on STI risk reduction 3 months after intervention across two therapeutic approaches: Motivational Interviewing and Brief Adolescent Mindfulness. Their study suggests that psychotherapeutic common factors, such as adolescent-provider connectedness, may play a crucial role in mitigating adolescent health risks in behavioral interventions targeting hazardous drinking or sexual activity. Romero Reyes et al. created a psychometric scale based on the Theory of Planned Behavior, designed to gauge attitudes, subjective norms, self-efficacy, past help-seeking behaviors, and intentions to seek help among young adults exhibiting hazardous and harmful alcohol consumption. The findings indicate that the designed instrument can contribute to developing and/or evaluating interventions that promote students' help-seeking behavior.

Overall, these nine studies underscore the complex interplay between the COVID-19 pandemic and shifts in social and addictive behaviors among different demographics. Going forward, it is critical to develop new measures and implement enhanced strategies to address the negative impact of the pandemic on mental health and addictive behaviors.

Author contributions

IS: Writing – original draft, Writing – review & editing. NK: Writing – review & editing. AS: Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

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

References

Alizadeh, H., Sharifi, A., Damanbagh, S., Nazarnia, H., and Nazarnia, M. (2023). Impacts of the COVID-19 pandemic on the social sphere and lessons for crisis management: a literature review. *Natural Hazards* 117, 2139–2164. doi: 10.1007/s11069-023-05959-2

Avena, N. M., Simkus, J., Gold, M. S., and Potenza, M. N. (2021). Substance use disorders and behavioral addictions during the COVID-19 pandemic and COVID-19-related restrictions. *Front. Psychiatr.* 12:653674. doi: 10.3389/fpsyt.2021.653674

Marciano, L., Ostroumova, M., Schulz, P. J., and Camerini, A. L. (2022). Digital media use and Adolescents' mental health during the COVID-19 pandemic: a systematic review and meta-analysis. *Front. Pub. Health* 9:793868. doi: 10.3389/fpubh.2021.793868

Vindegaard, N., and Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain Behav. Immun.* 89, 531–542. doi: 10.1016/j.bbi.2020.05.048

Von der Heiden, J. M., Braun, B., Müller, K. W., and Egloff, B. (2019). The association between video gaming and psychological functioning. *Front. Psychol.* 10:1731. doi: 10.3389/fpsyg.2019.01731

Zvolensky, M. J., Garey, L., Rogers, A. H., Schmidt, N. B., Vujanovic, A. A., Storch, E. A., et al. (2020). Psychological, addictive, and health behavior implications of the COVID-19 pandemic. *Behav. Res. Ther.* 134:103715. doi: 10.1016/j.brat.2020.103715

frontiers | Frontiers in Psychology

ORIGINAL RESEARCH
published: 11 April 2022
doi: 10.3389/fpsyg.2022.812247

The Impact of COVID-19 on Self-Reported Substance Use, Well-Being, and Functioning Among United States Veterans: A Cross-Sectional Study

Erin D. Reilly[1,2], Elizabeth S. Chamberlin[1], Brooke A. Duarte[3], J. Irene Harris[1,4], Steven D. Shirk[1,2] and Megan M. Kelly[1,2]*

[1]Mental Illness Research, Education, and Clinical Center (MIRECC), VA Bedford Healthcare System, Bedford, MA, United States, [2]The Department of Psychiatry and Department of Population and Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, MA, United States, [3]Suffolk University, Boston, MA, United States, [4]Department of Psychiatry, University of Minnesota Medical School, Minneapolis, MN, United States

OPEN ACCESS

Edited by:
Xun Yang,
Chongqing University,
China

Reviewed by:
Jiahui Deng,
Peking University Sixth Hospital,
China
André Luiz Monezi Andrade,
Pontifical Catholic University of Campinas, Brazil
Giovanni Mansueto,
University of Florence, Italy

***Correspondence:**
Erin D. Reilly
Erin.Reilly@va.gov

Specialty section:
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

Received: 09 November 2021
Accepted: 11 March 2022
Published: 11 April 2022

Citation:
Reilly ED, Chamberlin ES, Duarte BA, Harris JI, Shirk SD and Kelly MM (2022) The Impact of COVID-19 on Self-Reported Substance Use, Well-Being, and Functioning Among United States Veterans: A Cross-Sectional Study. Front. Psychol. 13:812247. doi: 10.3389/fpsyg.2022.812247

As the COVID-19 pandemic sweeps the globe, many veterans with substance use issues have faced the closure of treatment facilities, mandates to shelter in place, and social distancing measures. To better understand their pandemic experiences, substance use changes, and functioning, a survey was nationally administered to a sample of United States veterans reporting substance use issues during the pandemic. The purpose of this cross-sectional online survey for veterans ($N = 409$) was to report on COVID-19 experiences, safety behaviors, and infection experiences while also investigating the relationship among addictive behaviors, mental and physical health, and COVID-19 impact. Measures also assessed specific substance use concerns, pandemic-related loneliness, and functioning. Though few veterans reported personally receiving a confirmed COVID-19 medical diagnosis (10.5%), the impact of pandemic stressors was evident, with a majority reporting anxiety related to contracting COVID-19 (61.4%) or fear of a family member or close friend contracting COVID-19 (58.7%). Participants reported increased use of alcohol (45.3%), sedatives (36.6%), inhalants (35.7%), tobacco (35.0%), and cannabis (34.9%), attributed specifically to the pandemic. Regression analyses revealed that even when controlling for the contribution of problematic substance use issues, negative pandemic impacts and self-reported COVID-19 related loneliness were related to more impaired physical and mental health functioning during the pandemic. Findings from this sample of veterans with addiction issues add to the growing literature suggesting unique and adverse effects of COVID-19 stressors on functioning while also revealing specific pandemic impacts for this group.

Keywords: substance use disorders, addiction, veterans, pandemic (COVID19), functioning

INTRODUCTION

Since March 2020, the SARS-CoV-2 (COVID-19) pandemic has been an intense stressor across the United States. In the first year of the pandemic, sudden and dramatic behavioral changes were either mandated or encouraged to "flatten the curve," which included asking people to stay at home as much as possible, shutting down entire industries (e.g., restaurants and movie theaters), and shifting clinical resources to COVID-19 specific care (Emerick et al., 2020). While these shifts were intended to slow infection rates, there was also a negative peripheral impact for many citizens due to sudden job loss (Matthews et al., 2021), reduced social connectedness (Talcott et al., 2021), and loss of certain health treatments (Hochstatter et al., 2021). Across the globe, there were also reports of growing psychological distress such as heightened suicidal ideation (Brailovskaia et al., 2021), increased negative affective states such as nervousness and fear (Zhang et al., 2020), an increased sense of worry and loneliness (Cohn-Schwartz et al., 2021), and decreased coping resources (Mana et al., 2021). Pandemic stressors and negative psychological impact may have led to societal challenges exceeding individual coping resources, likely also contributing to reports of allostatic overload (Cosci and Guidi, 2021), or the cumulative impact of an individual's accumulated burden of stress on the body and mind (Danese and McEwen, 2012). Since allostatic overload can have downstream negative health consequences, it is unsurprising that at the beginning of the pandemic many citizens, with and without reported COVID-19 infections, reported both decreased mental health (Czeisler et al., 2020) and physical functioning (Morlock et al., 2021).

At the same time, the first few months of the pandemic saw increases in alcohol sales (The Nielsen Company, 2020) and self-reported use of some drugs (Janulis et al., 2021). In accordance with the motivational model of substance use (Cooper et al., 1995), there was concern that heightened pandemic-related psychological distress, combined with a lack of internal and external resources for stress and mood management, was leading to increased substance misuse by individuals seeking both positive affective states and coping with negative emotional experiences (Cooper et al., 1995, 2016). As COVID-19 stressors have the potential to increase substance misuse and health issues in vulnerable populations (Du et al., 2020), the Veterans Health Administration (VHA) became concerned with the impact of COVID-19 stressors on veterans' drinking and drug use (Insider, 2020). Substance use is a significant problem among United States military veterans (Oliva et al., 2017; Teeters et al., 2017) and is associated with numerous harmful effects, including adverse physical and mental health functioning (Boden and Hoggatt, 2018). Recent COVID-19 research also supports this trend, as veterans' increases in substance use have been associated with corresponding decreases in mental and physical health (Roberts et al., 2021).

Factors predictive of veteran functioning include more than merely problematic substance use. An important framework to consider when assessing the functional impact of substance misuse for veterans is the unique social conditions of their lives, referred to by the World Health Organization (WHO) as social determinants of health (SDH; World Health Organization, 2021). Social determinants include both structural determinants (e.g., income, finances, and age), and intermediary determinants (e.g., psychosocial circumstances and social support; Hosseini Shokouh et al., 2017), which can strongly influence health outcomes. The pandemic has had well-recorded and massive impacts on SDH areas, including changes in employment patterns, social networks, and reported quality of life (Guerin et al., 2021; Niles et al., 2021; Rogers et al., 2021). Conditions reflecting disadvantaged SDH contexts have been widely associated with psychosocial stressors and mental health issues (Allen et al., 2014). These SDH and environmental conditions can result in allostatic load issues and worse health outcomes (Thisted, 2003; Denny and Brownell, 2010). Attempts to reconcile the unbalanced number of stressors without adequate access to societal and personal coping resources may have an interactive effect with negative coping strategies such as problematic substance use, further negatively impacting the functioning of veterans.

The combined impact of these factors—pandemic impacts on quality of life (e.g., finances and meeting basic needs)—on the health and well-being of veterans is not yet clear. Though there have been studies on the impact of COVID-19 on veteran substance use (Fitzke et al., 2021; Pedersen et al., 2021), none have specifically investigated problematic substance use, COVID-19 related changes in SDH, and functional outcomes. There is also a continued and growing need to understand more precisely COVID-19 health, stressors, and infection-control behaviors, which have occurred in very particular contexts for individuals as they balance maintaining their quality of life and staying safe. For example, social distancing can increase safety from COVID-19 infection; however, loneliness is a risk factor for relapse (Volkow, 2020) because it triggers irritability, anxiety, fear, sadness, anger, or boredom (Ornell et al., 2020). These specific COVID-19 experiences for veterans are essential to consider when investigating the impact of COVID-19, substance use concerns, and health outcomes.

The Current Study

The main aim of the present study was to investigate the impact of the COVID-19 pandemic on United States veterans who self-reported problematic drug and alcohol use. Within the framework of SDH, the study specifically assessed veterans' lived experience of COVID-19 management, SDH (COVID-19 related quality of life indicators and loneliness), and their mental and physical health functioning. This included a particular aim to examine the contribution of SDH factors in the relationship between problematic substance use and functioning. The planned stepwise hierarchical regression model originally included *a priori* Hypotheses 1 and 2 (i.e., hypothesized prior to data collection but not publicly pre-registered). An additional *post hoc* Hypothesis 3 was added following data collection to examine a potential interaction between negative COVID-19 impacts on quality of life (e.g., finances and meeting basic needs) and COVID-19-related loneliness.

Hypotheses

Hypothesis 1: Greater self-reported substance use will be associated with both lower physical and mental health functioning during COVID-19 for Veterans.

Hypothesis 2: Greater levels of negative COVID-19 impacts on quality of life (e.g., finances and meeting basic needs) and COVID-19-related loneliness will each have a distinctive, significant negative relationship with physical and mental health functioning, even when modeled alongside problematic substance use, resulting in a significant increase in variance explained in functioning.

Hypothesis 3: Loneliness was hypothesized to moderate the relationship between the negative impact of COVID-19 and both physical and mental health functioning, such that individuals reporting higher levels of loneliness and higher levels of negative COVID-19 impacts on quality of life would report lower mental and physical health functioning, compared to those with higher levels of negative COVID-19 impacts on quality of life but lower levels of loneliness.

MATERIALS AND METHODS

Participants and Procedure

Procedures and methods for collecting this cross-sectional data were completed in accordance with a protocol approved by the Institutional Review Board at the VA Bedford Healthcare System. The survey was administered using the Qualtrics federal platform between November 24, 2020 and February 2, 2021, and United States veterans were identified *via* a Qualtrics panel. Study staff coordinated with a project coordinator from Qualtrics, who used their panel aggregator system, an internal Qualtrics system where over 20 Web-based panel providers have been identified, screened, and utilized by Qualtrics recruiters to supply diverse, quality respondents depending on survey inclusion/exclusion criteria. Research has supported the Qualtrics panel recruitment methodology as an effective recruitment strategy, unlike non-panel recruited anonymous online samples, with evidence supporting that these panels can produce higher quality samples due to internal quality control and prescreened respondents (Ibarra et al., 2018). This data collection method is thus becoming increasingly popular, with evidence showing data quality from the Qualtrics panel is on par with data from conventional data collection methods (e.g., Walter et al., 2019). Potential panel participants were provided with a link to a description of the study and an eligibility survey on the Qualtrics platform. Informed consent was provided and obtained prior to accessing the survey. The survey was estimated to take approximately 30 minutes to complete.

The eligibility criteria for the survey and included as pre-survey screening items were (1) reporting a minimum age of 18 years old, (2) problematic drug and alcohol use indicated by Cut Down, Annoyed, Guilty, and Eye Opener (CAGE)-AID minimum score of 1, and (3) being a veteran of the United States Armed Forces. Veteran status was further assessed by asking participants to report on employment/veteran status overall (such that participants were unaware of the veteran eligibility criteria). If they reported being a veteran, respondents were required to report their DD214 (the Certificate of Release or Discharge form) date and the years they served. Participants were excluded when (1) they had previously completed the survey, (2) did not meet the minimum CAGE-AID score of one, (3) did not meet our verification check for United States Veterans (e.g., were active duty military), or (4) were identified as non-attentive or potential survey spammers after quality-review (see below for criteria). To allow for a wide surveying of veterans with possible substance use concerns, responders were not excluded for (1) not having a formal substance use disorder (SUD) diagnosis, or (2) use of prescribed medications, but did have to report problematic use of drugs or alcohol to qualify for the survey.

Given the high possibility that potential recruited responders might be motivated to complete the survey even without being a veteran due to monetary gains, we instituted a series of survey items and validation checks similar to those utilized by Pedersen et al. (2017, 2021) when recruiting veteran community samples. To verify veteran status, an initial screening item asked respondents for their current military status (i.e., active duty, not and have never been a member of the military, a veteran, or other). If respondents answered they were a veteran, they answered a series of additional items to verify veteran status, including when they had served and in which era (e.g., Vietnam Era, August 1964 to April 1975), and branch of service (e.g., Army). They were then asked if they had received a DD214 and, if yes, were routed to indicate their date of discharge. This date needed to reasonably match their reported service era and self-reported age. If answers were inconsistent, these respondents were removed from the survey.

Approximately 58,500 surveys were sent out to panel participants, who were not aware of the contents of the survey prior to selecting it in their dashboard. A total of 6,500 (11.1%) potential participants entered the survey and were provided with the informational sheet and consent document for the survey. Of these, 381 (5.9%) did not consent to take the pre-survey screening items. Of those who consented to participate in the pre-survey screening, 5,366 (87.7%) were automatically screened out for not reporting being a United States veteran ($n = 3,200$) and for not reporting substance abuse issues on the CAGE-AID screener ($n = 2,166$). Following these automatic eligibility checks ($n = 753$), a total of 436 participants completed the survey (completion rate of 58%). Based on proposed guidance for online recruitment quality review by Heffner et al. (2021), potential participants were removed if three of the following four previously identified quality-review criteria were met: (1) self-reported veteran status was deemed impossible when reviewed in conjunction with age, reported military service era, and/or DD214 date, (2) attention check items showed participants reporting gibberish responses to open-ended questions, (3) total time spent on the survey was under 1/3 of median completion

time (< 10 min), and (4) response patterns flagged by the Qualtrics system as potential bots using their quality check software (i.e., IP-based "Prevent Ballot Box Stuffing" option, attempts to take the survey multiple times) were reviewed and found to be suspicious (e.g., answering all survey items as the last Likert scale option). A total of 27 (6.2%) potential participants were removed because they did not meet these criteria.

Study Measures

Demographic Characteristics

The present study evaluated several demographic characteristics, including age, gender, sexual orientation, race, ethnicity, income, armed service branch, VHA connection status, and relationship status.

Addiction Measures

Substance use concerns and behaviors were assessed in the screening survey and within the main survey. Problematic use of alcohol and other drugs was assessed using the CAGE Adapted to Include Drugs (CAGE-AID; Brown and Rounds, 1995), a validated four-item measure. Per the CAGE-AID protocol, the questionnaire was only given to participants who reported current alcohol or drug use. A minimum score of 1 on the CAGE-AID was used as a screener to participate in the survey, as recommended by the CAGE-AID Consensus Panel of the Substance Abuse and Mental Health Services Administration (SAMHSA) to cast a wider net and identify more patients with substance abuse or addiction issues (Sullivan and Fleming, 2008). Previous research indicates that a CAGE-AID score of one or more indicates a positive screen with a sensitivity of 0.79 and specificity of 0.77, and that scores can accurately classify 78% of substance users (Ashman et al., 2004).

A modified version of the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST; Humeniuk et al., 2010) was used to descriptively measure substance use frequency, urges, and changes in use during the pandemic for alcohol, tobacco, cannabis, cocaine, stimulants, inhalants, sedatives, hallucinogens, and opioids (four items for each substance). Item #1, assessing any lifetime non-medical use of a specific substance, was retained in its original form. As a main purpose of the current study was to describe potential changes in substance use during COVID, Item #2 was modified to read, "Since the beginning of the COVID-19 pandemic, how often have you used [specific substance]?" Additionally, Item #3 was modified to "Since the beginning of COVID-19, how has your desire or urge to use [specific substance] changed?" and Item #4 was added, "How has your frequency of using [specific substance] changed during COVID-19?," with the response scale ranging from More Use/Craving, No Change, and Less Use/Craving.

Medical Diagnoses

Medical diagnoses were obtained *via* self-report. Several general medical diagnoses were provided, and participants self-reported whether they had ever received an official medical diagnosis from a doctor or healthcare professional. As many of these diagnoses can be long-standing, we did not specify a timeframe for when the condition might have been officially diagnosed. These medical diagnoses included chronic pain, diabetes, insomnia, heart disease, apnea, and seizures.

Psychiatric Diagnoses

Psychiatric diagnoses were self-reported using the same criteria as medical diagnosis (e.g., had been diagnosed by a doctor or other healthcare professional specifically) by participants and included SUDs, major depressive disorder, post-traumatic stress disorder (PTSD), anxiety disorder, panic disorder, psychogenic non-epileptic seizures (PNES), schizophrenia, and bipolar disorder.

Psychosocial Functioning

The Short-Form Health Survey-12 (SF-12; Ware et al., 1996) is a 12-item measure that assesses mental and physical functioning. The SF-12 has been validated for predicting populations' mental and physical health without targeting specific health outcomes and has high reliability, including with United States veterans (Salyers et al., 2000). Scoring involves using a norm-based algorithm that produces a self-reported mental health composite score (MCS) and physical health composite score (PCS) between 0 and 100 (Jones et al., 2001), with lower scores associated with lower functioning. Test–retest reliability is 0.80 for the PCS and 0.76 for the MCS (Ware et al., 1996).

COVID-19 Measures

The present study evaluated the experiences, stressors, and impact of COVID-19 across several areas of interest. A subscale score was created using a modified version of the Pain Management Collaboratory Coronavirus Pandemic (COVID-19) 5-Item Measure (PMC-5), which measured the potential negative impact of COVID-19 on quality of life on a scale of 1 (Improved) to 4 (A Lot Worse). The five areas measured by the PMC-5 included finances, emotional health, ability to meet basic needs, and two additional items on physical health and concentration. For the present study, internal consistency for the PMC-5 was satisfactory (five items: $\alpha = 0.82$).

In addition, three modified questions from the Osteoporotic Fractures in Men (MROS) Study COVID-19 Social Impact Questionnaire (Cawthon et al., 2020) with multiple check-box options were asked to describe COVID-19 experiences, including (1) "Which of the following statements best describes your personal experience with the coronavirus," (2) "Which of the following have you done in the last month to keep yourself safe from coronavirus?," and (3) "Which of the following are worries of yours related to COVID-19, or are more difficult for you now because of the pandemic?"

Loneliness During COVID-19

The UCLA Loneliness Scale-8 (ULS-8; Hays and DiMatteo, 1987) was used to assess feelings loneliness during the pandemic. The scale instructions were slightly modified to assess

pandemic-related loneliness and read, "Indicate how often you have felt the following ways during your COVID-19 experience." The full eight-item measure was utilized, and sample items include "There is no one I can turn to" and "I lack companionship." Scores range on a scale from 1 (Never) to 4 (Often), with higher scores indicating greater levels of loneliness. Internal validity for this scale in the current sample was satisfactory (eight items: $\alpha = 0.83$).

Data Analysis

Means, SDs, and frequencies were calculated for the full sample. Zero-order correlations were first conducted among all the measures of interest to assess for initial relationships among model variables. To research the unique effects of each potential predictor, two hierarchical regression analyses were conducted for mental and physical health functioning. The hypothesized model first explored the relationship between problematic substance (CAGE-AID) use on mental health and physical functioning, respectively. In addition, by adding variables related to SDH factors (PMC5 and ULS-8) to the model, we anticipated greater predictive ability for both physical and mental health functioning, with problematic substance use still accounting for a significant amount of variance in functioning. Hierarchical or sequential regression allows for the analysis of multiple predictors when the order of entry is determined by a theoretical base, while also determining the contribution of each variable after controlling for those entered earlier in the model (Tabachnick and Fidell, 2007). In the first step, demographic control variables were included, showing significant zero-order correlations with the dependent variables (gender, age, and annual income). In the second step of the hierarchical multiple regression analysis to test Hypotheses 1, problematic alcohol and drug use concerns (CAGE-AID scores) were entered to investigate their impact on mental health. In the third step, we evaluated our proposed Hypothesis 2 by adding pandemic-related stressors Hierarchical or sequential regression allows for the analysis of multiple predictors when the order of entry is determined by a theoretical base, while also determining the contribution of each variable after controlling for those entered earlier in the model (Tabachnick and Fidell, 2007). In the first step, demographic control variables were included, showing significant zero-order correlations with the dependent variables (gender, age, and annual income). Hypothesis 1 was tested in the second step of the hierarchical multiple regression analysis, with problematic alcohol and drug use concerns (CAGE-AID scores) entered to investigate their impact on mental health (MCS-12). Hypothesis 2 was explored in the third step, with pandemic-related stressors (PMC-5 and ULS-8) added to the model to assess the unique impact of COVID-19 associated SDH factors on mental health functioning. A second hierarchical regression was conducted with the same variables and stepwise model to predict physical health. We tested the assumptions of regression analysis and for evidence of violations. Multicollinearity among predictor variables was set at zero-order correlations greater than 0.70, and continuous variables scores and errors were inspected for normalcy of distribution. In addition, to assess post-hoc Hypothesis 3, exploring a potential interaction between the ULS-8 and PMC5 on functioning, predictors variables were mean-centered to create a cross-product to regress on both outcome variables of interest in the final step. All tests were two-tailed, with all analyses conducted using SPSS v.26.

RESULTS

Survey Respondents

The mean age of the sample ($N = 409$) was 54.85 years ($SD = 16.44$), with 76.5% (313/409) of participants reporting a male gender identity. Participants could identify with multiple racial categories, with 90% (370/409) identifying as white/Caucasian, 5.4% (22/409) as Black/African American, and 1.2% (5/409) identifying as American Indian or Alaska Native, Asian, or Native Hawaiian or Pacific Islander, respectively. Additionally, 8.1% (376/409) of participants identified as Hispanic. A total of 91.4% (374/409) of participants reported identifying as straight/heterosexual, and a majority (66.7%; 273/409) of participants were married or living with a partner. See **Table 1** for detailed demographic information.

Descriptive Results

Of the 409 participants screened into the study with problematic substance use, a minority reported a formal, medically diagnosed alcohol (27.6%; 113/409) or substance use (20.5%; 84/409) disorder. The most reported substances for those with medically diagnosed SUD other than alcohol were tobacco and cannabis. The most reported psychiatric diagnoses were anxiety disorder (36.4%; 149/409), PTSD (27.4%; 112/409), and major depressive disorder (20.3%; 83/409); the most reported physical condition was chronic pain (31.5%; 129/409: see **Table 2**).

Regarding alcohol and non-prescription substance use during COVID-19, a substantial number of participants reported daily or mostly daily use of substances. Of the participants who reported at least some lifetime use of a particular substance, alcohol (45.8%; 182/397) was the most commonly used substance on a daily or mostly daily basis, followed by tobacco (44.9%; 150/334), sedatives (29.8%; 48/161), and opioids (26.6%; 29/109). Participants with current substance or alcohol use also reported changes in cravings during the COVID-19 pandemic. The majority reported no changes in urges/cravings of substances, apart from alcohol, with 47.6% (189/397) reporting an increased urge to drink. For all other substances, the largest increases in cravings were reported for cannabis (38.4%; 98/255) and tobacco (37.1%; 124/334). Finally, many participants reported increased substance use during COVID-19, with the highest increased use for alcohol (45.3%; 180/397). See **Table 3** for specific rates by substance.

Participants reported on their specific COVID-19 experiences, with 10.5% (43/409) reporting being officially diagnosed with COVID-19 and 12.7% (52/409) believing they had COVID-19 but were not officially diagnosed (see **Table 4**). The most frequently reported stressors related to the pandemic were fear of getting COVID-19 (61.4%; 251/409) or someone close to

TABLE 1 | Sample demographics ($N = 409$).

Variable	Frequency (%)	Variable	Frequency (%)
Gender		*Income*	
Male	313 (76.5%)	Less than $19,999	31 (7.60%)
Female	94 (23%)	$20,000–39,999	70 (17.11%)
Transgender Male	1 (0.2%)	$40,000–59,999	66 (16.14%)
Preferred not to answer	1 (0.2%)	$60,000–79,999	53 (12.96%)
Age	$m = 54.85 (SD = 16)$	$80,000–99,999	48 (11.74%)
*Race**		$100,000–149,999	87 (21.30%)
White	370 (90.50%)	$150,000 +	54 (13.20%)
Black/African American	22 (5.40%)	*Relationship status*	
Other	7 (1.70%)	Married	273 (66.70%)
Asian	5 (1.20%)	Divorced	47 (11.50%)
Native Hawaiian/Pacific Islander	5 (1.20%)	Single, never married	39 (9.50%)
American Indian/Alaska Native	5 (1.20%)	In a relationship, not married	24 (5.90%)
Ethnicity		Widowed	15 (3.70%)
Not Hispanic/Latino	376 (91.90%)	Separated	11 (2.70%)
Hispanic/Latino	33 (8.10%)	*Service Branch**	
Sexual Orientation		Army	202 (49.40%)
Heterosexual (straight)	374 (91.40%)	Air Force	81 (19.80%)
Bisexual	19 (4.6%)	Navy	65 (15.90%)
Homosexual (gay)	13 (3.2%)	Marines	44 (10.80%)
Prefer not to say	3 (0.70%)	National Guard	29 (7.10%)
*Service Era**		National Reserve	11 (2.70%)
September 2001 or later	156 (38.1%)	Coast Guard	7 (1.70%)
August 1990–August 2001	96 (23.5%)	Army Reserves	1 (0.20%)
May 1975–July 1990	99 (24.2%)	Connected to VHA Care	268 (65.5%)
Vietnam Era (1964–1975)	150 (36.7%)		
February 1955–July 1964	24 (5.9%)		
Korean War (1950–1955)	3 (0.7%)		

**Participants could choose multiple categories.*

TABLE 2 | Veteran sample substance use, psychiatric, and physical health diagnoses.

Substance use diagnoses*	**Frequency (%)**
Alcohol Use Disorder	113 (27.6%)
Substance Use Disorder	84 (20.5%)
Tobacco Use Disorder	*62 (73.8%)*
Cannabis Use Disorder	*47 (55.9%)*
Sedative Use Disorder	*31 (36.9%)*
Opioid Use Disorder	*26 (31.0%)*
Cocaine Use Disorder	*22 (26.2%)*
Amphetamine-type stimulant Use Disorder	*20 (23.8%)*
Inhalant Use Disorder	*5 (6.0%)*
Hallucinogen Use Disorder	*2 (2.4%)*
Psychiatric Diagnoses*	**Frequency (%)**
Anxiety Disorder	149 (36.4%)
Post-Traumatic Stress Disorder	112 (27.4%)
Major Depressive Disorder	83 (20.3%)
Panic Disorder	48 (11.7%)
Bipolar Disorder	31 (7.6%)
Schizophrenia	9 (2.2%)
Psychogenic non-epileptic seizures (PNES)	7 (1.7%)
Physical Health Diagnoses*	**Frequency (%)**
Chronic Pain	129 (31.5%)
Diabetes	73 (17.8%)
Insomnia	70 (17.1%)
Heart Disease	48 (11.7%)
Apnea	47 (11.5%)
Seizures	16 (3.9%)

**Participants could choose multiple categories.*

the participant getting COVID-19 (58.7%; 240/409). In terms of safety behaviors, the most common behaviors were wearing a facemask (88.8%; 363/409), avoiding public spaces and crowds (69.2%; 283/409), and avoiding in-person contact with friends and family (50.1%; 205/409).

Hierarchical Multiple Regression

Mental Health Functioning

Prior to multiple regressions, continuous outcome variables were inspected for normality, and all continuous variables had an approximate normal distribution with no significant outliers. In addition, control variables, predictors, and outcome variables were investigated using zero-order correlations (**Table 5**), which revealed that being young, having greater problematic substance use, reporting more negative COVID-19 impacts on quality of life, and experiencing greater reported loneliness were correlated with lower scores in both mental and physical health functioning. These statistically significant relationships among variables did not suggest multicollinearity (absolute correlation coefficient greater than 0.70).

Following the investigation of these correlations, hierarchical multiple regression analyses were conducted. In the first step of the regression, age, gender, and race were entered as covariates and explained a significant amount of the variance in mental health functioning, $F(3, 403) = 13.83$, $p < 0.001$, adjusted $R^2 = 0.09$. In the second step, results from the CAGE-AID were entered to control for the impact of problematic drug and alcohol use on mental health outcomes, and explained a significant amount

TABLE 3 | Alcohol and non-prescription substance use, urges, and changes in use due to COVID-19.

	Alcohol	Tobacco	Cannabis	Sedatives	Opioids	Stimulants	Cocaine	Inhalants	Hallucinogen
Lifetime/Any Use	397 (97.1%)	334 (81.7%)	255 (62.3%)	161 (39.4%)	109 (26.7%)	105 (25.7%)	95 (23.2%)	42 (10.3%)	74 (18.1%)
Using during COVID									
Not at all	39 (9.8%)	113 (33.8%)	84 (32.9%)	23 (14.3%)	34 (21.2%)	39 (37.1%)	49 (51.6%)	6 (14.3%)	39 (52.7%)
Once or twice	16 (4.0%)	20 (6.0%)	26 (10.2%)	19 (11.8%)	17 (15.6%)	18 (17.1%)	10 (10.5%)	9 (21.4%)	7 (9.5%)
Monthly	29 (7.3%)	16 (4.8%)	25 (9.8%)	16 (9.9%)	13 (11.9%)	11 (10.5%)	9 (9.5%)	5 (11.9%)	6 (8.1%)
Weekly	131 (33.0%)	35(10.5%)	60 (23.5%)	55 (34.2%)	16 (14.7%)	21 (20.0%)	15 (15.8%)	16 (38.1%)	17 (23.0%)
Daily or mostly daily	182 (45.8%)	150 (44.9%)	60 (23.5%)	48 (29.8%)	29 (26.6%)	16 (15.2%)	12 (12.6%)	6 (14.3%)	5 (6.8%)
*Changes in urge/craving**									
Lower urge/craving	54 (13.6%)	43 (12.9%)	32 (12.5%)	34 (21.2%)	16 (14.7%)	18 (17.1%)	10 (10.5%)	13 (31.0%)	6 (8.1%)
No change in urge/craving	154 (38.8%)	167 (50.0%)	125 (49.0%)	68 (42.2%)	55 (50.5%)	52 (49.5%)	59 (62.1%)	16 (38.1%)	49 (66.2%)
Higher urge/craving	189 (47.6%)	124 (37.1%)	98 (38.4%)	59 (36.6%)	38 (34.9%)	35 (33.3%)	26 (27.4%)	13 (31.0%)	19 (25.7%)
*Changes in use**									
Decreased use	68 (17.1%)	49 (14.7%)	32 (12.5%)	30 (18.6%)	19 (17.4%)	21 (20.0%)	11 (11.6%)	12 (28.6%)	5 (6.8%)
No change in use	149 (36.4%)	168 (50.3%)	134 (52.5%)	72 (44.7%)	60 (55.0%)	51 (48.6%)	61 (64.2%)	15 (35.7%)	50 (67.6%)
Increased use	180 (45.3%)	117 (35.0%)	89 (34.9%)	59 (36.6%)	30 (27.5%)	33 (31.4%)	23 (24.2%)	15 (35.7%)	19 (25.7%)

**Percentage of changes in urges and use based only on participants reporting lifetime/any use for the specific substance.*

TABLE 4 | Veteran experiences with COVID-19 health, stressors, and safety behaviors.

COVID-19 infection experiences	Frequency (%)
Received COVID-19 medical diagnosis	43 (10.5%)
Believe they had COVID-19, not officially diagnosed	52 (12.7%)
Average number of days experiencing symptoms	11.3 (*SD* = 23.8)
Hospitalized due to COVID-19	2 (0.5%)
Received COVID-19 vaccine[a]	14 (3.4%)
A family member/close friend was diagnosed	136 (33.3%)
A family member/close friend died	53 (13%)
COVID-19 Stressors	Frequency (%)
Getting COVID-19	251 (61.4%)
Someone close to participant getting COVID-19	240 (58.7%)
Feeling isolated and alone	148 (36.2%)
Worries about finances/income	134 (32.8%)
Not getting necessary medical care	99 (24.2%)
Meeting basic needs (e.g., food, housing)	92 (22.5%)
Having difficulty meeting conditions of probation/parole	16 (3.9%)
No worries or stressors related to COVID-19	6 (1.4%)
COVID-19 Safety Behaviors	Frequency (%)
Wore a facemask	363 (88.8%)
Avoided public spaces/crowds	283 (69.2%)
Avoided in-person contact with friends/family	205 (50.1%)
Cancelled/postponed travel	197 (48.2%)
Had a telehealth visit	136 (33.3%)
Had an in-person healthcare visit	124 (30.3%)
Stockpiled food and/or water	118 (28.9%)
Teleworked	101 (24.7%)
Prayed/meditated/engaged in spiritual practice	96 (23.5%)
Cancelled a healthcare appointment	73 (17.8%)
Cancelled/postponed work or school activities	51 (12.5%)
No safety behaviors used	7 (1.7%)

[a]*Vaccination item added 14/12/2021, available to 75.8% of participants.*

of variance, $F(4, 402) = 13.41$, $p < 0.001$ adjusted $R^2 = 0.12$, with CAGE-AID score explaining a significant additional amount in variance in mental health functioning ($\beta = -0.17$, $p = 0.001$), such that greater levels of problematic use of substances predicted decreases in mental health. In the third and final step, indicators of COVID-19-related impacts, specifically the PMC-5 (negative COVID-19 impacts on quality of life) and ULS-8 (pandemic-related loneliness), were entered. This addition resulted in a significant change in R^2 of 0.12 ($p < 0.001$), with PMC-5 ($\beta = -0.12$, $p = 0.03$) and ULS-8 scores ($\beta = -0.34$, $p < 0.001$) as significant predictors of decreased mental health functioning during COVID-19. With the addition of these pandemic stressor variables, CAGE-AID scores no longer predicted mental health functioning ($\beta = -0.07$, $p = 0.14$). There was no significant interaction between ULS-8 and PMC-5 on mental health functioning ($\beta = -0.05$, $p = 0.30$). This finding indicates that negative COVID-19 impacts on quality of life (PMC-5) and pandemic-related loneliness (ULS-8) had a unique and negative impact on veterans' mental health functioning (MCS-12). The entire model accounted for 23% of the variance in the MCS (see **Table 6**).

Physical Health Functioning

To begin testing the replicability of the previously outlined hierarchical multiple regression model on physical health, age, gender, and race were entered as covariates, which explained a significant amount of the variance in physical health functioning, $F(3, 403) = 6.25$, $p < 0.001$, adjusted $R^2 = 0.04$. In the second step, the CAGE-AID was entered into the model and explained a significant amount of variance, $F(4, 402) = 5.70$, $p < 0.001$, adjusted $R^2 = 0.04$ in physical health functioning ($\beta = -0.10$, $p = 0.04$), such that greater problematic use of substances predicted decreases in physical health. In the third step, indicators of COVID-19 related-impacts were entered. This addition resulted in a significant change in $R^2 = 0.04$, $p < 0.001$, and although CAGE-AID scores no longer predicted physical health ($\beta = -0.05$, $p = 0.38$), negative COVID-19 impacts on quality of life (PMC-5; $\beta = -0.11$, $p = 0.03$), and pandemic-related loneliness scores (ULS-8; $\beta = -0.14$, $p = 0.02$) emerged as significant predictors of decreased physical health functioning during COVID-19. There was no significant interaction between ULS-8 and PMC-5 on physical health functioning ($\beta = 0.03$, $p = 0.51$). This finding indicates that stressors from the pandemic, both loneliness and perceived negative impact of COVID-19 on quality of

TABLE 5 | Correlations among continuous predictor variables.

Measure	1	2	3	4	5	6
1. Age	-					
2. CAGE-AID	–0.33***	-				
3. PMC-5	–0.31***	0.31***				
4. ULS-8	–0.28***	0.28***	–0.49***			
5. PCS-12	0.10*	–0.14**	–0.24**	–0.24***		
6. MCS-12	0.28***	–0.24***	–0.33***	–0.45***	–0.19**	--
Mean	54.84	2.37	2.46	18.30	43.31	42.48
Median	56.00	2.00	2.40	18.00	43.95	43.06
SD	16.44	1.12	0.57	5.44	6.79	6.78
Range	19–88	1–4	1–4	8–32	24.56–59.81	19.91–63.72

*CAGE-AID, CAGE adapted to include drugs scale; ULS-8 Loneliness, UCLA Loneliness Scale-8; PMC-5, Pandemic Impact: Pain Management Collaboratory (PMC) 5-Item COVID Negative Impact Measure; MCS-12, Short-Form Health Survey's (SF-12) Mental health component scale; and PCS-12, Short-Form Health Survey's (SF-12) Physical health component scale. *p < 0.05, **p < 0.01, and ***p < 0.001.*

TABLE 6 | Summary of hierarchical regression analysis predicting mental and physical health functioning ($n = 409$).

Step and Variable	Mental Health Functioning					Physical Health Functioning				
	B	*SE*	*β*	sr^2	Adjusted R^2	*B*	*SE*	*β*	sr^2	Adjusted R^2
Step 1					0.09***					0.04***
Age	0.11	0.02	0.27	0.07***		0.05	0.02	0.09	0.02*	
Gender	1.30	0.81	0.08	0.01		0.16	0.84	0.01	0.00	
Income	0.14	0.10	0.07	0.00		0.36	0.10	0.18	0.03***	
Step 2					0.12***					0.04***
Age	0.09	0.02	0.21	0.02***		0.04	0.02	0.09	0.01	
Gender	1.50	0.80	0.09	0.01		0.28	0.84	0.02	0.00	
Income	0.11	0.10	0.05	0.00		0.34	0.10	0.17	0.03**	
CAGE-AID	–1.00	0.30	–0.17	0.02**		–0.62	0.31	–0.10	0.01*	
Step 3					0.23***					0.08***
Age	0.05	0.02	0.12	0.01*		0.02	0.02	0.04	0.00	
Gender	0.38	0.76	0.02	0.00		–0.37	0.84	–0.02	0.00	
Income	–0.07	0.09	–0.04	0.00		0.23	0.10	0.12	0.01*	
CAGE-AID	–0.43	0.29	–0.07	0.00		–0.28	0.32	–0.05	0.00	
ULS-8	–0.42	0.07	–0.34	0.08***		–0.18	0.07	–0.14	0.01*	
PMC-5	–1.37	0.63	–0.12	0.01*		–1.35	0.69	–0.11	0.01*	
PMC-5 × ULS-8	–0.97	0.09	–0.05	0.30		0.07	0.10	0.03	0.51	

*CAGE-AID, CAGE adapted to include drugs scale; ULS-8: Loneliness, UCLA Loneliness Scale-8; and PMC-5, Pandemic Impact: Pain Management Collaboratory (PMC) 5-Item COVID Negative Impact Measure. *p < 0.05, **p < 0.01, and ***p < 0.001.*

life, had a unique and negative impact on veterans' physical health functioning during COVID-19. The entire model accounted for 9% of the variance in the physical functioning composite score.

DISCUSSION

The primary aim of this study was to describe the experience of the COVID-19 pandemic on United States veterans reporting problematic substance use and model the pandemic's impact on functioning. Overall, results showed that physical and mental health functioning during COVID-19 had been strongly and negatively impacted by pandemic-related decreases in important life domains and quarantine-related loneliness for veterans reporting substance use issues. As pandemic infection and death rates continue to wane and surge, such findings are important in understanding the unique issues that might arise for veterans in our community dealing with substance use concerns.

Pandemic Experiences, Behaviors, and Stressors for United States Veterans

To investigate our primary descriptive aim, United States veteran participants reported on a broad range of pandemic-related health experiences and safety behaviors during the COVID-19 pandemic. Though only 23% had a confirmed or assumed COVID-19 diagnosis at the time of this survey, a third had experienced a family member or close friend becoming infected. Additionally, of those without reported coronavirus, nearly all participants sampled reported stress related to themselves or someone close to them becoming infected. Given these concerns, it is unsurprising that there was a high rate of reported safety behaviors, including mask-wearing and social distancing—although not all participants reported these behaviors. This

finding suggests that similar to civilian populations (Knowles and Olatunji, 2021), there has been a wide range of accepted and applied COVID-19 infection-control activities within the United States veteran population. In addition, only about a third of the participants had attended at least one healthcare appointment (either telehealth or in-person), and 17.8% had canceled a healthcare appointment due to COVID-19. As 35% of our sample was not receiving healthcare at the VA and given the low rates of help-seeking yet high rates of comorbid mental and physical health concerns in the veteran population, this finding was particularly concerning. This disruption of healthcare services during COVID-19 is ongoing and suggests that the VHA should make strong attempts to enroll unconnected community veterans across the United States or reconnect with veterans who may have lapsed in their VHA healthcare utilization during the pandemic.

Our results also emphasized that many United States veterans reporting problematic substance use over the past year had increased their alcohol and non-prescription drug use during COVID-19 and attributed this increase specifically to the pandemic. This finding was most pronounced in drinking, where most participants reported an increase in drinking during the pandemic. Although all participants self-reported at least some problematic drug or alcohol use for study inclusion, only about a third of participants of our sample reported a formal substance use diagnosis. This discrepancy coincides with research showing problematic use of substances is perhaps more ubiquitous than during non-pandemic times (Satre et al., 2020), possibly as a means of coping with pandemic-related stressors (Wardell et al., 2020). However, other research suggests the COVID-19 related increases in substance use vary for different veteran populations, such as those with pre-COVID mental health concerns being associated with increased drinking (Davis et al., 2021; Pedersen et al., 2021). From a clinical perspective, this increase in substance use may be explained by additional underlying psychological mechanisms, such as cognitive process (e.g., Desire Thinking; Mansueto et al., 2019), psychiatric symptom management (Cosci et al., 2019), personality vulnerabilities such as impulsive sensation-seeking or behavioral disinhibition (Sher et al., 2000; Oh et al., 2021), and dysfunctional coping strategies (see Cavicchioli et al., 2018). These should be assessed in the future, to both investigate what factors may maintain increased COVID-19 substance use and as potential therapeutic targets for addictive behaviors interventions. Given our finding of increased substance use for many veterans, providers should be even more committed to screening patients, especially those with diagnosed mental health disorders, for potential SUDs during our continued COVID-19 pandemic management.

The Relationship Among Substance Issues, Pandemic Experiences, and Loneliness

To explore the physical and mental health functioning of these United States veterans during the pandemic, we investigated several potentially relevant variables hypothesized to be significantly associated with functioning. Consistent with our first hypotheses, higher subjective drug and alcohol concerns were related to lower mental and physical health functioning, similar to other research on substance misuse and functioning (e.g., Sheckter et al., 2020). Our second hypothesis, that negative COVID-19 impacts on quality of life (e.g., finances and meeting basic needs), greater self-reporting of problematic substance use, and COVID-19-related loneliness will have each a distinctive, significant negative physical and mental health functioning, was only partially supported by our data. Findings revealed COVID-19 related pandemic impacts and loneliness were negatively associated with both mental and physical functioning; indicating that distress due to the COVID-19 pandemic has strongly impacted both areas of functioning. This finding aligns with ongoing research into pandemic stressors and their impact on quality of life (Yu et al., 2021). Researchers are likely underestimating the negative impact of COVID-19 across multiple life domains and social isolation on United States veterans with SUD concerns in terms of functioning, treatment, and relapse rates (Linas et al., 2021). Our findings show that there have been serious, negative impacts reported by United States veterans due to COVID-19 on quality of life, social relationships, and substance use. Continued research during and beyond the pandemic should account for these stressors and model their long-term impact on SUD behaviors and coping.

Our final regression model assessing our second hypothesis highlighted that, when considered in conjunction with pandemic-related quality of life and COVID-19 related loneliness, problematic substance use behaviors alone did not significantly predict either mental or physical health functioning. Our *post hoc* interaction analysis, exploring the possibility that the negative impact of COVID-19 on quality of life and its relation to functioning might be moderated by reported levels of loneliness, was not supported. Instead, the final model highlighted the strong, main effect of negative COVID-19 impacts on quality of life and self-reported loneliness on decreased functioning for these veterans reporting problematic substance use concerns. The impact of COVID-19 related quality of life factors, such as financial well-being and being able to meet basic needs, emphasized the importance of attending to changes in SDH factors and environmental contexts when considering the physical and psychological functioning of veterans with substance use concerns. The strong association between loneliness and both physical and mental health functioning was also particularly important. This aligns with pre-pandemic evidence showing social support being associated with decreased all-cause mortality, cardiovascular disease, depression, and anxiety (Leigh-Hunt et al., 2017), and pandemic-specific research showing loneliness as a strong predictor of worse functioning, affective illness, and non-accidental self-injury (Greig et al., 2022). As loneliness can lead to worse outcomes, effective interventions that are also consistent with COVID-19 infection control and social distancing measures, such as those suggested in the systematic review by Williams et al. (2021), may be of particular importance in veteran treatment.

Given these findings, it is recommended that ongoing assessments of U.S. veterans' mental and physical health

functioning should evaluate not only addictive behaviors but also pandemic-related experiences and SDH. Particular emphasis should be placed upon assessing veterans' basic needs, financial insecurity, and loneliness, as these may be particularly predictive of physical and mental health functioning. These data align with decades of research into the importance of SDH impacting individuals with substance use concerns (Rhodes, 2002; Collins et al., 2019), highlighting that these factors may be even stronger determinants of functioning in the context of a global pandemic (Russell et al., 2021).

Limitations

A major limitation with this anonymous survey was having only self-reported data. First, all diagnoses were collected *via* participant self-report, with no diagnostic evaluation or medical record review conducted to confirm veteran's reported psychiatric, medical, and SUD diagnoses. Though a clinically validated screening instrument (CAGE-AID) was used to assess for problematic drug and alcohol use concerns, a more rigorous evaluation of substance use diagnostic criteria would have strengthened the study. Second, as changes in the frequency of use and cravings related to alcohol and drugs were also self-reported, responses might be subject to recall, response, and social desirability biases. Yet, most surveys are limited to recall limitations, and given the online and anonymous nature of the survey, biases in response and social desirability are likely low. In addition, generalizability of the current sample may be limited due to a sample that was less ethnically and racially diverse than the national United States veteran sample (i.e., sample is 90% White/Caucasian, whereas nationally, White/Caucasian veterans are 80% of the veteran population). Using a panel-recruited, web-based survey methodology may have been susceptible to fraudulent and biased responses. The research team implemented standardized quality control reviews, veteran status verification procedures, and data inclusion screening procedures to minimize this concern, including analysis of click-through behavior and scrubbing methods for web-based panel quality, resulting in higher confidence related to survey response quality. A final and important limitation of our study is that it was cross-sectional. We are thus unable to assess directionality or causality of the relationship between variables, limiting our ability to predict changes in substance use or functioning outside of participant self-report of such changes. Although logistic regressions to investigate COVID-19 related factors impacting changes in substance use may have added to this understanding, this analysis is beyond the scope of the current paper and will be examined in future analyses.

CONCLUSION

The level of anxiety and stress that the COVID-19 global pandemic has inflicted on the world is staggering. United States veterans struggling with alcohol and substance addiction have reported significant increases in substance use and feelings of pandemic-related anxiety. In addition to substance-use related concerns, pandemic-related stressors and loneliness have further diminished these veterans' physical and mental health. As the spread of vaccines curtails the potential impact of COVID-19, increased research on the mental health impact of the months-long lockdowns, variant impacts, and possibly years-long social distancing protocols have had on individuals suffering from substance use issues will need to be investigated. Future research using a community sample of United States veterans would benefit from both continued, longitudinal data collection and additional assessments of drug and alcohol use (e.g., the AUDIT or DAST). Additionally, future work should further investigate the underlying mechanisms of substance use changes, as well as moderating factors related to managing allostatic load and the impact of SDH during the pandemic, such as psychological flexibility. This would allow for the assessment of alcohol and drug use disorders diagnostically, while also modeling the impact of resiliency factors on health and functioning trajectories in this population. A better understanding of how veterans with self-reported problematic substance use have been both struggling and successfully navigating their unique COVID-19 societal conditions may provide further information on areas of future interventions.

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 VA Bedford Healthcare System Institutional Review Board. The patients/participants provided their informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ER, EC, BD, SS, JH, and MK conceived the study, provided conceptual guidance, and survey distribution procedures and data collection and contributed to writing the manuscript. ER organized, cleaned, and initially analyzed the data. ER, MK, and SS interpreted the data. All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by funds from the VISN 1 New England Mental Illness Research, Education, and Clinical Center (MIRECC) for COVID-19 veteran research (PI: ER). The findings and interpretations of the data expressed in the article are the sole responsibility of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

REFERENCES

Allen, J., Balfour, R., Bell, R., and Marmot, M. (2014). Social determinants of mental health. *Int. Rev. Psychiatry* 26, 392–407. doi: 10.3109/09540261.2014.928270

Ashman, T. A., Schwartz, M. E., Cantor, J. B., Hibbard, M. R., and Gordon, W. A. (2004). Screening for substance abuse in individuals with traumatic brain injury. *Brain Inj.* 18, 191–202. doi: 10.1080/0269905031000149506

Boden, M. T., and Hoggatt, K. J. (2018). Substance use disorders among veterans in a nationally representative sample: prevalence and associated functioning and treatment utilization. *J. Stud. Alcohol Drugs* 79, 853–861. doi: 10.15288/jsad.2018.79.853

Brailovskaia, J., Teismann, T., Friedrich, S., Schneider, S., and Margraf, J. (2021). Suicide ideation during the COVID-19 outbreak in German university students: comparison with pre-COVID 19 rates. *J. Affect. Disord. Rep.* 6:100228. doi: 10.1016/j.jadr.2021.100228

Brown, R. L., and Rounds, L. A. (1995). Conjoint screening questionnaires for alcohol and other drug abuse: criterion validity in a primary care practice. *Wis. Med. J.* 94, 135–140. PMID: 7778330

Cavicchioli, M., Vassena, G., Movalli, M., and Maffei, C. (2018). Addictive behaviors in alcohol use disorder: dysregulation of reward processing systems and maladaptive coping strategies. *J. Addict. Dis.* 37, 173–184. doi: 10.1080/10550887.2019.1643211

Cawthon, P., Orwoll, E., Ensrud, K., Cauley, J. A., Kritchevsky, S. B., Cummings, S. R., et al. (2020). Assessing the impact of the covid-19 pandemic and accompanying mitigation efforts on older adults. *J. Gerontol. A Biol. Sci. Med. Sci.* 75, e123–e125. doi: 10.1093/gerona/glaa099

Cohn-Schwartz, E., Vitman-Schorr, A., and Khalaila, R. (2021). Physical distancing is related to fewer electronic and in-person contacts and to increased loneliness during the COVID-19 pandemic among older Europeans. *Qual. Life Res.* 1–10. doi: 10.1007/s11136-021-02949-4 [Epub ahead of print].

Collins, A. B., Boyd, J., Cooper, H. L., and McNeil, R. (2019). The intersectional risk environment of people who use drugs. *Soc. Sci. Med.* 234:112384. doi: 10.1016/j.socscimed.2019.112384

Cooper, M. L., Frone, M. R., Russell, M., and Mudar, P. (1995). Drinking to regulate positive and negative emotions: a motivational model of alcohol use. *J. Pers. Soc. Psychol.* 69, 990–1005. doi: 10.1037/0022-3514.69.5.990

Cooper, M. L., Kuntsche, E., Levitt, A., Barber, L. L., and Wolf, S. (2016). "Motivational models of substance use: a review of theory and research on motives for using alcohol, marijuana, and tobacco" in *The Oxford Handbook of Substance Use and Substance Use Disorders. Vol. 1*. ed. K. J. Sher (New York, NY: Oxford University Press), 375–421.

Cosci, F., and Guidi, J. (2021). The role of illness behavior in the COVID-19 pandemic. *Psychother. Psychosom.* 90, 156–159. doi: 10.1159/000513968

Cosci, F., Mansueto, G., Zamboni, L., and Lugoboni, F. (2019). Cigarette smoking in subjects maintained with methadone or buprenorphine: The role of psychiatric symptoms and psychological distress. *J. Psychosom. Res.* 122, 82–87. doi: 10.1016/j.jpsychores.2019.04.009

Czeisler, M. E., Lane, R. I., Petrosky, E., Wiley, J. F., Christensen, A., Njai, R., et al. (2020). Mental health, substance use, and suicidal ideation during the COVID-19 pandemic—United States, June 24–30, 2020. *Morb. Mortal. Wkly Rep.* 69, 1049–1057. doi: 10.15585/mmwr.mm6932a1

Danese, A., and McEwen, B. S. (2012). Adverse childhood experiences, allostasis, allostatic load, and age-related disease. *Physiol. Behav.* 106, 29–39. doi: 10.1016/j.physbeh.2011.08.019

Davis, J. P., Prindle, J., Castro, C. C., Saba, S., Fitzke, R. E., and Pedersen, E. R. (2021). Changes in alcohol use during the COVID-19 pandemic among American veterans. *Addict. Behav.* 122:107052. doi: 10.1016/j.addbeh.2021.107052

Denny, K., and Brownell, M. (2010). Taking a social determinants perspective on children's health and development. *Can. J. Public Health* 101, S4–S7. doi: 10.1007/BF03403974

Du, J., Fan, N., Zhao, M., and Shi, J. (2020). Expert consensus on the prevention and treatment of substance use and addictive behaviour-related disorders during the COVID-19 pandemic. *Gen. Psychiatr.* 33:e100252. doi: 10.1136/gpsych-2020-100252

Emerick, T., Alter, B., Jarquin, S., Brancolini, S., Bernstein, C., Luong, K., et al. (2020). Telemedicine for chronic pain in the COVID-19 era and beyond. *Pain Med.* 21, 1743–1748. doi: 10.1093/pm/pnaa220

Fitzke, R. E., Wang, J., Davis, J. P., and Pedersen, E. R. (2021). Substance use, depression, and loneliness among American veterans during the COVID-19 pandemic. *Am. J. Addict.* 30, 552–559. doi: 10.1111/ajad.13211

Greig, F., Perera, G., Tsamakis, K., Stewart, R., Velayudhan, L., and Mueller, C. (2022). Loneliness in older adult mental health services during the COVID-19 pandemic and before: associations with disability, functioning and pharmacotherapy. *Int. J. Geriatr. Psychiatry* 37. doi: 10.1002/gps.5630 [Epub ahead of print].

Guerin, R. J., Barile, J. P., Thompson, W. W., McKnight-Eily, L., and Okun, A. H. (2021). Investigating the impact of job loss and decreased work hours on physical and mental health outcomes among US adults during the COVID-19 pandemic. *J. Occup. Environ. Med.* 63, e571–e579. doi: 10.1097/JOM.0000000000002288

Hays, R. D., and DiMatteo, M. R. (1987). A short-form measure of loneliness. *J. Pers. Assess.* 51, 69–81. doi: 10.1207/s15327752jpa5101_6

Heffner, J. L., Watson, N. L., Dahne, J., Croghan, I., Kelly, M. M., McClure, J. B., et al. (2021). Recognizing and preventing participant deception in online nicotine and tobacco research studies: suggested tactics and a call to action. *Nicotine Tob. Res.* 23, 1810–1812. doi: 10.1093/ntr/ntab077

Hochstatter, K. R., Akhtar, W. Z., Dietz, S., Pe-Romashko, K., Gustafson, D. H., Shah, D. V., et al. (2021). Potential influences of the COVID-19 pandemic on drug use and HIV care among people living with HIV and substance use disorders: experience from a pilot mHealth intervention. *AIDS Behav.* 25, 354–359. doi: 10.1007/s10461-020-02976-1

Hosseini Shokouh, S. M., Arab, M., Emamgholipour, S., Rashidian, A., Montazeri, A., and Zaboli, R. (2017). Conceptual models of social determinants of health: a narrative review. *Iran. J. Public Health* 46, 435–446.

Humeniuk, R.E., Henry-Edwards, S., Ali, R.L., Poznyak, V., and Monteiro, M. (2010). *The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): Manual for Use in Primary Care*. Geneva: World Health Organization

Ibarra, J. L., Agas, J. M., Lee, M., Pan, J. L., and Buttenheim, A. M. (2018). Comparison of online survey recruitment platforms for hard-to-reach pregnant smoking populations: feasibility study. *JMIR Res. Protoc.* 7:e101. doi: 10.2196/resprot.8071

Insider, V. A. (2020). How the Veterans Health Administration is responding to COVID-19. Available at https://vaww.insider.va.gov/how-the-veterans-health-administration-is-responding-to-covid-19/ (Accessed February 24, 2022).

Janulis, P., Newcomb, M. E., and Mustanski, B. (2021). Decrease in prevalence but increase in frequency of non-marijuana drug use following the onset of the COVID-19 pandemic in a large cohort of young men who have sex with men and young transgender women. *Drug Alcohol Depend.* 223:108701. doi: 10.1016/j.drugalcdep.2021.108701

Jones, D., Kazis, L., Lee, A., Rogers, W., Skinner, K., Cassar, L., et al. (2001). Health status assessments using the veterans SF-12 and SF-36: methods for evaluating outcomes in the veterans health administration. *J. Ambul. Care Manag.* 24, 68–86. doi: 10.1097/00004479-200107000-00011

Knowles, K. A., and Olatunji, B. O. (2021). Anxiety and safety behavior usage during the COVID-19 pandemic: the prospective role of contamination fear. *J. Anxiety Disord.* 77:102323. doi: 10.1016/j.janxdis.2020.102323

Leigh-Hunt, N., Bagguley, D., Bash, K., Turner, V., Turnbull, S., Valtorta, N., et al. (2017). An overview of systematic reviews on the public health consequences of social isolation and loneliness. *Public Health* 152, 157–171. doi: 10.1016/j.puhe.2017.07.035

Linas, B. P., Savinkina, A., Barbosa, C., Mueller, P. P., Cerdá, M., Keyes, K., et al. (2021). A clash of epidemics: impact of the COVID-19 pandemic response on opioid overdose. *J. Subst. Abus. Treat.* 120:108158. doi: 10.1016/j.jsat.2020.108158

Mana, A., Catz, O., Mana, Y., Neuman, M., Benheim, S., and Sagy, S. (2021). How do people cope during the COVID-19 pandemic and stay well? A salutogenic longitudinal study in Israel. *Front. Psychol.* 12:729543. doi: 10.3389/fpsyg.2021.729543

Mansueto, G., Martino, F., Palmieri, S., Scaini, S., Ruggiero, G. M., Sassaroli, S., et al. (2019). Desire thinking across addictive behaviours: a systematic review and meta-analysis. *Addict. Behav.* 98:106018. doi: 10.1016/j.addbeh.2019.06.007

Matthews, T. A., Chen, L., Chen, Z., Han, X., Shi, L., Li, Y., et al. (2021). Negative employment changes during the COVID-19 pandemic and psychological distress: evidence from a nationally representative survey in the US. *J. Occup. Environ. Med.* 63, 931–937. doi: 10.1097/JOM.0000000000002325

Morlock, R., Morlock, A., Downen, M., and Shah, S. N. (2021). COVID-19 prevalence and predictors in United States adults during peak stay-at-home orders. *PLoS One* 16:e0245586. doi: 10.1371/journal.pone.0245586

Niles, M. T., Beavers, A. W., Clay, L. A., Dougan, M. M., Pignotti, G. A., Rogus, S., et al. (2021). A multi-site analysis of the prevalence of food insecurity in the United States, before and during the COVID-19 pandemic. *Curr. Dev. Nutr.* 5:nzab135. doi: 10.1093/cdn/nzab135

Oh, H., Jang, S. K., Lee, H. S., Lee, E. B., and Choi, K. H. (2021). Personality traits in individuals with the dual diagnosis of psychosis and substance use disorders: a comprehensive review and meta-analysis. *J. Dual Diagn.* 17, 34–51. doi: 10.1080/15504263.2020.1839827

Oliva, E., Bowe, T., Tavakoli, S., Martins, S., Lewis, E., Paik, M., et al. (2017). Development and applications of the veterans health Administration's stratification tool for opioid risk mitigation (STORM) to improve opioid safety and prevent overdose and suicide. *Psychol. Serv.* 14, 34–49. doi: 10.1037/ser0000099

Ornell, F., Moura, H., Scherer, J., Pechansky, F., Kessler, F., and von Diemen, L. (2020). The COVID-19 pandemic and its impact on substance use: implications for prevention and treatment. *Psychiatry Res.* 289:113096. doi: 10.1016/j.psychres.2020.113096

Pedersen, E. R., Davis, J. P., Fitzke, R. E., Lee, D. S., and Saba, S. (2021). American veterans in the era of COVID-19: reactions to the pandemic, posttraumatic stress disorder, and substance use behaviors. *Int. J. Ment. Heal. Addict.* 26, 1–16. doi: 10.1007/s11469-021-00620-0

Pedersen, E. R., Naranjo, D., and Marshall, G. N. (2017). Recruitment and retention of young adult veteran drinkers using Facebook. *PLoS One* 12:e0172972. doi: 10.1371/journal.pone.0172972

Rhodes, T. (2002). The 'risk environment': a framework for understanding and reducing drug related harm. *Int. J. Drug Policy* 13, 85–94. doi: 10.1016/S0955-3959(02)00007-5

Roberts, A., Rogers, J., Mason, R., Siriwardena, A. N., Hogue, T., Whitley, G. A., et al. (2021). Alcohol and other substance use during the COVID-19 pandemic: a systematic review. *Drug Alcohol Depend.* 229:109150. doi: 10.1016/j.drugalcdep.2021.109150

Rogers, A. M., Lauren, B. N., Baidal, J. A. W., Ozanne, E. M., and Hur, C. (2021). Persistent effects of the COVID-19 pandemic on diet, exercise, risk for food insecurity, and quality of life: a longitudinal study among US adults. *Appetite* 167:105639. doi: 10.1016/j.appet.2021.105639

Russell, C., Ali, F., Nafeh, F., Rehm, J., LeBlanc, S., and Elton-Marshall, T. (2021). Identifying the impacts of the covid-19 pandemic on service access for people who use drugs (PWUD): a national qualitative study. *J. Subst. Abus. Treat.* 129:108374. doi: 10.1016/j.jsat.2021.108374

Salyers, M. P., Bosworth, H. B., Swanson, J. W., Lamb-Pagone, J., and Osher, F. C. (2000). Reliability and validity of the SF-12 health survey among people with severe mental illness. *Med. Care* 38, 1141–1150. doi: 10.1097/00005650-200011000-00008

Satre, D. D., Hirschtritt, M. E., Silverberg, M. J., and Sterling, S. A. (2020). Addressing problems with alcohol and other substances among older adults during the COVID-19 pandemic. *Am. J. Geriatr. Psychiatry* 28, 780–783. doi: 10.1016/j.jagp.2020.04.012

Sheckter, C. C., Li, K., Carrougher, G. J., Pham, T. N., Gibran, N. S., and Stewart, B. T. (2020). The impact of comorbid conditions on long-term patient-reported outcomes from burn survivors. *J. Burn Care Res.* 41, 956–962. doi: 10.1093/jbcr/iraa090

Sher, K. J., Bartholow, B. D., and Wood, M. D. (2000). Personality and substance use disorders: a prospective study. *J. Consult. Clin. Psychol.* 68, 818–829.

Sullivan, E., and Fleming, M. (2008). A Guide to Substance Abuse Services for Primary Care Clinicians. Treatment Improvement Protocol (TIP) Series. U.S. Department of Health and Human Services, Publication No. (SMA) 08-4075. Available at: https://store.samhsa.gov/sites/default/files/SAMHSA_Digital_Download/SMA08-4075_508.pdf (Accessed February 1, 2022).

Tabachnick, B. G., and Fidell, L. S. (2007). *Using Multivariate Statistics. 5th Edn.* New York: Allyn and Bacon.

Talcott, W. J., James, B. Y., Gross, C. P., and Park, H. S. (2021). Social connectedness among medicare beneficiaries following the onset of the COVID-19 pandemic. *JAMA Intern. Med.* 181, 1245–1248. doi: 10.1001/jamainternmed.2021.2348

Teeters, J. B., Lancaster, C. L., Brown, D. G., and Back, S. E. (2017). Substance use disorders in military veterans: prevalence and treatment challenges. *Subst. Abus. Rehabil.* 8, 69–77. doi: 10.2147/SAR.S116720

The Nielsen Company (2020). Rebalancing the 'COVID-19 Effect' on alcohol sales. Available at: https://www.nielsen.com/us/en/insights/article/2020/rebalancing-the-covid-19-effect-on-alcohol-sales/ (Accessed February 6, 2022).

Thisted, R. A. (2003). Are there social determinants of health and disease? *Perspect. Biol. Med.* 46, S65–S73. doi: 10.1353/pbm.2003.0062

Volkow, N. (2020). COVID-19: Potential Implications for Individuals with Substance Use Disorders: National Institute On Drug Abuse. [online] National Institute on Drug Abuse. Available at: https://www.drugabuse.gov/about-nida/noras-blog/2020/04/covid-19-potential-implications-individuals-substance-use-disorders (Accessed July 2, 2020).

Walter, S. L., Seibert, S. E., Goering, D., and O'Boyle, E. H. (2019). A tale of two sample sources: do results from online panel data and conventional data converge? *J. Bus. Psychol.* 34, 425–452. doi: 10.1007/s10869-018-9552-y

Wardell, J. D., Kempe, T., Rapinda, K. K., Single, A., Bilevicius, E., Frohlich, J. R., et al. (2020). Drinking to cope during COVID-19 pandemic: the role of external and internal factors in coping motive pathways to alcohol use, solitary drinking, and alcohol problems. *Alcohol. Clin. Exp. Res.* 44, 2073–2083. doi: 10.31234/osf.io/8vfp9

Ware, J. E. Jr., Kosinski, M., and Keller, S. D. (1996). A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. *Med. Care* 34, 220–233. doi: 10.1097/00005650-199603000-00003

Williams, C. Y., Townson, A. T., Kapur, M., Ferreira, A. F., Nunn, R., Galante, J., et al. (2021). Interventions to reduce social isolation and loneliness during COVID-19 physical distancing measures: a rapid systematic review. *PLoS One* 16:e0247139. doi: 10.1371/journal.pone.0247139

World Health Organization (2021). Social determinants of health. Available at: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1 (Accessed February 4, 2022).

Yu, L., Kioskli, K., and McCracken, L. M. (2021). Psychological functioning in the COVID-19 pandemic and its association with psychological flexibility and broader functioning in people with chronic pain. *J. Pain* 22, 926–939. doi: 10.1016/j.jpain.2021.02.011

Zhang, Y., Cao, X., Wang, P., Wang, G., Lei, G., Shou, Z., et al. (2020). Emotional "inflection point" in public health emergencies with the 2019 new coronavirus pneumonia (NCP) in China. *J. Affect. Disord.* 276, 797–803. doi: 10.1016/j.jad.2020.07.097

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.

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 01 August 2022
DOI 10.3389/fpsyg.2022.926697

OPEN ACCESS

EDITED BY
Xiaohuan Xia,
Tongji Hospital Affiliated to Tongji University, China

REVIEWED BY
Yi Wang,
Tongji University, China
Stephen Wai Hang Kwok,
Hong Kong Polytechnic University, Hong Kong SAR, China

*CORRESPONDENCE
Robin L. Aupperle
raupperle@laureateinstitute.org

†These authors share first authorship

SPECIALTY SECTION
This article was submitted to Psychology for Clinical Settings, a section of the journal Frontiers in Psychology

RECEIVED 22 April 2022
ACCEPTED 05 July 2022
PUBLISHED 01 August 2022

CITATION
Akeman E, Cannon MJ, Kirlic N, Cosgrove KT, DeVille DC, McDermott TJ, White EJ, Cohen ZP, Forthman KL, Paulus MP and Aupperle RL (2022) Active coping strategies and less pre-pandemic alcohol use relate to college student mental health during the COVID-19 pandemic.
Front. Psychol. 13:926697.
doi: 10.3389/fpsyg.2022.926697

Active coping strategies and less pre-pandemic alcohol use relate to college student mental health during the COVID-19 pandemic

Elisabeth Akeman[1†], Mallory J. Cannon[1†], Namik Kirlic[1,2], Kelly T. Cosgrove[1,3], Danielle C. DeVille[1,3], Timothy J. McDermott[1,3], Evan J. White[1,2], Zsofia P. Cohen[1,4], K. L. Forthman[1], Martin P. Paulus[1,2] and Robin L. Aupperle[1,2*]

[1]Laureate Institute for Brain Research, Tulsa, OK, United States, [2]School of Community Medicine, The University of Tulsa, Tulsa, OK, United States, [3]Department of Psychology, The University of Tulsa, Tulsa, OK, United States, [4]Department of Psychology, Oklahoma State University, Stillwater, OK, United States

Objective: To further delineate risk and resilience factors contributing to trajectories of mental health symptoms experienced by college students through the pandemic.

Participants: *n* = 183 college students (67.2% female).

Methods: Linear mixed models examined time effects on depression and anxiety. Propensity-matched subgroups exhibiting "increased" versus "low and stable" depression symptoms from before to after the pandemic-onset were compared on pre-pandemic demographic and psychological factors and COVID-related experiences and coping strategies.

Results: Students experienced worsening of mental health symptoms throughout the pandemic, particularly during Fall 2020 compared with Fall 2019 (Depression scale $d = -0.43$ [95% CI: −0.65 to −0.21]). The propensity-matched subgroup exhibiting relative resilience ("low and stable" symptoms) reported less alcohol use prior to the pandemic, greater use of active coping strategies, and less of an impact on their college progress.

Conclusions: Results point to several potential targets of screening and intervention to decrease residual impacts of the pandemic.

KEYWORDS

college, depression, anxiety, COVID-19, resilience

Introduction

On January 30, 2020, the World Health Organization declared the COVID-19 (i.e., SARS-CoV-2) outbreak a public health emergency of international concern (World Health Organization, 2020). In March and April 2020, the United States began implementing safety protocols to limit the spread of the virus. Safety provisions included

mask mandates, social distancing measures, and lockdowns (Centers for Disease Control and Prevention, 2020). For many, this marked a dramatic life change, cutting people off from friends and family, introducing increased health and financial concerns, and restricted everyday activities. The global influence of COVID-19 also provides an opportunity to examine the vulnerability and resilience factors moderating the impact of a severe life event. Delineating pre-existing and concurrent psychological, behavioral, and environmental factors that increased risk for or protect against negative mental health outcomes during the COVID-19 pandemic will be useful for informing how we may optimize responses to future negative world events and enhance human resilience in general.

Previous research indicates that the COVID-19 pandemic has had detrimental effects on the psychological and emotional health of the general population, contributing to increased depression, anxiety, and loneliness (Marroquín et al., 2020; Tull et al., 2020). However, some studies have reported no change or even a decline in mental health symptoms (e.g., decreased suicide rates) (Pirkis et al., 2021). There is some evidence to suggest that the COVID-19 pandemic and related social distancing measures may have had a particularly negative impact on the mental health of young adults, including college students specifically (Kecojevic et al., 2020; Son et al., 2020). Previous research has highlighted that college is a significant stressor and that college students are at greater risk for developing mental health disorders than the general population (Hunt and Eisenberg, 2010). Pre-pandemic, the 1-year prevalence rate of anxiety and depressive disorders in college students was estimated between 15 and 30% (compared with rates between 7 and 18% for the general adult population) (Kessler et al., 2005; Hunt and Eisenberg, 2010; Ibrahim et al., 2013). Concerns about college student mental health have only been strengthened with the onset of the COVID-19 pandemic, as over 70% of college students report increased stress and anxiety because of the pandemic and an estimated 48% experience moderate to severe levels of depression after the onset of the pandemic (Hunt and Eisenberg, 2010; Son et al., 2020; Wang X. et al., 2020).

There are numerous factors related to the COVID-19 pandemic response that have likely impacted college student mental health. For example, students have faced not only concerns about the virus itself and social isolation but also disruptions in academic progress toward graduation, sudden changes in the structure of coursework (i.e., to virtual format), financial hardships, and decreased job opportunities (Lederer et al., 2020; Hawley et al., 2021). Previous research has reported that students' greatest concerns during the pandemic include worry for their health and that of their families, disruption of sleep patterns, difficulty concentrating, and increased concern for academic performance (Son et al., 2020).

Prior studies have also identified coping strategies that individuals have found helpful in managing their wellbeing during the COVID-19 pandemic. Research suggests that approach-based coping strategies, positive reframing, access to social support, and findings ways to stay connected with friends and family, healthy lifestyle activities (e.g., exercise, sleep, healthy eating, self-care), engagement in faith-based activities, and access to and use of greenspace may be beneficial (Wang S. et al., 2020; Cohen et al., 2021; Shamblaw et al., 2021; Soga et al., 2021). On the other hand, maladaptive coping strategies such as distraction techniques, excessive alcohol use, denial, and isolation, have been associated with lower levels of mental health and quality of life in response to the COVID-19 pandemic (Wang X. et al., 2020; Shamblaw et al., 2021).

Studies have identified numerous pre-pandemic risk factors that may impact a person's likelihood of developing mental health symptoms in response to the pandemic. These include having a history of mental health symptoms, being single or divorced, lower education level, frequent exposure to COVID-related news, or identifying as a racial minority or LGBTQ+ (Gonzales et al., 2020; Xiong et al., 2020; Fruehwirth et al., 2021). Researchers have also identified potential resilience factors, that is, potential reasons that one may be able to better adapt and cope with the pandemic including optimism, religiosity or faith, greater levels of social support, approach-based coping strategies (Lawal et al., 2020; Pirutinsky et al., 2020; Wang S. et al., 2020; Vos et al., 2021).

There have only been a few studies reporting changes in mental health from before to after the pandemic for the same population of students (Copeland et al., 2021). The current study sought to extend previous work by (1) examining the trajectory of depression and anxiety symptoms for a cohort of college students who were followed from 1 year before to approximately 6 months after the COVID-19 pandemic began and (2) identify factors contributing to different trajectories of mental health response. For the latter, groups of students matched on sociodemographic variables and pre-pandemic mental health symptoms who showed different trajectories of response to the COVID-19 pandemic were identified to enable examination of (1) pre-pandemic external/environmental and internal/psychological factors and (2) COVID-related experiences and coping strategies, that contributed to mental health trajectory.

Materials and methods

Participants

Participants in this study were students from a private, mid-Western university who voluntarily enrolled in a larger, longitudinal study designed to increase resilience in university students during their first year (Akeman et al., 2019). Participants were recruited during the first semester of their enrollment at the college (Fall semester, cohorts recruited in

2016, 2017, and 2018) as part of a previously conducted clinical trial. Participants were asked to complete demographic and self-report measures at the beginning of their first semester of college and once per semester thereafter for the following 5 years. The current analysis focused on a sample of 177 students (67.8% female) who completed surveys during at least one of the three timepoints prior to the start of the COVID-19 pandemic (Spring 2019, Summer 2019, and Fall 2019), and the timepoint after the start of the COVID-19 pandemic, in which we added surveys specifically related to their experiences related to COVID-19 (Summer 2020). Included in analysis were also timepoints corresponding to the semester in which the pandemic began but no COVID-19 related surveys were implemented yet (Spring 2020) and the Fall 2020 timepoint in which all surveys (including COVID-19 specific surveys) were repeated. Thus, in total, we included data from three time points prior to the beginning of the COVID-19 pandemic and three timepoints at or after the start of the pandemic. A timeline of state and local government restrictions and trajectory of total cases in the region in relation to study survey time points is provided in **Supplementary Figure 1**. The participants included in the current study overlap with the participants included in a previous study examining clinical outcomes of a resilience-based intervention for first-year college students (Akeman et al., 2019).

Participants were excluded if they were under 18 years of age, not in their first year of college, unable to understand the consent form or surveys presented in English, or if they reported significant mental or physical health problems requiring immediate medical attention. In accordance with federal and university regulations preventing students on international visas from receiving research compensation, these students were also excluded. All students provided written informed consent prior to participation and were compensated for their time. Research was approved by the Western Institutional Review Board and conducted in accordance with the World Medical Association Declaration of Helsinki. The study was registered at the United States National Institutes of Health (ClinicalTrials.gov #NCT02982070).

Measures

All measures were completed via secure survey links through Research Electronic Data Capture (REDCap) (Harris et al., 2009). This survey capture method is designed in a way that all fields must be completed before submission, thereby eliminating missing questions within surveys. Demographic surveys obtained information related to gender, race, ethnicity, current college within the university (Arts and Sciences, Business, etc.), parent/household income, financial aid amount received for college, whether they were the first in their family to attend college, and whether they had received psychological treatment. The primary outcome measure was the National Institute of Health Patient Reported Outcome Measurement Information System (PROMIS) computer adaptive Depression symptom measure, with the PROMIS Anxiety symptom measure serving as a secondary outcome (Cella et al., 2010; Gershon et al., 2010). PROMIS Depression was selected as the primary outcome based on previous literature which highlighted the prevalence of depression with the COVID-19 pandemic (Ettman et al., 2020; Wang X. et al., 2020; Bueno-Notivol et al., 2021). Other measures of interest for assessing pre-pandemic psychological risk and resilience included PROMIS measures for sleep impairment, sleep disturbance, social isolation, emotional support, and informational support (Cella et al., 2010; Gershon et al., 2010); NIH Toolbox measures for meaning and purpose, positive affect, friendship, self-efficacy, and perceived stress (Salsman et al., 2013a,b, 2014), the Connor-Davidson Resilience Scale (CD-RISC 10) total score (Connor and Davidson, 2003); the Emotion Regulation Questionnaire (ERQ) total, reappraisal, and suppression subscale scores (Gross and John, 2003); Alcohol, Smoking and Substance Involvement Screening Test (Group, 2002) for assessing alcohol and cannabis use (Group, 2002), the Epworth Sleepiness Scale (ESS) (Johns, 1992); and an item asking students to rate how important religion is to them on a 1–7 Likert scale.

For Summer and Fall 2020 time points (i.e., after pandemic onset), participants also completed surveys consisting of (1) aspects of the COVID-19 Adolescent Symptom & Psychological Experience Questionnaire [CASPE (Ladouceur, 2020)] and (2) the COVID Wellbeing scales (Veldhuis et al., 2021). For current analysis, we focused on (1) the Brief Cope Scale, which asked students to rate how often they utilize different coping skills "right now" and results in subscales for acceptance, distraction, active coping, denial, substance use, emotional support, instrumental support, behavioral disengagement, venting, positive reframing, planning, faith or religion, humor, and self-blame, (2) COVID Wellbeing scale in which students indicated how much they are worried "right now" about the following aspects of the COVID-19 outbreak (rated on a scale of 0–100): the coronavirus, their own health, their family's health, money, their job, their future, and their performance at college (added specifically for this study), and (3) a scale in which participants rated how much time they were spending on the following activities each day: school work, social media, video games, reading books, talking to friends and family, engaging in fun activities, work, exercising, watching/reading the news, or watching tv/movies. Additional variables of interest included whether the participant, family member, friend, or anyone they knew had been diagnosed or were hospitalized with COVID-19, as well as whether anyone in their family had died due to COVID-19, the level of engagement in social distancing, and one's political views (rated 1–8, with 1 = extremely liberal and 8 = extremely conservative). This latter variable was included because political views have the potential to relate to one's experience and opinions concerning the COVID-19 pandemic

and given that the COVID-19 pandemic was overlaid upon a relatively tumultuous political context in the United States (Bruine de Bruin et al., 2020; Calvillo et al., 2020).

Statistical analysis

Statistical analyses were conducted using R 4.0.4 (R Core Team, 2021). Linear mixed models (LMM); conducted by "lme4" package (Bates et al., 2015), with subject entered as a random effect, were used to determine whether there were time effects on depression (primary outcome) and anxiety (secondary outcome) symptoms. The inclusion of potential covariates (gender; college; cohort) were determined by comparing models using the Bayesian Information Criterion (Bicanic et al., 2015). The use of LMM allowed for the inclusion of participants who may have not completed some timepoints, while making use of the data that was available for each participant. Thresholds for significance for symptom outcomes was set to $p < 0.05$. Tukey's HSD (honestly significant difference) tests were used to examine differences between paired time points from before to after the beginning of the pandemic (i.e., comparing Spring 2019 to Spring 2020; Summer 2019 to Summer 2020; and Fall 2019 to Fall 2020), with confidence intervals and effect sizes estimated using the "emmeans" package (Russell, 2021).

Subgroups of participants were identified concerning the profile of symptom response to the COVID-19 pandemic. Specifically, we identified three groups of students (1) Increased depression: those whose average PROMIS Depression scale after the start of the pandemic was at least 3.5 points higher than the average before the start of the pandemic, (2) High stable depression: those with less than 3.5 points increase on PROMIS Depression (or a decrease in symptoms) but with relatively high pre-pandemic symptoms (>55 T score, averaged across pre-pandemic time points), and (3) Low stable depression: those with less than 3.5 points increase on PROMIS Depression (or a decrease in symptoms) but with relatively low pre-pandemic symptoms (<55 T score, averaged across pre-pandemic time points). The cutoff of 3.5 T points for change in symptoms and the cutoff of $T = 55$ for symptom severity was based on the minimally important difference (MID) and the cutoff associated with mild symptom severity identified in previous research on the PROMIS Depression scale (Kroenke et al., 2020). To support analysis identifying factors that may contribute to students' mental health risk versus resilience with the COVID-19 pandemic, we focused on the "increased" and the "low stable" depression groups. Focusing on these two groups allowed for us to compare subgroups that had similar pre-pandemic symptom measures but for whom the mental health response to the pandemic differed (whereas we were unable to match pre-pandemic symptoms for the "high stable" group with the other groups). Using the "MatchIt" package (method = "optimal"; distance = "glm") (Ho et al., 2011), we identified cases in the "low stable" group that matched the "increased" group on gender, race (binary variable: minority, white), ethnicity (binary: Hispanic vs. non-Hispanic), cohort (2016, 2017, 2018), and pre-pandemic average PROMIS Depression score. This resulted in a total sample of 63 2 126 for analysis with the matched groups. We chose to use optimal pair matching, as it minimizes the sum of the absolute pairwise distances in the matched samples.

Mann-Whitney tests and chi-square analyses were used to compare these groups on the following COVID-related experiences and responses: (1) COVID-19 health experiences (i.e., having or knowing others with COVID, hospitalized for COVID, or dying of COVID) and level of social distancing endorsed (using Bonferroni-corrected p-value threshold of 0.008), (2) Brief Cope Scale subscales (corrected $p < 0.004$), (3) COVID Wellbeing subscales, where participants endorsed their level of worry concerning seven COVID-related domains (corrected $p < 0.007$), and (4) whether they endorsed that their college progress or performance had been impacted by the COVID-19 pandemic (corrected $p < 0.025$).

In addition, Mann-Whitney tests (using packages "stats" and "rstatix" (Kassambara, 2021)were used to compare groups on pre-pandemic scales related to risk and resilience factors. Given the number of scales collected in this regard (19 variables collected across three pre-pandemic time points), GFA was conducted to identify latent factors. GFA was performed using the "optmThrGFA" package (Forthman and Yeh, 2021) which extends the GFA package developed by Leppäaho et al. (2017) by optimizing the parameters. The GFA method developed by Leppäaho et al. builds on previous group factor analysis by applying an advanced structural sparsity prior that does not assume the groups are independent, enabling the examination of variance within a set of variables, but also covariance between the sets (i.e., time points) (Klami et al., 2015). The optmThrGFA package runs the GFA multiple times in order to identify robust factors (factors that are replicated across repetitions of the GFA). We sought to identify factors accounting for at least 5% of model variance either overall or within a group of variables (i.e., at each time point). Our subsequent analyses examining potential pre-pandemic risk and resilience factors relating to group ("increased" versus "low stable") aimed to focused on any GFA factors identified as well as any individual variables of interest that did not load strongly onto a factor but were of specific interest in relation to outcomes (using Bonferroni correction for multiple comparisons).

If any set of the above Mann-Whitney or chi-squared analyses identified variables that may be meaningful in predicting group, we entered these variables into a stepwise binomial logistic regression using the "stats" (R Core Team, 2021) and "aod" (Lesnoff and Lancelot, 2012) packages to identify the combined utility of these variables for group prediction.

Results

Changes in symptoms over time

Baseline demographics for the entire sample are shown in Table 1. Results from LMM (with gender included as a covariate, determined via BIC) and Tukey's HSD tests are provided in Table 2. Results revealed a significant increase in depression symptoms over time (see Figure 1) and Tukey's HSD tests indicated significantly greater depression symptoms for Summer 2020 compared with Summer 2019 and for Fall, 2020 compared with Fall, 2019, but not when comparing Spring 2020 with Spring 2019. The gender effect was characterized by higher depression symptoms reported by female than male participants. There was also an overall effect of increasing anxiety symptoms over time, but without significant differences when comparing the specific corresponding time points using Tukey's HSD. The gender effect was again characterized by higher anxiety symptoms reported by female than male participants.

Subgroups were identified that exhibited "increased depression" (N = 63; an increase in >3.5 T points from the average of symptoms pre-pandemic to the average of symptoms since the start of the pandemic); "low stable depression" (N = 79; mean pre-pandemic symptoms < 55 and change of < 3.5 T-score points from before to after the start of the pandemic); and "high stable" depression (N = 41; mean pre-pandemic symptoms >55 and change of < 3.5 T-score points). Demographic information for these subgroups is provided in Supplementary Table 1. Notably, this original "increased" depression group was more female, Hispanic, and more likely to report household income < $100,000, corroborating how the pandemic may have disproportionately impacted some demographic groups more than others (Phiri et al., 2021). To support analyses examining psychological and COVID-related variables that may have predicted mental health trajectories, propensity matching was used to match the "low stable" group to the "increased" group in relation to gender, race (binary variable: minority, white), ethnicity (binary: Hispanic vs. non-Hispanic), cohort (2016, 2017, 2018), and pre-pandemic average PROMIS Depression score, resulting in groups of N = 63 each. See Table 3 for demographic information for these matched groups.

TABLE 1 Demographics.

	N = 183
Age, Mean (SD)	20.08 (1.33)
Gender, N (%)	
Female	123 (67.2%)
Male	58 (31.7%)
Other	2 (1.1%)
Ethnicity, N = Non-Hispanic (%)	166 (90.7%)
Race, N (%)	
American Indian	3 (1.6%)
Asian Indian	3 (1.6%)
Black	11 (6.0%)
Chinese	4 (2.2)%
Korean	2 (1.1%)
Middle Eastern	1 (0.5%)
Multi-Race	17 (9.3%)
Other	2 (1.1%)
Other Asian	5 (2.7%)
White	135 (73.8%)
Annual parent or household income, N (%)	
$50,000 and less	59 (32.2%)
$50,000 – $100,000	54 (29.5%)
$100,000 – $150,000	34 (18.6%)
$150,000 and over	36 (19.7%)
Psychotropic medication, N = yes (%)	11 (6.0%)
Consent Year, N (%)	
2016	45 (24.6%)
2017	63 (34.4%)
2018	75 (41.0%)
Resilience training, N (%)	80 (43.7%)
College, N (%)	
A&S college	48 (26.2%)
Business college	24 (13.1%)
Eng&NS college	67 (36.6%)
HS college	44 (24.0%)
First in college, N (%)	
Yes	24 (13.1%)
No	157 (85.8%)
Uncertain	2 (1.1%)
Number completing each time point (based on PROMIS Depression scale)	
Spring, 2019	171
Summer, 2019	153
Fall, 2019	176
Spring, 2020	151
Summer, 2020	183
Fall, 2020	155

A&S, arts and sciences; HS, health sciences; Eng&NS, engineering and natural sciences; PROMIS, patient reported outcome measurement information system.

Group factor analysis of pre-pandemic risk/resilience factors

Only one factor explained >5% variance across blocks (Factor 1). This factor, exhibited moderate to high positive loadings for risk variables (i.e., >0.40 for sleep impairment, sleep disturbance, social isolation) and negative loadings for resilience variables (i.e., <−0.40 for emotional and information support, meaning and purpose, friendship, self-efficacy, and ERQ reappraisal; see Supplementary Figures 2, 3 and Supplementary Table 2 for further detail on factor analysis

TABLE 2 Changes in symptoms over time.

Variables	*F*	*p*	*t*	*p*	*Cohen's d*	95% CI	
						Lower	Upper
Model for PROMIS depression	9.71	<0.001					
Time							
Summer 2019 vs. 2020			−2.03	0.015	−0.36	−0.58	−0.14
Fall 2019 vs. 2020			−2.40	0.002	−0.42	−0.64	−0.20
Spring 2019 vs. 2020			−2.31	0.191	−0.26	−0.48	−0.038
Gender							
Female vs. Male			10.43	<0.001	0.83	0.47	1.19
Model for PROMIS anxiety	9.42	<0.001					
Time							
Summer 2019 vs. 2020			−1.80	0.102	−0.29	−0.50	−0.067
Fall 2019 vs. 2020			−1.62	0.702	−0.26	−0.48	−0.037
Spring 2019 vs. 2020			−1.74	0.508	−0.20	−0.42	−0.027
Gender							
Female vs. Male			6.00	<0.001	0.95	0.57	1.33

PROMIS, patient reporting outcome measurement information system; CI, confidence interval. Degrees of freedom (df) for the time effect on depression and anxiety symptoms from the linear mixed model were df1 = 5, df2 = 799; the df = 799 for Tukey's HSD (honestly significant difference) test comparing specific time points.

results and loadings). Thus, this factor was termed a "general risk factor." No additional factors were identified that explained significant variance or included substantial loadings by more than one variable. Thus, in subsequent analysis to identify pre-pandemic risk/resilience variables that may predict trajectory of response to COVID, we used the Factor 1 score and the individual scores from the additional measures that did not load >0.30 onto this factor (i.e., alcohol use, cannabis use, and total occurrence of traumatic events; corrected $p < 0.008$).

Variables collected after the start of the pandemic relating to symptom trajectory

Very few students in the current sample endorsed being diagnosed with COVID-19 (3 in the "increased depression," 2 in the "low stable" depression groups) and there were no participants who endorsed that they had been hospitalized with COVID-19. The matched "increased" and "low stable" depression groups did not differ significantly on whether they knew someone who had COVID-19 (43 in "low stable" group; 40 in the "increased" group; X^2 (1) = 1.00, p = 0.317, 1.00, OR = 1.40 [95% CI: 0.72 – 2.72]), had someone in the household who had COVID-19 (7 in "low stable" group; 6 in "increased" group; X^2 (1) = 0.00, p = 1.00, OR = NA), or had a friend diagnosed with COVID-19 (8 in the "low stable" group; 7 in the "increased" group): X^2 (1) = 0.34, p = 0.56, OR = 1.22 [95% CI: 0.63 – 2.38]). While those in the "increased" group reported knowing more people who had been hospitalized (N = 16 or 25%) or died (N = 7 or 11%) due to COVID-19 than those in the "low stable" group (hospitalized: N = 10 or 16%; death by COVID-19: N = 2 or 3%), though these differences were not statistically significant (hospitalized: X^2 (1) = 1.21, p = 0.271, OR = 1.43 [95% CI: 0.76 – 2.70]; death by COVID-19: X^2 (1) = 1.92, p = 0.167, OR = 1.43 [95% CI = 0.76 – 2.70]) though the ability to detect statistical differences was likely impacted by the low incidence rate. There were no group differences in the level of social distancing endorsed at either post-pandemic time point (Summer 2020: W = 2,043, p = 0.77, r = 0.026; Fall 2020: W = 1,332, p = 0.635, r = 0.046). There were group differences in political leanings, with the "increased" group rating themselves as somewhat more liberal on average (Summer: W = 1552.5, p = 0.033 r = 0.19; Fall: W = 1,073, p = 0.048, r = 0.19).

For the Brief Cope Scale, the "low stable" depression group (compared with the "increased" depression group) exhibited greater scores on the active coping (W = 1,380, p = 0.003, r = 0.26), positive reframing (W = 1,528, p = 0.026, r = 0.35), and religion subscales (W = 1506.5, p = 0.018, r = 0.21), as well as lower scores on the behavioral disengagement subscale (W = 2,752, $p < 0.001$, r = 0.35; see **Figure 2** and **Supplementary Table 3** for statistical results for all subscales), though only the active coping and behavioral disengagement subscales would meet specified multiple comparison correction thresholds. These four variables were entered into a stepwise binomial logistic regression predicting group status, which identified a model that included only active coping (B = −0.22, SE B = 0.13, Z = −1.67, p = 0.095; OR: 0.80 [95% CI: 0.62 – 1.04]) and behavioral disengagement (B = 0.71, SE B = 0.22, Z = 3.24, p = 0.001; OR = 2.03 [95% CI: 1.35 – 3.20]) and had a classification accuracy of 62.70%.

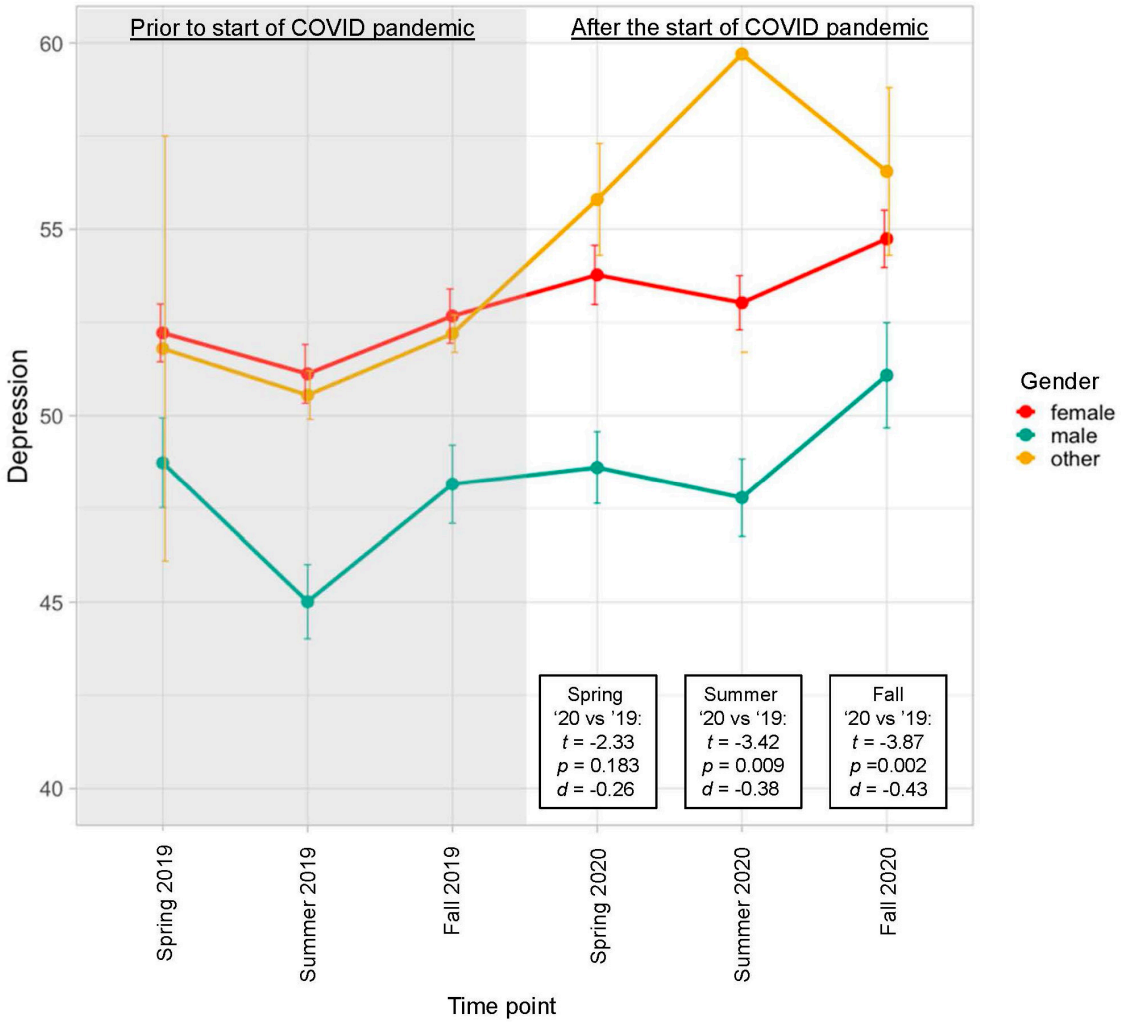


FIGURE 1
Average depression symptom severity reported over time by group. Linear mixed effects models (with gender included as a covariate, determined via BIC) revealed a significant increase in symptoms over time [$F(5,807) = 10.36$, $p < 0.001$]. T statistics listed in the figure were obtained from Tukey's HSD tests comparing corresponding time points from 2020 to 2019.

Across groups, the areas that participants endorsed worrying about the most since the start of the pandemic was their family's health and their future (see Figure 3). The "increased" and "low stable" depression groups did not differ significantly on any of the domains of worry associated with COVID-19 (i.e., about COVID, their own or family's health, money, job, future, college performance; all *p*s > 0.10; see Supplementary Table 4 for full statistical results). However, those in the "increased" group were more likely to report their college progress being slowed due to COVID-19 then the "low stable" group (X^2 (1) = 5.45, $p = 0.020$. *OR* = 2.16 [95% *CI*: 1.15 – 4.76]) but were not significantly more likely to endorse that their college performance had been impacted (endorsed by 19 in the "increased" group, 15 in the "low stable" group; X^2 (1) = 0.31, $p = 0.577$ *OR* = 1.20 [95% *CI*: 0.64 – 2.25]).

Variables collected pre-pandemic relating to symptom trajectory

In regard to pre-pandemic risk and resilience factors, the groups did not differ on the general risk factor identified by the GFA (W = 1,208, p = 0.908, r = 0.012) or on the total occurrence of past traumatic events (W = 2,096, p = 0.57, r = 0.048). However, there were trend differences in alcohol (W = 2,394, p = 0.038, r = 0.19) and cannabis use (W = 2,209, p = 0.092, r = 0.15), in which the "increased" depression groups exhibited higher levels of use pre-pandemic then the "low stable" group (see Supplementary Table 5 for descriptive and full statistical results). When entered into a stepwise binomial logistic regression, the model identified only included alcohol use (B = 0.14, SE B = 0.062, Z = 2.26,

TABLE 3 Overall demographics with matched groups.

	Increased (*N* = 63)	Low stable (*N* = 63)	*p*
Age, Mean (SD)	19.97 (0.95)	19.91 (0.98)	0.75
Gender, N (%)			0.245
Female	46 (73.0%)	43 (68.3%)	
Male	15 (23.8%)	20 (31.7%)	
Other	2 (3.2%)	0 (0.0%)	
Ethnicity, *N* = Non-Hispanic (%)	52 (82.5%)	59 (93.7%)	0.099
Race, N (%)			0.327*
American Indian	0 (0.0%)	2 (3.2%)	
Asian Indian	2 (3.2%)	0 (0.0%)	
Black	2 (3.2%)	4 (6.3%)	
Chinese	1 (1.6%)	1 (1.6%)	
Middle Eastern	0 (0.0%)	1 (1.6%)	
Multi-Race	2 (3.2%)	5 (7.9%)	
Other	2 (3.2%)	0 (0.0%)	
Other Asian	1 (1.6%)	2 (3.2%)	
White	53 (84.1%)	48 (76.2%)	
Race, *N* = White (%)	53 (84.1%)	48 (76.2%)	0.372
Annual parent or household income, N (%)			0.222*
$50,000 and less	21 (33.3%)	22 (34.8%)	
$50,000 – $100,000	24 (38.1%)	13 (20.6%)	
$100,000 – $150,000	8 (12.7%)	9 (14.3%)	
$150,000 and over	10 (15.8%)	19 (30.1%)	
Parent income, *N* = less than $100,000 (%)	45 (71.4%)	35 (55.6%)	0.096
Financial Aid amount, Mean (SD)	24097.41 (14749.40)	27919.21 (15228.26)	0.176
Psychotropic medication use, N (%)			0.273*
Yes	1 (1.6%)	3 (4.8%)	
No	60 (95.2%)	58 (92.1%)	
NA	2 (3.2%)	2 (3.2%)	
Therapy in past 3 months, N (%)			1.00*
Yes	3 (4.8%)	3 (4.8%)	
No	58 (92.1%)	58 (92.1%)	
NA	2 (3.2%)	2 (3.2%)	
Past Therapy, *N* = no (%)	61 (96.8%)	61 (96.8%)	1.00*
Consent Year, N (%)			0.834
2016	17 (27.0%)	15 (23.8%)	
2017	19 (30.2%)	22 (34.9%)	
2018	27 (42.9%)	26 (41.3%)	
Resilience training, *N* = yes (%)	30 (47.6%)	30 (47.6%)	1.00*
College, N (%)			0.222
A&S college	20 (31.7%)	12 (19.0%)	
Business college	4 (6.3%)	11 (17.5%)	
Eng&NS college	21 (33.3%)	25 (39.7%)	
HS college	18 (28.6%)	15 (23.8%)	
First in college, N (%)			0.193*
Yes	11 (17.5%)	7 (11.1%)	
No	50 (79.4%)	56 (88.9%)	
Uncertain	2 (3.2%)	0 (0.0%)	

A&S, arts and sciences; HS, health sciences; Eng&NS, engineering and natural sciences. Independent samples *t*-tests were utilized to compare groups on continuous variables. Chi-square tests were used for testing differences group differences in categorical variables, except for those denoted with *, for which Fisher's Exact tests were utilized due to small sample sizes in some cells.

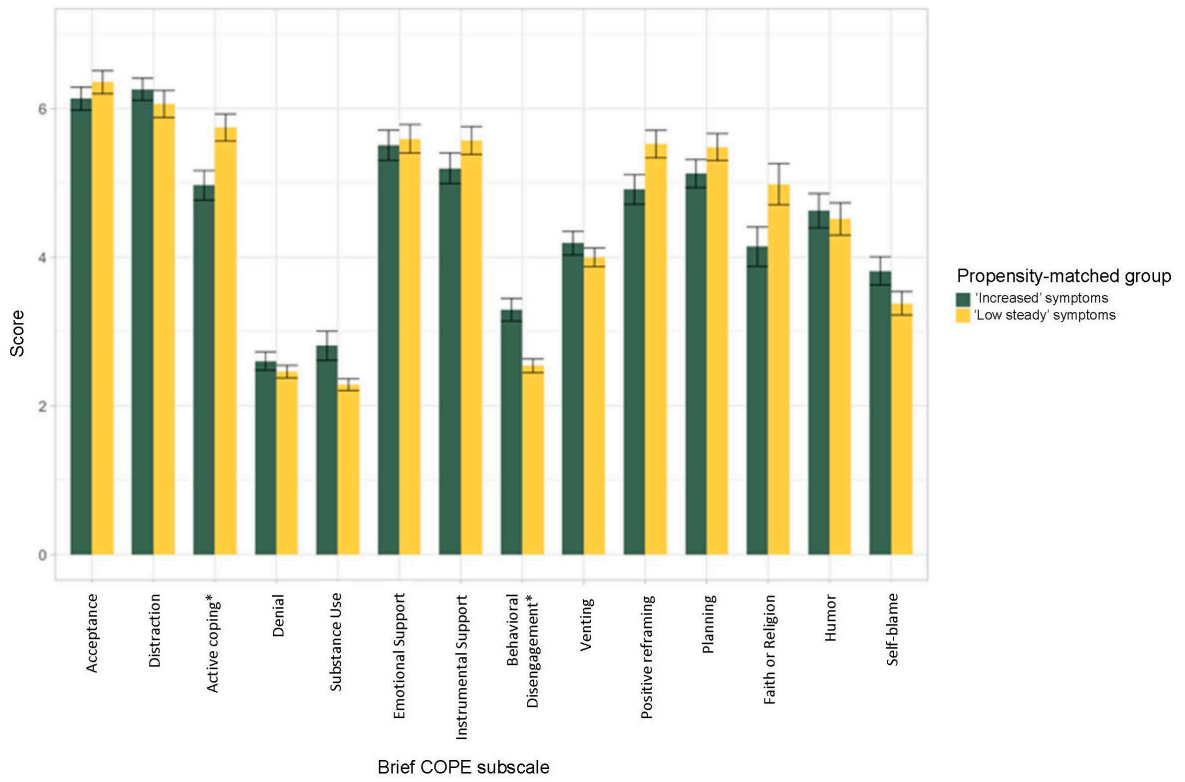


FIGURE 2
Average subscale score on the Brief Cope Scale. Subscale scores were averaged across Spring, Summer, and Fall 2020 time points. As compared with the "increased" depression group, the "low stable" depression group exhibited greater scores on the active coping (W = 1,380, p = 0.003, r = 0.26), positive reframing (W = 1,528, p = 0.026, r = 0.35), and religion subscales (W = 1506.5, p = 0.018, r = 0.21), as well as lower scores on the behavioral disengagement subscale (W = 2,752, $p < 0.001$, r = 0.35) of the Brief Cope scale (see **Supplementary Table 3** for statistical results for all subscales), though only the active coping and behavioral disengagement subscales would meet specified multiple comparison correction thresholds (as indicated by "*").

p = 0.024, OR = 1.15 [95% CI: 1.03 – 1.31]; 58% classification accuracy).

Discussion

The current study examined (1) the trajectory of symptoms of depression and anxiety for a cohort of college students who were followed 1 year pre- to approximately 6 months post-onset of the COVID-19 pandemic, and (2) factors that may account for differentiation of the trajectories based on groups propensity-matched on pre-pandemic depression and sociodemographic factors. Results corroborate other reports indicating that students experienced worsening of mental health symptoms with the pandemic, with symptoms getting worse as the pandemic progressed and classes resumed in Fall 2020. Students who reported using more active coping strategies were less likely to exhibit worsening of symptoms with the pandemic. Similarly, those who were using more alcohol prior to the pandemic were more likely to experience worsening of symptoms. There was further indication that students with worsening mental health symptoms were also more likely to report their college progress being slowed, liberal political leanings, and have had someone in their household hospitalized or die due to COVID-19.

Although some studies have reported worsening mental health in the general population as a results of the COVID-19 pandemic, there have also been studies reporting a lack of change (Pirkis et al., 2021). Current results support prior studies indicating that the pandemic has a negative impact on mental health, particularly among younger adults (Son et al., 2020). Given the stressors of college (i.e., transition period, financial stress, clinically significant mental health symptoms, changing social networks, etc.) and increased mental health risk for this population more generally, it is perhaps understandable that college students may be vulnerable when there is the added stress of a negative world event such as the COVID-19 pandemic. Given the low rates of diagnosis and hospitalization due to COVID-19 in the current sample, it is difficult to conclude the mental health impact arising directly from COVID-19 infections (of oneself and family/friends); however, results corroborate how life stressors relating to the pandemic, which are likely

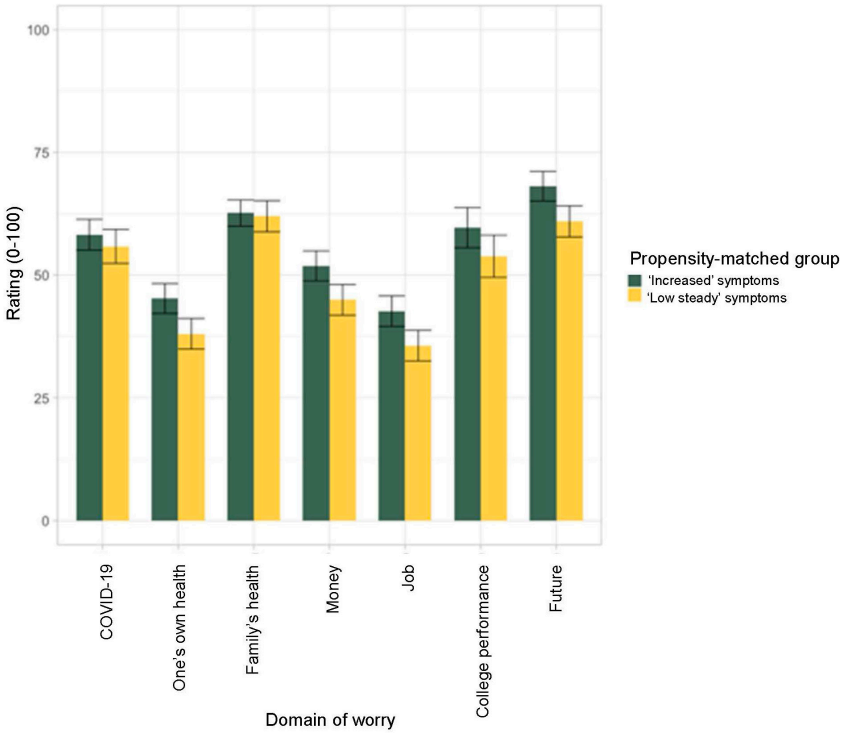


FIGURE 3
Average level of worry endorsed for different domains of concern related to the COVID-19 pandemic. Ratings were averaged across Spring, Summer, and Fall 2020 time points. Student on average reported worrying the most about their family's health and their future. There were no significant differences between the propensity matched groups exhibiting "increased" depression symptoms or "low stable" depression symptoms from before to after the start of the COVID-19 pandemic.

influenced by numerous contextual and individual factors (e.g., financial resources, coping mechanisms, etc.), have a negative impact on college student mental health.

Also consistent with previous reports were findings that in the unmatched groups, those showing "increased" depression symptoms were more likely to be female, from under-represented race/ethnicity, and have lower income than those showing "low stable" depression symptoms. It has been suggested that some of these negative impacts may be due to the impact of the pandemic on jobs often occupied by women (e.g., retail, service industry, healthcare) and due to minority groups and those with lower income being hit the hardest by the COVID-19 virus and related economic impacts (Gonzales et al., 2020; Xiong et al., 2020; Charles et al., 2021). These factors may play a role directly for college students or by impacting their family support system. However, it is important to note that in our analysis of the matched groups, students with worsening symptoms reported, on average, more liberal political leanings. Overlayed onto the timeline of the COVID-19 pandemic was a tumultuous political climate in the United States, particularly concerning issues of immigration, gender, and race (Alang et al., 2020). It is possible that the worsening mental health observed during this time period may be due to a combination of factors, including not only direct impact of the COVID-19 pandemic, but also from political and governmental mistrust or racial unrest, which may have been experienced differently by individuals from various racial or ethnic backgrounds or by those with different political leanings.

Given that college occurs at an age in which the focus is on increasing independence and changing/increasing social networks, we expected the level of social distancing to be a factor contributing to the different trajectories of mental health. However, this hypothesis was not supported in the current data. Instead, it seemed that across the sample, the greatest source of worry was about their family's health and their future. Students exhibiting a worsening trajectory of mental health tended to have more experiences with serious COVID-19 related illness in their family and were more likely to report their college progress being impacted. Thus, at least in this sample, academic and health-related concerns related to trajectory of mental health for college students more so than social distancing behavior. In addition to recognizing the external and societal factors contributing to mental health during the pandemic, it is also important to delve into individuals' coping strategies that may provide protective effects against poor mental health outcomes. The current results suggest that active coping, or the process of taking active steps to try to remove or circumvent the stressor or to ameliorate its effects, may be one important resilience factor

(Carver et al., 1989; Agha, 2021). Thus, while a pandemic may seem to be a negative life event in which the individual has very little control, active coping strategies may support identifying the aspects that are in their control and taking action to address those specific stressors. Maladaptive coping strategies on the other hand, such as behavioral disengagement and substance use, may serve as important risk factors among young adults (Czeisler et al., 2020; Horigian et al., 2020). Results suggest that engaging in heavier alcohol use during college may have deleterious effects on one's ability to build resilience skills to optimally respond to future stressors.

Colleges should consider the strain that COVID-19 places on their students when crafting college-based policies. Given that active-based coping strategies may serve as a resilience factor against poor mental health outcomes; colleges should look to increase access to potentially beneficial coping strategies, including social support, such as mental health resources and group-based extracurricular organizations (Wang S. et al., 2020; Xiong et al., 2020; Cohen et al., 2021; Soga et al., 2021). Additionally, it is essential that colleges look to provide additional support, both financial and social, to at-risk groups to help support their academic success.

Limitations

The students in this sample were those enrolled in a study examining clinical outcomes of a resilience-based intervention implemented during the first semester of college (Akeman et al., 2019). Unfortunately, students who completed the intervention did not seem to exhibit greater protection from the impact of the pandemic on mental health. While the intervention did not seem to have an impact, it is possible that generalizability to other samples may be limited by the fact that the current sample was from an intervention study. In addition, the sample size was based on power calculations for the original purpose of the study rather than for the current analyses. Thus, it is possible that some of the current analyses may have been underpowered. We also recognize that current findings relate to responses within approximately 6 months after the start of the COVID-19 pandemic and that further studies are needed to explore the longer-term mental health impact of the pandemic on college students.

Conclusion

Researchers have long called for an increase in screening, programming, and accessible services to address the notable rise in college student mental health difficulties. As the COVID-19 pandemic has had, and continues to cause, a significant impact on the mental health, education, and daily routine of college students, it is more urgent than ever to evaluate and implement programming to address the needs of college students today. While the availability of the COVID-19 vaccines has dramatically decreased transmission rates and may support at least a partial return to "college as usual," there are likely to be residual effects of the pandemic. This could include lasting mental health effects for subgroups of students, difficulties "catching up" to the prior expectations concerning academic progress and attainment, and potentially lasting negative impacts on the type and availability of job opportunities after graduation. It is prudent for universities and colleges to implement widespread programming focused on increasing resilience to stress and adversity through the use of active coping strategies; providing additional support as needed to women, lower income, and under-represented minority students; and to help support students' academic progress despite the additional obstacles of the pandemic.

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 Western Institutional Review Board® (WIRB®). The patients/participants provided their written informed consent to participate in this study.

Author contributions

EA contributed to study design, data collection, intervention delivery, literature search, writing of the manuscript, and creation of figures and tables. MC contributed to the literature search, writing of the manuscript, and revisions to the manuscript. NK, KC, TM, DD, and EW contributed to data collection, intervention delivery, creation of figures, and revisions to the manuscript. ZC contributed to the creation of figures and revisions to the manuscript. KF contributed to data analyses and revisions to the manuscript. MP contributed to the study design and provided revisions to the manuscript. RA contributed to study design, data collection, supervision of intervention delivery, data analysis, literature search, and writing of the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This study was funded by the William K. Warren Foundation. The study sponsor had no direct role in data collection, analysis, or interpretation; trial design; patient

recruitment; or any aspect pertinent to the study. The authors were not paid to write this article by a pharmaceutical company or other agency. In addition NK received grants from National Institute for General Medical Sciences (P20GM121312). KC received grant funding from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (F31HD103340). TM reports receiving grant funding from the National Institute of Mental Health (F31MH122090). EW reports grant funding from the National Institute on Minority Health and Health Disparities (K99MD015736). MP received grant funding from the National Institutes of Health (U01DA050989), National Institute of General Medical Sciences (P20GM121312), National Institute of Mental Health (R01MH123691 and R01MH127225), and National Institute on Drug Abuse (R01DA050677). RA reports grant funding from the National Institute of Mental Health (R01MH123691), National Institute on Drug Abuse (U01DA050989 and R01DA050677), and the National Institute of General Medical Sciences (P20GM121312).

Acknowledgments

We would like to acknowledge the support and work of administration and staff at The University of Tulsa that assisted in the planning stages and made it possible to complete this project. We also acknowledge the contribution of the students who volunteered their time as research participants. Without the dedication of students, staff, and administration at The University of Tulsa, this work would not have been possible. We also would like to acknowledge the work of Hung-Wen Yeh, Ph.D. in creating the original scripts implemented in R statistical package for group factor analysis.

Conflict of interest

MP has received royalties for an article about methamphetamine in UpToDate.

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

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.926697/full#supplementary-material

References

Agha, S. (2021). Mental well-being and association of the four factors coping structure model: a perspective of people living in lockdown during COVID-19. *Ethics Med. Public Health* 16:100605. doi: 10.1016/j.jemep.2020.100605

Akeman, E., Kirlic, N., Clausen, A. N., Cosgrove, K. T., McDermott, T. J., Cromer, L. D., et al. (2019). A pragmatic clinical trial examining the impact of a resilience program on college student mental health. *Depress. Anxiety* 37, 202–213. doi: 10.1002/da.22969

Alang, S., McAlpine, D. D., and Hardeman, R. (2020). Police brutality and mistrust in medical institutions. *J. Racial Ethn. Health Disparities* 7, 760–768.

Bates, D., Maechler, M., Bolker, B., and Walker, S. (2015). Fitting linear mixed-effects models using lme4. *J. Statist. Softw.* 67, 1–48. doi: 10.18637/jss.v067.i01

Bicanic, I. A. E., Hehenkamp, L. M., van de Putte, E. M., van Wijk, A. J., and de Jongh, A. (2015). Predictors of delayed disclosure of rape in female adolescents and young adults. *Eur. J. Psychotraumatol.* 6:25883. doi: 10.3402/ejpt.v6.25883

Bruine de Bruin, W., Saw, H.-W., and Goldman, D. P. (2020). Political polarization in US residents' COVID-19 risk perceptions, policy preferences, and protective behaviors. *J. Risk Uncertain.* 61, 177–194. doi: 10.1007/s11166-020-09336-3

Bueno-Notivol, J., Gracia-Garcia, P., Olaya, B., Lasheras, I., Lopez-Anton, R., and Santabarbara, J. (2021). Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. *Int. J. Clin. Health Psychol.* 21:100196. doi: 10.1016/j.ijchp.2020.07.007

Calvillo, D. P., Ross, B. J., Garcia, R. J., Smelter, T. J., and Rutchick, A. M. (2020). Political ideology predicts perceptions of the threat of COVID-19 (and susceptibility to fake news about it). *Soc. Psychol. Pers. Sci.* 11, 1119–1128.

Carver, C. S., Scheier, M. F., and Weintraub, J. K. (1989). Assessing coping strategies: a theoretically based approach. *J. Pers. Soc. Psychol.* 56: 267.

Cella, D., Riley, W., Stone, A., Rothrock, N., Reeve, B., Yount, S., et al. (2010). The patient-reported outcomes measurement information system (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. *J. Clin. Epidemiol.* 63, 1179–1194. doi: 10.1016/j.jclinepi.2010.04.011

Centers for Disease Control and Prevention (2020). *Coronavirus Disease 2019 (COVID-19): How to Protect Yourself.* Available online at: https://web.archive.org/web/20200331143006/https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html (accessed June 2021).

Charles, N. E., Strong, S. J., Burns, L. C., Bullerjahn, M. R., and Serafine, K. M. (2021). Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. *Psychiatry Res.* 296:113706. doi: 10.1016/j.psychres.2021.113706

Cohen, Z. P., Cosgrove, K. T., DeVille, D. C., Akeman, E., Singh, M. K., White, E., et al. (2021). The impact of COVID-19 on adolescent mental health: preliminary findings from a longitudinal sample of healthy and at-risk adolescents. *Front. Pediatr.* 9:622608. doi: 10.3389/fped.2021.622608

Connor, K. M., and Davidson, J. R. (2003). Development of a new resilience scale: the connor-davidson resilience scale (CD-RISC). *Depress. Anxiety* 18, 76–82.

Copeland, W. E., McGinnis, E., Bai, Y., Adams, Z., Nardone, H., Devadanam, V., et al. (2021). Impact of COVID-19 pandemic on college student mental health and wellness. *J. Am. Acad. Child Adolesc. Psychiatry* 60, 134–141.

Czeisler, M. É, Lane, R. I., Petrosky, E., Wiley, J. F., Christensen, A., Njai, R., et al. (2020). Mental health, substance use, and suicidal ideation during the COVID-19 pandemic-United States, June 24–30, 2020. *Morb. Mortal Weekly Rep.* 69:1049.

Ettman, C. K., Abdalla, S. M., Cohen, G. H., Sampson, L., Vivier, P. M., and Galea, S. (2020). Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. *JAMA Netw Open* 3:e2019686. doi: 10.1001/jamanetworkopen.2020.19686

Forthman, K., and Yeh, H.-W. (2021). *OptmThrGFA: Optimize Thresholds for GFA*. R Package Version 0.0.1.0.

Fruehwirth, J. C., Biswas, S., and Perreira, K. M. (2021). The Covid-19 pandemic and mental health of first-year college students: examining the effect of Covid-19 stressors using longitudinal data. *PLoS One* 16:e0247999. doi: 10.1371/journal.pone.0247999

Gershon, R. C., Rothrock, N., Hanrahan, R., Bass, M., and Cella, D. (2010). The use of PROMIS and assessment center to deliver patient-reported outcome measures in clinical research. *J. Appl. Meas.* 11, 304–314.

Gonzales, G., de Mola, E. L., Gavulic, K. A., McKay, T., and Purcell, C. (2020). Mental health needs among lesbian, gay, bisexual, and transgender college students during the COVID-19 pandemic. *J. Adolesc. Health.* 67, 645–648.

Gross, J. J., and John, O. P. (2003). Individual differences in two emotion regulation processes: implications for affect, relationships, and well-being. *J. Pers. Soc. Psychol.* 85, 348–362.

Group, W. A. W. (2002). The alcohol, smoking and substance involvement screening test (ASSIST): development, reliability and feasibility. *Addiction* 97, 1183–1194.

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., and Conde, J. G. (2009). Research electronic data capture (REDCap)-A metadata-driven methodology and workflow process for providing translational research informatics support. *J. Biomed. Inform.* 42, 377–381. doi: 10.1016/j.jbi.2008.08.010

Hawley, S. R., Thrivikraman, J. K., Noveck, N., Romain, T. S., Ludy, M.-J., Barnhart, L., et al. (2021). Concerns of college students during the COVID-19 pandemic: thematic perspectives from the United States, Asia, and Europe. *J. Appl. Learn. Teach.* 4, 1–10.

Ho, D. E., Imai, K., King, G., and Stuart, E. A. (2011). MatchIt: nonparametric preprocessing for parametric causal inference. *J Stat Softw.* 42, 1–28.

Horigian, V. E., Schmidt, R. D., and Feaster, D. J. (2020). Loneliness, mental health, and substance use among US young adults during COVID-19. *J. Psychoactive Drugs* 53, 1–9.

Hunt, J., and Eisenberg, D. (2010). Mental health problems and help-seeking behavior among college students. *J. Adolesc. Health.* 46, 3–10.

Ibrahim, A. K., Shelly, S. J., Adams, C. E., and Glazebrook, C. (2013). A systematic review of studies of depression prevalence in university students. *J. Psychiatr. Res.* 47, 391–400.

Johns, M. W. (1992). Reliability and factor analysis of the epworth sleepiness scale. *Sleep* 15, 376–381.

Kassambara, A. (2021). *Rstatix: Pipe-Friendly Framework for Basic Statistical Tests. 2021;* R Package Version 0.7.0. Available online at: https://CRAN.R-project.org/package=rstatix (accessed June 2021).

Kecojevic, A., Basch, C. H., Sullivan, M., and Davi, N. K. (2020). The impact of the COVID-19 epidemic on mental health of undergraduate students in New Jersey, cross-sectional study. *PLoS One* 15:e0239696. doi: 10.1371/journal.pone.0239696

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., and Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the national co-morbidity survey replication. *Arch. Gen. Psychiatry* 62, 593–602.

Klami, A., Virtanen, E., Leppäaho, E., and Kaski, S. (2015). Group factor analysis. *IEEE Trans. Neural Netw. Learn. Syst.* 26, 2136–2147. doi: 10.1109/TNNLS.2014.2376974

Kroenke, K., Stump, T. E., Chen, C. X., Kean, J., Bair, M. J., Damush, T. M., et al. (2020). Minimally important differences and severity thresholds are estimated for the PROMIS depression scales from three randomized clinical trials. *J. Affect. Disord.* 266, 100–108.

Ladouceur, C. D. (2020). *COVID-19 Adolescent Symptom & Psychological Experience Questionnaire*. Melbourne, VC: Murdoch Children's Research Institute.

Lawal, A. M., Alhassan, E. O., Mogaji, H. O., Odoh, I. M., and Essien, E. A. (2020). Differential effect of gender, marital status, religion, ethnicity, education and employment status on mental health during COVID-19 lockdown in Nigeria. *Psychol. Health Med.* 27, 1–12. doi: 10.1080/13548506.2020.1865548

Lederer, A. M., Hoban, M. T., Lipson, S. K., Zhou, S., and Eisenberg, D. (2020). More than inconvenienced: the unique needs of US college students during the CoViD-19 pandemic. *Health Educ. Behav.* 48, 14–19. doi: 10.1177/1090198120969372

Leppäaho, E., Ammad-ud-din, M., and Kaski, S. G. F. A. (2017). Exploratory analysis of multiple data sources with group factor analysis. *J. Mach. Learn. Res.* 18, 1–5.

Lesnoff, M., and Lancelot, R. (2012). *Aod: Analysis of Overdispersed Data. R Package Version 1.3.1*, Available online at: https://cran.r-project.org/package=aod (accessed June 2021).

Marroquín, B., Vine, V., and Morgan, R. (2020). Mental health during the COVID-19 pandemic: effects of stay-at-home policies, social distancing behavior, and social resources. *Psychiatry Res.* 293:113419. doi: 10.1016/j.psychres.2020.113419

Phiri, P., Delanerolle, G., Al-Sudani, A., and Rathod, S. (2021). COVID-19 and black, Asian, and minority ethnic communities: a complex relationship without just cause. *JMIR Public Health Surveill.* 7:e22581. doi: 10.2196/22581

Pirkis, J., John, A., Shin, S., DelPozo-Banos, M., Arya, V., Analuisa-Aguilar, P., et al. (2021). Suicide trends in the early months of the COVID-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries. *Lancet Psychiatry* 8, 579–588. doi: 10.1016/S2215-0366(21)00091-2

Pirutinsky, S., Cherniak, A. D., and Rosmarin, D. H. (2020). COVID-19, mental health, and religious coping among american orthodox jews. *J. Relig. Health* 59, 2288–2301. doi: 10.1007/s10943-020-01070-z

R Core Team (2021). *R: A Language And Environment For Statistical Computing*.

Russell, V. (2021). *Emmeans: Estimated Marginal Means, Aka Least-Squares Means. 2021;*R Package Version 1.5.5-1. Available online at: https://CRAN.R-project.org/package=emmeans (accessed June 2021).

Salsman, J. M., Butt, Z., Pilkonis, P. A., Cyranowski, J. M., Zill, N., Hendrie, H. C., et al. (2013a). Emotion assessment using the NIH Toolbox. *Neurology* 80(11 Suppl. 3), S76–S86.

Salsman, J. M., Victorson, D., Choi, S. W., Peterman, A. H., Heinemann, A. W., Nowinski, C., et al. (2013b). Development and validation of the positive affect and well-being scale for the neurology quality of life (Neuro-QOL) measurement system. *Qual. Life Res.* 22, 2569–2580. doi: 10.1007/s11136-013-0382-0

Salsman, J. M., Lai, J.-S., Hendrie, H. C., Butt, Z., Zill, N., Pilkonis, P. A., et al. (2014). Assessing psychological well-being: self-report instruments for the NIH Toolbox. *Qual. Life Res.* 23, 205–215.

Shamblaw, A. L., Rumas, R. L., and Best, M. W. (2021). Coping during the COVID-19 pandemic: relations with mental health and quality of life. *Can. Psychol.* 62, 92–100.

Soga, M., Evans, M. J., Tsuchiya, K., and Fukano, Y. (2021). A room with a green view: the importance of nearby nature for mental health during the COVID-19 pandemic. *Ecol. Appl.* 31:e2248. doi: 10.1002/eap.2248

Son, C., Hegde, S., Smith, A., Wang, X., and Sasangohar, F. (2020). Effects of COVID-19 on college students' mental health in the United States: interview survey study. *J. Med. Internet Res.* 22:e21279.

Tull, M. T., Edmonds, K. A., Scamaldo, K. M., Richmond, J. R., Rose, J. P., and Gratz, K. L. (2020). Psychological outcomes associated with stay-at-home orders and the perceived impact of COVID-19 on daily life. *Psychiatry Res.* 289:113098. doi: 10.1016/j.psychres.2020.113098

Veldhuis, C. B., Nesoff, E. D., McKowen, A. L. W., Rice, D. R., Ghoneima, H., Wootton, A. R., et al. (2021). Addressing the critical need for long-term mental health data during the COVID-19 pandemic: changes in mental health from April to September 2020. *Prev Med.* 146:106465. doi: 10.1016/j.ypmed.2021.106465

Vos, L. M., Habiboviæ, M., Nyklíèek, I., Smeets, T., and Mertens, G. (2021). Optimism, mindfulness, and resilience as potential protective factors for the mental health consequences of fear of the coronavirus. *Psychiatry Res.* 300:113927. doi: 10.1016/j.psychres.2021.113927

Wang, S., Feng, K., Zhang, Y., Liu, J., Wang, W., and Li, Y. (2020). Antecedents of Public mental health during the COVID-19 pandemic: mediation of pandemic-related knowledge and self-efficacy and moderation of risk level. *Front. Psychiatry* 11:567119. doi: 10.3389/fpsyt.2020.567119

Wang, X., Hegde, S., Son, C., Keller, B., Smith, A., and Sasangohar, F. (2020). Investigating mental health of us college students during the COVID-19 pandemic: cross-sectional survey study. *J. Med. Internet Res.* 22:e22817. doi: 10.2196/22817

World Health Organization (2020). *Timeline: WHO's COVID-19 response 2020*. Available online at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#! (accessed June 2021).

Xiong, J., Lipsitz, O., Nasri, F., Lui, L. M., Gill, H., Phan, L., et al. (2020). Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J. Affect. Disord.* 277:55–64.

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 09 August 2022
DOI 10.3389/fpsyg.2022.931134

OPEN ACCESS

EDITED BY
Kostas Karpouzis,
Panteion University,
Greece

REVIEWED BY
Elizabeth A. Boyle,
University of the West of Scotland,
United Kingdom
Yannis Skarpelos,
Panteion University,
Greece

*CORRESPONDENCE
Eui Jun Jeong
stevejeong@gmail.com

SPECIALTY SECTION
This article was submitted to Human-Media Interaction, a section of the journal Frontiers in Psychology

RECEIVED 28 April 2022
ACCEPTED 18 July 2022
PUBLISHED 09 August 2022

CITATION
Kim GM, Jeong EJ, Lee JY and Yoo JH (2022) Role of social capital in adolescents' online gaming: A longitudinal study focused on the moderating effect of social capital between gaming time and psychosocial factors.
Front. Psychol. 13:931134.
doi: 10.3389/fpsyg.2022.931134

Role of social capital in adolescents' online gaming: A longitudinal study focused on the moderating effect of social capital between gaming time and psychosocial factors

Gyoung Mo Kim[1], Eui Jun Jeong[1]*, Ji Young Lee[1] and Ji Hye Yoo[2]

[1]Department of Digital Culture and Contents, Konkuk University, Seoul, South Korea, [2]Ministry of Culture, Sports and Tourism, Sejong, South Korea

Adolescents often create social relationships with their gaming peers who take on the role of offline friends and peer groups. Through collaboration and competition in the games, the social relationships of adolescents are becoming broader and thicker. Although this is a common phenomenon in online games, few studies have focused on the formation and roles of social capital among adolescent gamers. In particular, longitudinal research that examines the role of social capital in terms of influencing gaming time on adolescent gamers' psychosocial factors has been minimal. This study was designed to fill this gap to see the long-term effect of social capital among adolescent gamers. Specifically, by using the three-year longitudinal data involving 403 adolescents, we analyzed the effect of gaming time on psychological factors (i.e., loneliness, depression, self-esteem, and life satisfaction) with the moderating role of social capital. Results showed that social capital played a crucial moderating role. In the higher social capital group, gaming time enhanced the degree of self-esteem and life satisfaction. However, a vicious circle was found in the lower social capital group: Gaming time increased the degree of depression but decreased self-esteem, which in turn led to increase in gaming time. These results indicate that games work as an important tool for social capital cultivation among adolescent gamers, which imply successful cultivation of social capital is a key to positive gaming effects. Theoretical and practical implications are discussed.

KEYWORDS

online gaming, social capital, psychosocial effects, adolescent gamers, longitudinal study

Introduction

Social network creation and formation of social capital (i.e., personal benefits through relationship) have been discussed as among the most important aspects of online games (Kolo and Baur, 2004; Taylor, 2006; Ju and Lee., 2018; Perry et al., 2018). As games are increasingly played online, communication activities with other players account for a large part of players' activities in a game (Suznjevic et al., 2009). These communication behaviors include having a conversation to cooperate with other game players, helping other game players, and engaging in activities to lead the group and accomplish the goal. These behaviors are aligned with social interactions, which are a motivation in online games (Yee, 2006). As a means of self-expression and social interactions with others, games can play an important role in predicting and nurturing a user's psychosocial characteristics and social relationship (Ducheneaut and Moore, 2004; Brian and Hastings, 2005; Cole and Griffiths, 2007; Zhong, 2009).

Considering that adolescence is a time when young people expand their relationships with others, the role of games in social interaction could peak during this time. In this period, adolescents experience physical, cognitive, and emotional changes internally, and various social relationship changes externally as the scope of their social activities expands (Engels et al., 2002). Acquiring social capital through appropriate interactions in this period can be the element that positively affects adaptive behavior during adolescence (Jung, 2022).

Even though playing online games is fundamentally a social activity among adolescents, the effects of social capital among adolescent gamers were rarely proven empirically. It was because many scholars had not agreed to consider that online games were a place for activities such as sharing emotional support with peers, discussing issues, and expanding the network (Ju and Lee, 2018). The social capital formed through online games has value as a study reflecting the peer culture during adolescence.

Many studies have examined the relationship between the use of games and individuals' psychosocial well-being, producing various findings (Griffiths and Hunt, 1995; Ballard and Wiest, 1996; Anderson and Bushman, 2001; Durkin and Barber, 2002; Lager and Bremberg, 2005; Young, 2007; Abreu et al., 2011; Grizzard et al., 2014). There are only a few longitudinal studies on the use of games and early adolescents' psychosocial factors, especially ones related to social capital. Nevertheless, the longitudinal study is a further attempt to view the social capital accumulated through playing games as a critical factor affecting adolescents' psychosocial characteristics (depression, loneliness, life satisfaction, and self-esteem).

This study examined the impact of games on the cultivation of adolescents' social capital and psychosocial variables and explores how adolescents utilize their social capital to manage psychological status through longitudinal empirical data. Consequently, this supplements the shortage of previous research and social capital's impact on adolescents' psychosocial factors and change in gaming play behavior.

Literature review and analysis framework

Social capital and online gaming

Social Capital is defined as an attribute that makes specific actions available within a social structure (Coleman, 1998), including personal relationships and benefits that go with them (Williams, 2006). Social capital has been reported to improve the community's efficiency by promoting collaborative behavior among individuals in society. Thus, various fields have applied it to communication and networking. Likewise, since social capital is conceptualized as a network of shared dependencies and obligations within a society, it has been applied to the field of societal problems (Weiss, 2011).

Individual social capital includes two aspects of social capital-social bonding and social bridging (Trepte et al., 2012). Social bonding implies accumulated social capital in a network and expected benefits from strong ties such as emotional and financial support. Social bridging refers to social capital with benefits or relationships from weak links, and it encompasses connectedness with members in a different group (Pénard and Poussing, 2010). A group with solid degrees of social bonding reveals personalities that show internally condensed socialization rather than external communication, while a group with high levels of social bridging creates cooperative communities of diversity in gender, age, and race.

The core figurative requirements of social capital consist of trust based on reciprocity and social relationship in a network (Putnam, 2000). Trust based on reciprocity is the belief that a community member (or organization) responds in good faith. The social network in a society serves as a pathway for amicable relationships to provide and receive solid support (Castillo, 2019).

In this research, the concept of social capital is referred to as the achieved experience of acceptance and belonging that enable adolescents to interact. Since the core need lies in the innate human tendency to gain acceptance and avoid rejection (Hladik and Hrbackova, 2021), peer relationship plays a distinct developmental role during adolescence (Sullivan, 1953; Rudolph, 2020).

Compared to offline groups, online communities can build social relationships and build reciprocal trust because people usually participate voluntarily in online communities (Perry et al., 2018). Owing to these characteristics, many studies have considered the influence of social capital on the Internet or social media users (Williams, 2006; Yoo and Jeong, 2017). However, research on social capital foundation and influence through online game use remains insufficient. Research on whether online game players form social capital through gameplay or positive or negative social capital effects through online games is still minimal.

Online games provide rich virtual environments that enhance a wide range of social experiences (Ducheneaut and Moore, 2004; Brian and Hastings, 2005; Cole and Griffiths, 2007; Zhong, 2009; Kaye et al., 2017). Through player-to-player cooperation and

competition, players follow the norms within the group. These conduct activities are aligned with the group's interest (Gong et al., 2019) and the players interact socially. Social interaction is "the process of reflecting on relationship with people around us" (Giddens, 2001), and online games function as a virtual reality space where social capital is formed based on active social interaction (Lo et al., 2005; Yee, 2006). Online games provide players with a teamwork experience to win in-game battles and communicate to solve problems and allow players to share information about gameplay and recent game achievements (Arbeau et al., 2020).

Adolescence is when peer relationships become the center of social relationships, so it is common for adolescents to spend less time with parents and more time with peers (Kim et al., 2019). For adolescents, online game play is one of their playing cultures, and it becomes the most crucial space where they make friends and experience peer attachment. Social support from peers has a tremendous effect on adolescents' self-esteem development and life satisfaction. It could also be inferred that social capital influences adolescents' psychosocial well-being.

Online gaming and psychosocial well-being

Based on the claim that media use affects players' perceptions or behaviors and forms a strengthened usage pattern (Slater, 2007), online games can create social capital based on the degree of involvement in games and a players' usage habit change. Online game social capital formation is highly related to players' habits and motivations (Reer and Kramer, 2019). The results of an empirical study that players' social capital and psychological factors could be affected (Williams, 2006) supports the claim mentioned above.

Social support through the formation of social capital reduced the player's sense of loneliness (Snodgrass et al., 2019), while the achievement and failure in terms of the player's psychosocial needs could be an essential factor in game immersion (Weinstein et al., 2017). In this regard, it is meaningful to analyze the influence of social capital formation experience on online game use and the psychosocial factors of players.

Psychosocial factors demonstrated by the players were relatively common when the themes are related mainly to excessive game use, game addiction, or problematic game use. Most previous studies showed that the amount of gaming time influenced players' depression and loneliness (McKenna and Bargh, 2000; Nie et al., 2002; Cheung and Wong, 2011; Lemmens et al., 2011; Guo et al., 2012; Wei et al., 2012; Ko et al., 2014). Controversies about these results still exist, but depression and loneliness are representative of the psychosocial factors (Carras et al., 2017). Also, as a recent study revealed that levels of need satisfaction in games cause online game players' real-life satisfaction (Allen and Anderson, 2018; Fazeli et al., 2020), with life satisfaction chosen as one of the psychosocial well-being factors. The unfulfilled needs caused depression and loneliness, and their change would affect life satisfaction.

Most studies involving adolescents considered self-esteem as one of the psychosocial factors in general, and this is because self-esteem is important during adolescence. Self-esteem established in this period lasts for the rest of their lives and if they consider themselves as worthy, then self-esteem rises (Banstola et al., 2020). It is also worth noting that self-esteem is vulnerable to social exclusion or rejection of insufficient social capital (Arslan, 2019). Therefore, this research included self-esteem as one of the most essential psychosocial well-being factors among adolescents.

Depression and loneliness

Depression refers to a state where one is constantly sad and loses interest in activities (Association, 1997). It has been reported to strongly affect interpersonal relationships, and people who suffer from it can try to fight it by developing their social life and forming interpersonal relationships. Numerous studies report that too much online gameplay increases adolescents' depression (McKenna and Bargh, 2000; Nie et al., 2002; Ko et al., 2014). Some studies have shown that excessive game use can increase depression and anxiety levels (Cheung and Wong, 2011; Guo et al., 2012; Wei et al., 2012). Several types of research have accentuated the positive relationship between depression and online game dependence (Peng and Liu, 2010; Griffiths et al., 2017; Chang and Lin, 2019). Fazeli et al. (2020) also demonstrated that depression was a potent mediator between excessive game playing and quality of life. Based on these previous studies, it can be stated that depression is an essential factor that relates to online gameplay directly or indirectly.

Loneliness is typically defined as the cognitive awareness of a deficiency in one's social and personal relationships and the ensuring affective reactions of sadness, emptiness, or longing (Asher and Paquette, 2003). Various studies also show an association between online games and loneliness (Kim et al., 2009; Lemmens et al., 2011; Jeong et al., 2017). Hussain and Griffiths (2009) confirmed that adolescents who played games repeatedly felt more isolated and lonelier. Seay and Kraut (2007) showed that playing games directly increased adolescents' loneliness. Lemmens et al. (2011) also suggested that lonely individuals are more likely to engage in games excessively. Over time, problematic use of this medium contributes to increased levels of loneliness.

In contrast, Chappell et al. (2006) suggested that playing an online game is an effortless, speedy, and inexpensive way to socialize and avoid feelings of loneliness. When gamers were actively involved in their community activities, loneliness was not related to gaming time (Carras et al., 2017). Although some results of previous studies are controversial, loneliness certainly has been viewed as one of the most valuable factors in the relationship between online gaming and players' psychological needs.

Life satisfaction and self-esteem

Life satisfaction is a general evaluation of one's quality of life according to a personally chosen set of criteria. It refers to the level

of satisfaction with one's current state and a cognitive appraisal of how satisfying one's present life is, based on one's previous life experiences (Shin and Johnson, 1978). While studies focus on whether online games have a positive (Kim et al., 2005) or negative (Rasmussen, 2000; Shapira et al., 2000; Wang et al., 2008) effect on life satisfaction, the conclusions are inconsistent. Recent research focused on levels of need satisfaction in online games, which affected the levels of real-life satisfaction (Allen and Anderson, 2018). In Putnam's (2000) opinion, social connectedness is an influential factor determining happiness, and the relevance between online games with much social interaction for the gratification of needs and players' life satisfaction can be inferred.

Self-esteem is the subjective evaluation a person makes and maintains about oneself and the extent of belief in one's capability, worth, and significance conveyed through their attitudes and verbal behavior (Wilson et al., 2010). Furthermore, self-esteem is considered a critical psychosocial factor during adolescence. Thus, the number of studies on the relationship between online games and adolescents' self-esteem is growing. Self-esteem directly affects online games or online addiction, and research indicates that self-esteem harms game addiction and adolescents addicted to games have low self-esteem (Armstrong et al., 2000; Ko et al., 2005; Niemz et al., 2005). In contrast, some studies emphasize that when adolescents earn a high level of satisfaction through games, they have a higher level of self-esteem than those who do not (Lee and Jeong, 2015).

Self-esteem is also affected by experiencing social support and exclusion. Social support can help increase self-esteem, but social exclusion can hurt self-esteem and prevent growth (Lin et al., 2018). People encourage themselves to decrease the chance of rejection and exclusion by gaining reciprocal trust and building social networks.

Adolescents also want to build and maintain self-esteem through psychological and social support from peers (Gorrese and Ruggieri, 2013; Shin et al., 2017). Positive self-esteem formed during adolescence increases life satisfaction (Baumeister et al., 2003) while negative self-esteem hurts psychological and physical adaptation (Sowislo and Orth, 2013), so peer group and social interaction within it is a vital variable during adolescence (Kwon and Kim, 2019).

Analysis framework and research questions

Slater (2007) applied social cognitive theory (Bandura, 2001) to propose a "reinforcing spirals approach" composed of three stages to understand the complex interaction between the player's psychosocial factors and media effects. The three stages are as follows: (1) use of the media affects players' cognition or behavior; (2) players' affected cognition or behavior affects the use of the media; and (3) repeating this process is reinforced reciprocally over time. Researchers who demonstrated a reinforcing spirals pattern for mutual reciprocity of media use and psychosocial well-being substantiated this process (Slater, 2007; Slater and Hayes, 2010; Lemmens et al., 2011).

This study proposes a reciprocal effect between online game use and the player's psychosocial factors based on the reinforcing spiral model. Therefore, this study used SCT to test the reciprocal relations between online games and psychosocial factors depending on online social capital. Defined by the level of online social capital, the following assumptions were made: (1) online game use will influence personal psychosocial factors (positively or negatively); (2) psychosocial factors will in turn influence online game use; and (3) continuous repetition of the processes will reinforce the reciprocal relations among the variables.

This repeating process will demonstrate the mechanism of mutual influence among social capital, psychosocial well-being factors, and online gaming. Under the assumption, accumulated social capital in online games functions as peer groups considering the characteristics of the developmental cycle of adolescents. Thus, the level of amicable relationships with peers influences the psychosocial factors of game players. Ultimately, these effects will lead to change in game use or specific patterns of playing.

Social capital catalyzes online gameplay and adolescents' psychosocial characteristics. Furthermore, the relationship between the use of online games and psychosocial factors varies depending on the level of social capital (increased or decreased). In this regard, we proposed the following research questions.

RQ1. What is the longitudinal effect of online games on adolescents' psychosocial factors?

RQ2. Is the relationship between T1 variables (online gaming time and psychosocial variables) and others (T2 and T3 variables) moderated by cultivated social capital? In other words, is there a moderating effect depending on the level of social capital (increased or decreased)?

Materials and methods

Sampling and data collection

To analyze the causation and cumulative effects of social capital, psychosocial factors, and online games, this study used a panel survey with a professional survey research company in South Korea[1]: Two years of panel data were used to carry out the longitudinal study. A panel survey was conducted involving adolescents (aged 14–16 years) with whom the survey was conducted 3 times over the course of 3 years (T1, T2, T3: one-year interval) to acquire longitudinal data. Primary respondents included 710 individuals, among whom 592 participated in the second round, and 461 in the third round. A total of 403 individuals, excluding missing values, were selected for the final group.

1 www.hrc.com

In the first round of survey results, 362 (51%) of the respondents were male, and 348 (49%) were female. In the second round of survey results, 293 (49.5%) respondents were male, and 299 (50.5%) were female. In the third round of survey results, of the 403 selected participants, 202 (50.1%) were male and 201 (49.9%) were female. The 403 participants were subsequently divided into two groups based on social capital levels and were examined. Differences between participant social capital scores between T1 and T3 were divided into two groups, one group with social capital increase and one group with social capital decline, using a median split in order to investigate whether participants had experienced a change (or maintenance) in social capital during the two years (Trepte et al., 2012). Accordingly, participants were placed in the lower social capital group ($n = 169$) if the difference in their social capital scores were below 0.0, while participants were placed in the higher social capital group ($n = 234$) if their social capital scores exhibited no difference or were above 0.0. The median split of this study was 0.00, with 169 participants included in the lower social capital group and 234 included in the higher social capital group.

Analytical strategy

A structural equation modeling (SEM) and repeated measures analysis, which uses the GLM (General Linear Model), were used to verify the research questions. Because this study is composed of dichotomous factors (social capital level: higher and lower), the repeated measures GLM can test the meaningful influence of social capital levels and change over time. It is also an appropriate method to measure whether time functions as a factor regulating social capital. This study utilized SEM to estimate and analyze the cause and effect between subject factors, or the entire panel. The GLM was supplemented with the SEM analysis, which increased the estimation efficiency that considers time-sequential characteristics. The SEM also presented extremely useful results for analyzing the correlations between factors from the perspective of the entire model.

Measures

Social capital was measured using Internet Social Capital Scales (ISCS; D. Williams, 2006), with each question measured on a scale of 5 points (1 = not at all; 5 = very much so). Using a questionnaire of 20 items, 17 items were selected through a reliability analysis (e.g., "People who are interactive with me would gladly help me, even though they have to sacrifice themselves," "Meeting with others in games reminds me that everyone is connected in the world").: T1:M (SD) = 3.524 (0.559), Cronbach's α = 0.914; T2: M (SD) = 3.633 (0.604), Cronbach's α = 0.925; T3: M (SD) = 3.655 (0.612), Cronbach's α = 0.934.

Loneliness was measured using Russell's (1996) UCLA loneliness scale (Russell, 1996). Using a questionnaire of 10 items on loneliness with answers measured on a 4-point scale (1 = not at all; 4 = all the time), 8 items were selected through a correlation and reliability analysis (e.g., "I feel a lack of camaraderie with my friends"):. T1: M (SD) = 1.620 (0.559), Cronbach's α (AVE) = 0.929 (0.629); T2: M (SD) = 1.651 (0.604), Cronbach's α (AVE) = 0.936 (0.660); T3: M (SD) = 1.673 (0.604), Cronbach's α (AVE) = 0.929(0.628).

Depression was measured using the Center for Epidemiological Studies-Depression scale (CESD scale) developed by the National Institute of Mental Health (NIMH). Using a questionnaire of 11 items (CESD-11) on depression with respondents measured on a 4-point scale (0 = extremely rare; 3 = most of the time), 7 items were selected through a correlation and reliability analysis (e.g., "I'm very depressed").: T1: M (SD) = 0.354 (0.457), Cronbach's α (AVE) = 0.872 (0.509); T2: M (SD) = 0.347 (0.513), Cronbach's α (AVE) = 0.893 (0.558); T3: M (SD) = 0.357 (0.490), Cronbach's α (AVE) = 0.889 (0.545).

Life satisfaction was measured using Satisfaction with Life Scale (SWLS; Diener et al., 1985). Respondents were presented with a total of 5 questions (e.g., "My life now is close to the life I hoped for"), and answers were measured on a 5-point scale (1 = not at all; 5 = very much so).: T1: M (SD) = 4.175 (1.213), Cronbach's α (AVE) = 0.910 (0.678); T2: M (SD) = 4.091 (1.247), Cronbach's α (AVE) = 0.910 (0.678); T3: M (SD) = 4.183 (1.267), Cronbach's α (AVE) = 0.916 (0.692).

Self-esteem was measured using the Rosenberg Self Esteem Scale (RSES; M. Rosenberg, 1965). Using a questionnaire of 10 items on self-esteem with answers measured using a 5-point scale (1 = not at all; 5 = very much so), 5 items were selected through a correlation and reliability analysis (e.g., "I feel that I have value, or at the least am equal to others): T1: M (SD) = 2.094 (0.545), Cronbach's α (AVE) = 0.874 (0.587); T2: M (SD) = 2.090 (0.568), Cronbach's α (AVE) = 0.873 (0.583); T3: M (SD) = 2.069 (0.583), Cronbach's α (AVE) = 0.876 (0.585).

Gaming time was measured as "average daily online gaming time" among players through open-ended questions [T1, M (SD) = 38.49 min. (53.938); T2, 46.01 min. (60.837); T3, 54.43 min. (70.857)].

Results

First, the validity and reliability of the basic statistics and measured items of the variables used in this study were investigated. The measurement invariance of life satisfaction, depression, loneliness and self-esteem was tested through factor analysis, and the eigenvalue all satisfied the fundamental assumption. In the factor analysis, the validity is secured when the eigenvalue was over 1.0. All the variables showed high validity with one component (Table 1).

Correlations and discriminant validity (Table 2) for variables by year were measured and determined to be suitable before moving on to the next steps of the study. As the AVE (average variance extracted) coefficients were above 0.5, each item's convergent validity was verified.

TABLE 1 Number of components and Eigen value of independent variables.

Variables	Number of factors	Eigen value		
		T1	T2	T3
Life satisfaction	1	3.703	3.704	3.763
	2	0.442	0.415	0.401
Depression	1	4.040	4.327	4.272
	2	0.780	0.717	0.707
Loneliness	1	5.398	5.612	5.395
	2	0.515	0.491	0.583
Self-esteem	1	3.324	3.327	3.347
	2	0.564	0.761	0.614

T1 = the first wave, T2 = the second wave, T3 = the third wave.

Lastly, a repeated measures GLM analysis was conducted to examine the effect of the relationships between online game, social capital, and adolescent psychosocial factors. The results showed that there was an interaction between time and social capital (Wilks' Lambda = 0.962, $p < 0.01$), plus there was a significant difference in adolescent game use and the transformation of psychosocial factors based on the passage of time and increase in social capital (Wilks' Lambda = 0.868, $p < 0.01$, Table 3).

Based on the above results and under longitudinal circumstances, one can determine that social capital regulates the reciprocal relationship between online gameplay and time indicators of psychosocial well-being. Additionally, a more detailed analysis of the repeated measurements shows that adolescent's life satisfaction ($F = 9.621$, $p = 0.000$), depression ($F = 7.142$, $p = 0.001$), loneliness ($F = 23.1261$, p = 0.000) and self-esteem ($F = 3.565$, $p = 0.029$) are significantly regulated by social capital (Figure 1).

Next, SEM was used to structurally examine the correlations between online game use, social capital, and adolescent psychosocial factors. With a $\chi^2/df = 2.460$, $p > 0.05$, NFI = 0.948, CFI = 0.967, TLI = 0.900, RMSEA = 0.060, the tested two-group model showed a good fit.

Based on the above results, and under the notion that the research model presented in this study is appropriate, the cause-and-effect relationship of the reciprocal relationship between adolescent game use and psychosocial factors regarding differences based on social capital levels and the passage of time was verified (Table 4; Figure 2). In the higher social capital group, the increase of gaming time (T1 and T2) enhanced the degree of life satisfaction (T2 and T3); Life satisfaction (T2) also heightened the degree of self-esteem (T3). In the lower social capital group, gaming time (T1) increased depression (T2) and decreased self-esteem (T2); Self-esteem (T2) decreased gaming time (T3) while depression (T2) decreased the degree of self-esteem (T3).

The longitudinal mediating effect was verified based on each variable and according to social capital groups. Significant indirect effects were observed from both groups, but the differences between the groups are quite profound. For the lower social capital group, indirect paths from gaming time of T1 to psychosocial factors of T3 as mediated by psychosocial factors of T2 were statistically significant: (1) gaming time → depression → self-esteem [Sobel' Z = −2.624, $p < 0.01$; 95% bootstrap confidence interval = (−0.0903, −0.0081)], (2) gaming time → self-esteem → gaming time [Sobel' Z = 2.055, $p < 0.05$; 95% bootstrap CI = (0.0023, 0.0395)]. For the higher social capital group, one indirect path from gaming time of T1 to self-esteem of T3 as mediated by life satisfaction of T2 (gaming time → life satisfaction → self-esteem) was statistically significant [Sobel' Z = 2.184, $p < 0.05$; 95% bootstrap CI = (0.0059, 0.0935)].

Discussion

Findings

The purpose of this study was to identify the role of social capital in the effects of early adolescents' gaming time on their psychosocial factors using a 3-wave (two years) longitudinal setting. To this end, we divided the subjects into two groups in terms of the degree of social capital (higher vs. lower), and compared the reciprocal relations among the variables in the two groups with each other. The results point to several interesting findings.

The first finding was that social capital plays a crucial mediation role. In the higher social capital group, gaming time increased the degree of life satisfaction in the first year (T1–T2), and finally enhanced both life satisfaction and self-esteem in the second year (T2–T3). However, in the lower social capital group, gaming time increased depression and decreased the degree of self-esteem in the first year. This, in turn, resulted in the decrease of self-esteem and increase in gaming time in the second year. In multivariate GLM tests, there was a significant difference in the degree of social capital between the two groups and a substantive interaction effect between time and social capital on psychosocial factors (i.e., life satisfaction, depression, and loneliness) within each group.

Second, a vicious circle was found only in the lower social capital group. In the mediation test, self-esteem (T2) strongly mediated between game play (T1) and gaming time (T3): game play ultimately increased gaming time by aggravating the degree of self-esteem. Although gaming time tend to increase in both groups, the negative loop effect of gaming time was only in the lower social capital group. The contrasting effects of gaming time in the two groups showed the importance of social capital cultivation in online games among adolescent gamers.

Third, self-esteem was the key variable differentiating the positive effect of gaming time from the negative effect among adolescent gamers. Gaming time could both increase and decrease the degree of self-esteem. In the higher group, the degree of self-esteem was enhanced with the increase in gaming time (T1–T2 and T2–T3) and life satisfaction (T2–T3). In contrast, self-esteem decreased as gaming time increased (T1–T2) and as depression increased (T2–T3) in the lower group. Considering that self-esteem is one of the critical factors to be cultivated during adolescence and

TABLE 2 Correlations and discriminant validity analysis.

	G_T1	G_T2	G_T3	Satis1	Satis2	Satis3	Dep1	Dep2	Dep3	Lon1	Lon2	Lon3	SE1	SE2	SE3	SC1	SC2	SC3	SC31
G_T1	•																		
G_T2	0.622**	•																	
G_T3	0.576**	0.617**	•																
Satis1	−0.069	−0.021	−0.012	(0.823)															
Satis2	−0.034	−0.009	−0.081	0.555**	(0.823)														
Satis3	0.068	0.128**	0.027	0.443**	0.579**	(0.832)													
Dep1	0.087	0.006	0.017	−0.314**	−0.274**	−0.210**	(0.794)												
Dep2	0.128*	0.113*	0.151**	−0.232**	−0.262**	−0.192**	0.451**	(0.812)											
Dep3	0.164**	0.037	0.121*	−0.129**	−0.156**	−0.244**	0.296**	0.470**	(0.793)										
Lon1	0.022	0.018	−0.008	−0.326**	−0.241**	−0.230**	0.537**	0.261**	0.209**	(0.713)									
Lon2	0.061	0.081	0.150**	−0.260**	−0.330**	−0.238**	0.338**	0.610**	0.376**	0.456**	(0.747)								
Lon3	0.090	0.012	0.138**	−0.138**	−0.197**	−0.337**	0.249**	0.361**	0.580**	0.382**	0.545**	(0.738)							
SE1	−0.130**	−0.029	−0.083	0.343**	0.303**	0.319**	−0.198**	−0.181**	−0.190**	−0.231**	−0.249**	−0.251**	(0.761)						
SE2	−0.110*	−0.028	−0.108*	0.335**	0.466**	0.372**	−0.254**	−0.351**	−0.277**	−0.242**	−0.373**	−0.382**	0.596**	(0.764)					
SE3	−0.078	0.007	−0.094	0.270**	0.303**	0.511**	−0.241**	−0.327**	−0.362**	−0.257**	−0.332**	−0.404**	0.466**	0.583**	(0.765)				
SC1	−0.145**	0.002	−0.032	0.377**	0.200**	0.182**	−0.260**	−0.098	−0.108*	−0.457**	−0.261**	−0.176**	0.264**	0.286**	0.216**	•			
SC2	−0.065	0.038	−0.071	0.276**	0.340**	0.321**	−0.129**	−0.174**	−0.198**	−0.198**	−0.364**	−0.305**	0.328**	0.482**	0.340**	0.359**	•		
SC3	−0.138**	−0.043	−0.111*	0.218**	0.272**	0.322**	−0.160**	−0.166**	−0.233**	−0.220**	−0.295**	−0.361**	0.371**	0.407**	0.466**	0.337**	0.525**	•	
SC3_ SC1	0.002	−0.040	−0.071	−0.130**	0.069	0.129**	0.081	−0.063	−0.113*	0.196**	−0.037	−0.168**	0.102*	0.115*	0.227**	−0.557**	0.156**	0.595**	•

Number in brackets: root square AVE. Off-diagonal area: correlation coefficient of each variable (*p < 0.05, **p <. 01). G_t1 = gaming time1; G_t2 = gaming time2; G_t3 = gaming time 3; satis1 = life satisfaction1; satis2 = life satisfaction2; satis3 = life satisfaction3; dep1 = depression1; dep2 = depression2; dep3 = depression3; lon1 = loneliness1; lon2 = loneliness2; lon3 = loneliness3; SE1 = self-esteem1; SE 2 = self-esteem2; SE 3 = self-esteem3; SC1 = social capital1; SC2 = social capital2; SC3 = social capital3; t3_t1 = social capital t3-social capital.

10.3389/fpsyg.2022.931134

TABLE 3 Results of GLM (General Linear Model): Multivariate tests.

Effect			Value	*F*	Hypothesis df	Error df	Sig.	Partial Eta Squared
Between	Intercept	Pillai's Trace	0.986	5712.704	5.000	397.000	0.000	0.986
		Wilks's Lambda	0.014	5712.704	5.000	397.000	0.000	0.986
		Hotelling's Trace	71.948	5712.704	5.000	397.000	0.000	0.986
		Roy's Largest Root	71.948	5712.704	5.000	397.000	0.000	0.986
	SC groups	Pillai's Trace	0.038	3.136	5.000	397.000	0.009	0.038
		Wilks's Lambda	0.962	3.136	5.000	397.000	0.009	0.038
		Hotelling's Trace	0.039	3.136	5.000	397.000	0.009	0.038
		Roy's Largest Root	0.039	3.136	5.000	397.000	0.009	0.038
Within	Time	Pillai's Trace	0.042	1.716	10.000	392.000	0.075	0.042
		Wilks's Lambda	0.958	1.716	10.000	392.000	0.075	0.042
		Hotelling's Trace	0.044	1.716	10.000	392.000	0.075	0.042
		Roy's Largest Root	0.044	1.716	10.000	392.000	0.075	0.042
	Time × SC	Pillai's Trace	0.132	5.941	10.000	392.000	0.000	0.132
	groups	Wilks's Lambda	0.868	5.941	10.000	392.000	0.000	0.132
		Hotelling's Trace	0.152	5.941	10.000	392.000	0.000	0.132
		Roy's Largest Root	0.152	5.941	10.000	392.000	0.000	0.132

SC groups (Social Capital groups: higher-and lower-social-capital group); Time (T1, T2, T3).

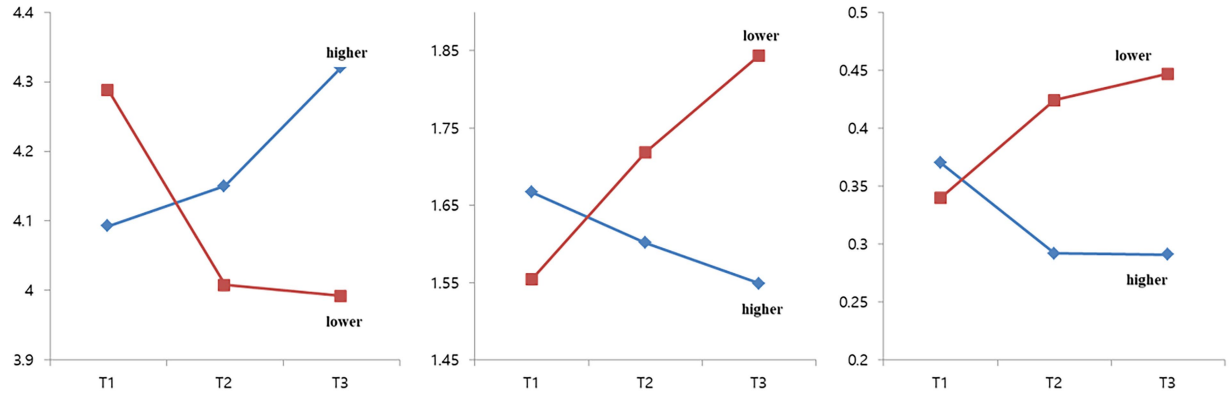


FIGURE 1
Change of life satisfaction (left), depression (middle), loneliness (right).

online gaming has become a major part of the daily culture of adolescents, these results imply the importance of positive cultivation of self-esteem from online gaming of adolescents.

Theoretical and practical implications

The result of this study also provided several implications. Firstly, it was the cumulative degree of social capital that determined the (positive or negative) effects of online gaming on psychosocial factors rather than gaming time. Previous studies have focused on identifying the effects of the quantitative factors of online gaming time rather than the nature of online gaming activities. Adolescents' social capital cultivation in online games is as important as social capital formation in real life. Due to the nature of the online space, it is considered that game players, through online gaming activities, may have the opportunities to form a broader and deeper social relationship than actual reality space (Kaye et al., 2017; Gong et al., 2021). However, failure or loss of social capital development could bring about excessive gaming. Players' emotional factors such as loneliness and depression influenced gaming time, and the degree of self-esteem mediated by social capital significantly affected the growth of gaming time. Analysis of the social support and exclusion experiences within adolescents' online games should be prioritized.

Secondly, regarding the effects of adolescents' gaming time on psychosocial factors, more attention should be paid to self-esteem. Since adolescent online game players who possessed poor social capital were vulnerable to exclusion from peer groups, their self-esteem, characterized by negative self-assessment and self-criticism, weakened the overall development of adolescents and made them turn to online games (Jung, 2022). Teenagers actively

TABLE 4 Results of hypotheses testing: Social capital lower group vs. higher group.

		Lower Group		Higher Group	
T1		T2	T3	T2	T3
		B (C.R)	B (C.R)	B (C.R)	B (C.R)
Gaming time	gaming time	0.641**(8.806)	0.624**(12.017)	0.400**(5.611)	1.171**(5.466)
	life satisfaction	−0.020(−0.512)	0.043(1.121)	0.112*(2.486)	0.151**(4.327)
	depression	0.042*(1.844)	−0.014(−0.712)	−0.001(−0.057)	−0.002(−0.138)
	loneliness	0.031(1.311)	−0.003(−0.143)	0.000(0.012)	−0.026(−1.597)
	self-esteem	−0.042*(−2.237)	0.001(0.031)	−0.005(−0.211)	0.030*(1.736)
Life satisfaction	gaming time	0.011(0.093)	−0.019(−0.179)	−0.004(−0.039)	0.081(0.385)
	life satisfaction	0.396**(6.434)	0.533**(6.974)	0.595**(9.043)	0.530**(10.251)
	depression	−0.013(−0.368)	0.007(0.189)	−0.064*(−2.644)	0.016(0.797)
	loneliness	0.011(0.295)	0.001(0.031)	−0.082*(−2.624)	0.035(1.466)
	self-esteem	0.002(0.070)	0.015(0.411)	0.164**(4.795)	0.049*(1.933)
Depression	gaming time	−0.276(−0.872)	0.035(0.162)	−0.105(−0.463)	0.106(0.354)
	life satisfaction	−0.508(−2.966)*	−0.247(−1.554)	−0.036(−0.196)	0.203(1.076)
	depression	0.562(5.698)**	0.350**(4.418)	0.280**(4.150)	0.318**(4.404)
	loneliness	0.146(1.407)	0.007(0.088)	0.097(1.125)	−0.012(−0.137)
	self-esteem	−0.111(−1.340)	−0.195*(−2.653)	−0.107(−1.124)	−0.055(−0.587)
Loneliness	gaming time	−0.076(−0.272)	−0.172(−0.825)	−0.155(−0.808)	0.288(1.143)
	life satisfaction	−0.291*(−1.929)	−0.192(−1.295)	0.058(0.396)	0.120(0.798)
	depression	−0.037(−0.423)	0.155*(2.104)	0.088(1.622)	0.042(0.734)
	loneliness	0.453**(4.955)	0.537**(6.944)	0.359**(5.157)	0.407**(5.803)
	self-esteem	−0.037(−0.505)	−0.040(−0.586)	−0.320**(−4.194)	−0.107(−1.438)
Self-esteem	gaming time	−0.081(−0.306)	−0.374*(−1.817)	0.106(0.630)	−0.089(−0.429)
	life satisfaction	0.187(1.299)	−0.014(−0.093)	0.226(1.695)	0.489**(5.082)
	depression	−0.135(−1.631)	−0.136(−1.803)	0.035(0.712)	−0.099*(−2.682)
	loneliness	−0.192*(−2.197)	−0.220*(−2.789)	−0.047(−0.744)	−0.200**(−4.458)
	self-esteem	0.727**(10.463)	0.421**(6.019)	0.341**(4.884)	0.363**(7.595)

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

engaged in game activities so as not to be excluded by their peers in online games, and these endeavors led to the possibility of an increase in their online gaming time. In order to prevent gamers with poor social capital from wasting their time on games, self-esteem needs to be boosted or recovered. Several studies have confirmed that self-esteem was a moderator between social exclusion and adolescents' life satisfaction. Reducing the adverse effects of social exclusion through positive self-assessment, lower self-criticism, and strong self-image was considerably helpful in preventing disruptive behaviors (Arslan, 2019; Banstola et al., 2020). Adequate self-esteem based on the feeling of life satisfaction among higher social capital forming players did not influence the gaming time. Thus, it is natural to infer that improving self-esteem could assist the process of social capital development.

Thirdly, the overall results of this study imply that online gaming space is as important as the real space in the cultivation of social capital for adolescents. Previous research on social capital in online games is rare, but this study focused on adolescents' social capital in gaming experiences based on longitudinal empirical data analysis. In particular, this study emphasized that online gaming experience reflected adolescents' developmental characteristics and social capital accumulated from the online games played an important role as peer groups of adolescence. Understanding the developmental characteristics of adolescence is necessary for research on adolescents' online game players in that such online gameplay experience is based on virtual world play. Thus, it should not be overlooked that gaming activities could reflect real human life: cultivation of social capital in online games could be as important as social capital formation in the real world.

This study found that gaming time was not a crucial variable in terms of its effects on psychosocial factors. The lower degree of social capital and aggravated self-esteem were key variables affecting gaming time growth patterns. Peer relationships and self-esteem developed during adolescence could last for life. Therefore, online games need to be considered within the boundary of adolescents' peer relationships and developmental self-esteem characteristics. In addition, most adolescents believe that online gaming is a combination of easy access to play with many other people and the opportunity to watch other players glean tips on how to improve their performance in a game (Clark et al., 2020).

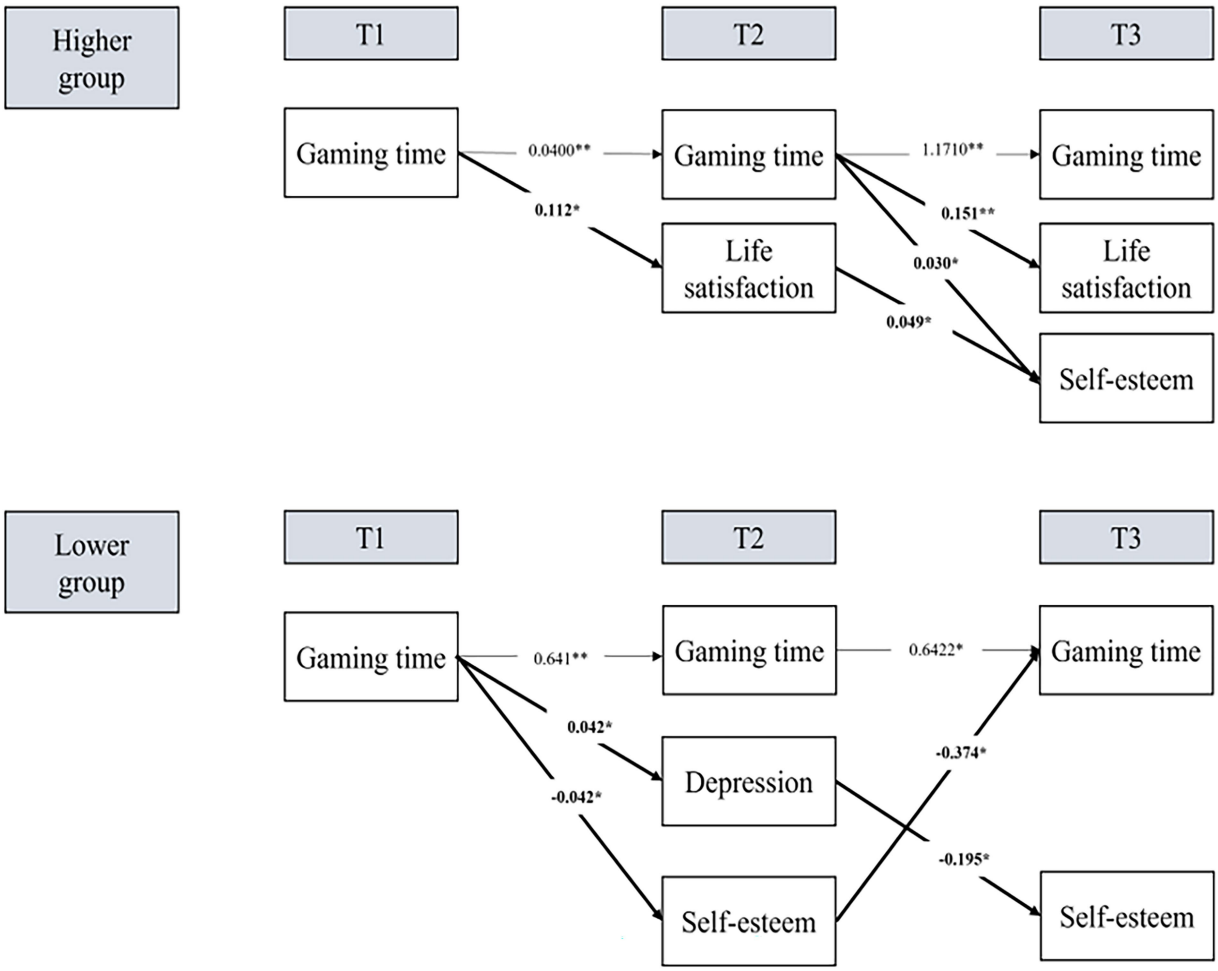


FIGURE 2
Two-group structural equation model.

So, researchers might admit that online gameplay is the main culture of adolescents and adolescent gamers naturally long for peer support. Without fulfilling this desire, game playing tended to be long until they were satisfied with peer relationships.

This study also suggests some practical implications. Focused on the crucial role of social capital among adolescents' gamers, game developers who want to contribute to healthy game use by adolescents could open new communities and customize events for compliments and encouragement. In addition, training programs for making good peer relationships could be helpful for excessive adolescent gamers in schools and homes. By combining online and offline social capital formation training, adolescents could have more confidence and improve game playing satisfaction levels.

In relation to the importance of self-esteem, the development of self-esteem-focused prevention and intervention programs is recommended to game policymakers. Facilitating intervention programs using in-game activities is one of the effective solutions for reducing negative effects of gaming time. Parental and youth counseling programs, physical activities programs, and arts and music lessons within local schools, communities, and counseling centers could improve the degree of self-esteem.

Finally, this study poses some limitations. The survey was conducted only in one country, South Korea, so the data used for the analysis may not reflect global characteristics. Second, more diverse variables for measuring game use behaviors could have been included. Except for gaming time, the number of games played concurrently, duration time of single play, and access time could be used as variables in assessing game use behavior. Further studies may consider these factors in longitudinal settings from diverse cultural backgrounds.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The data used in this study are available with permission from Korea Creative Content Agency (KOCCA,

http://www.kocca.kr). Requests to access these datasets should be directed to EJ (stevejeong@gmail.com).

Ethics statement

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

Author contributions

GK conducted original draft preparation and data processing. EJ supervised, performed results and discussion section, and reviewed the manuscripts. JL performed literature review and discussion section. JY performed literature review and data analysis. All authors contributed to the article and approved the submitted version.

Funding

This research was supported by Konkuk University in 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.

References

Abreu, C. N. D., Góes, D. S., Vieira, A., and Chwartzmann, F. (2011). *Dependência de internet. Psicoterapias cognitivo-comportamentais*. Porto Alegre: Artmed, 440–458.

Allen, J. J., and Anderson, C. A. (2018). Satisfaction and frustration of basic psychological needs in the real world and video games predict internet gaming disorder scores and well-being. *Comput. Hum. Behav.* 84, 220–229. doi: 10.1016/j.chb.2018.02.034

Anderson, C. A., and Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychol. Sci.* 12, 353–359. doi: 10.1111/1467-9280.00366

Arbeau, K., Thorpe, C., Stinson, M., Budlong, B., and Wolff, J. (2020). The meaning of the experience of being an online video game player. *Comput. Hum. Behav. Rep.* 2:100013. doi: 10.1016/j.chbr.2020.100013

Armstrong, L., Phillips, J. G., and Saling, L. L. (2000). Potential determinants of heavier internet usage. *Int. J. Hum. Comput. Stud.* 53, 537–550. doi: 10.1006/ijhc.2000.0400

Arslan, G. (2019). Mediating role of the self-esteem and resilience in the association between social exclusion and life satisfaction among adolescents. *Pers. Individ. Differ.* 151:109955, 109514. doi: 10.1016/j.paid.2019.109514

Asher, S. R., and Paquette, J. A. (2003). Loneliness and peer relations in childhood. *Curr. Dir. Psychol.* 12, 75–78. doi: 10.1111/1467-8721.01233

Association, A. P. (1997). Practice guideline for the treatment of patients with schizophrenia. *Am. J. Psychiatry* 154, 1–63. doi: 10.1176/ajp.154.4.1

Ballard, M. E., and Wiest, J. R. (1996). Mortal Kombat (tm): The Effects of Violent Videogame Play on Males' Hostility and Cardiovascular Responding 1. *J. Appl. Soc. Psychol.* 26, 717–730. doi: 10.1111/j.1559-1816.1996.tb02740.x

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annu. Rev. Psychol.* 52, 1–26. doi: 10.1146/annurev.psych.52.1.1

Banstola, R. S., Ogino, T., and Inoue, S. (2020). Self-esteem, perceived social support, social capital, and risk-behavior among urban high school adolescents in Nepal. *SSM Popul. Health* 11:100570. doi: 10.1016/j.ssmph.2020.100570

Baumeister, R. F., Campbell, J. D., Krueger, J. I., and Vohs, K. D. (2003). Does High Self-Esteem Cause Better Performance, Interpersonal Success, Happiness, or Healthier Lifestyles? *Psychol. Sci. Public Interest* 4, 1–44. doi: 10.1111/1529-1006.01431

Brian, D., and Hastings, P. W. (2005). Addiction to the Internet and Game online Gaming. *Cyberpsychol. Behav.* 8, 110–113. doi: 10.1089/cpb.2005.8.110

Carras, M. C., Van Rooij, A. J., Van de Mheen, D., Musci, R., Xue, Q. L., and Mendelson, T. (2017). Video gaming in a hyperconnected world: a cross-sectional study of heavy gaming, problematic gaming symptoms, and online socializing in adolescents. *Comput. Hum. Behav.* 68, 472–479. doi: 10.1016/j.chb.2016.11.060

Castillo, R. P. (2019). Exploring the differential effects of social and individualistic gameplay motivations on bridging social capital for players of a massively multiplayer online game. *Comput. Hum. Behav.* 91, 263–270. doi: 10.1016/j.chb.2018.10.016

Chang, S., and Lin, S. S. J. (2019). Online gaming motive profiles in late adolescence and the related longitudinal development of stress, depression, and problematic internet use. *Comput. Educ.* 135, 123–137. doi: 10.1016/j.compedu.2019.02.003

Chappell, D., Eatough, V., Davies, M. N., and Griffiths, M. (2006). EverQuest—It's just a computer game, right? An interpretative phenomenological analysis of online gaming addiction. *Int. J. Ment. Health Addict.* 4, 205–216. doi: 10.1007/s11469-006-9028-6

Cheung, L. M., and Wong, W. S. (2011). The effects of insomnia and internet addiction on depression in Hong Kong Chinese adolescents: an exploratory cross-sectional analysis. *J. Sleep Res.* 20, 311–317. doi: 10.1111/j.1365-2869.2010.00883.x

Clark, S. J., Freed, G. L., Singer, D. C., Gebremariam, A., and Schultz, S. L. (2020). Game On: Teens and Video Games. C.S. Mott Children's Hospital National Poll on Children's Health 35. Available at: https://mottpoll.org/sites/default/files/documents/012020_VideoGames.pdf (Accessed January 20, 2022).

Cole, H., and Griffiths, M. D. (2007). Social interactions in massively multiplayer online role-playing gamers. *Cyberpsychol. Behav.* 10, 575–583. doi: 10.1089/cpb.2007.9988

Coleman, J. S. (1998). Social capital in the creation of human capital. *Am. J. Sociol.* 94, S95–S120. doi: 10.1086/228943

Diener, E. D., Emmons, R. A., Larsen, R. J., and Griffin, S. (1985). The satisfaction with life scale. *J. Pers. Assess.* 49, 71–75. doi: 10.1207/s15327752jpa4901_13

Ducheneaut, N., and Moore, R. J. (2004). "The social side of gaming: a study of interaction patterns in a massively multiplayer online game." In *Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work*, 360–369.

Durkin, K., and Barber, B. (2002). Not so doomed: Computer game play and positive adolescent development. *J. Appl. Dev. Psychol.* 23, 373–392. doi: 10.1016/S0193-3973(02)00124-7

Engels, R. C., Deković, M., and Meeus, W. (2002). Parenting practices, social skills, and peer relationships in adolescence. *Soc. Behav. Personal. Int. J.* 30, 3–17. doi: 10.2224/sbp.2002.30.1.3

Fazeli, S., Mohammadi Zeidi, I., Lin, C. Y., Namdar, P., Griffiths, M. D., Ahorsu, D. K., et al. (2020). Depression, anxiety, and stress mediate the associations between internet gaming disorder, insomnia, and quality of life during the COVID-19 outbreak. *Addict. Behav. Rep.* 12:100307. doi: 10.1016/j.abrep.2020.100307

Giddens, A. (ed.) (2001). *The Global Third Way Debate*. Cambridge: Polity Press, 1–24.

Gong, S., Xu, P., and Wang, S. (2021). Social capital and psychological well-being of Chinese immigrants in Japan. *Int. J. Environ. Res. Public Health* 18:547. doi: 10.3390/ijerph18020547

Gong, X., Zhang, K., Cheung, C., Chen, C., and Lee, M. (2019). Alone or together? exploring the role of desire for online group gaming in players' social game addiction: a dual-system perspective. *Inf. Manage.* 56:103139. doi: 10.1016/j.im.2019.01.001

Gorrese, A., and Ruggieri, R. (2013). Peer attachment and self-esteem: A meta-analytic review. *Pers. Individ. Differ.* 55, 559–568. doi: 10.1016/j.paid.2013.04.025

Griffiths, M. D., and Hunt, N. (1995). Computer game playing in adolescence: Prevalence and demographic indicators. *J. Community Appl. Soc. Psychol.* 5, 189–193. doi: 10.1002/casp.2450050307

Griffiths, M., Kuss, D. J., and Ortiz de Gortari, A. B. (2017). Videogames as therapy: An updated selective review of the medical and psychological literature. *Int. J. Priv. Health Inf. Manag.* 5, 71–96. doi: 10.4018/IJPHIM.2017070105

Grizzard, M., Tamborini, R., Lewis, R. J., Wang, L., and Prabhu, S. (2014). Being bad in a video game can make us morally sensitive. *Cyberpsychol. Behav. Soc. Netw.* 17, 499–504. doi: 10.1089/cyber.2013.0658

Guo, H., Li, H., Chan, G., and Skitmore, M. (2012). Using game technologies to improve the safety of construction plant operations. *Accid. Anal. Prev.* 48, 204–213. doi: 10.1016/j.aap.2011.06.002

Hladik, J., and Hrbackova, K. (2021). Peer-rejected students: An analysis of their self-regulatory mechanisms. *Child Youth Serv. Rev.* 126:106030. doi: 10.1016/j.childyouth.2021.106030

Hussain, Z., and Griffiths, M. D. (2009). The attitudes, feelings, and experiences of online gamers: a qualitative analysis. *Cyberpsychol. Behav.* 12, 747–753. doi: 10.1089/cpb.2009.0059

Jeong, E. J., Kim, D. J., and Lee, D. M. (2017). Why do some people become addicted to digital games more easily? A study of digital game addiction from a psychosocial health perspective. *Int. J. Hum.-Comput. Interact.* 33, 199–214. doi: 10.1080/10447318.2016.1232908

Ju, S., and Lee, Y. (2018). Developmental trajectories and longitudinal mediation effects of self-esteem, peer attachment, child maltreatment and depression on early adolescents. *Child Abuse Negl.* 76, 353–363. doi: 10.1016/j.chiabu.2017.11.015

Jung, C. W. (2022). Two perspectives on gaming social capital among Korean adolescents'gamers. *Entertain. Comput.* 41:100470. doi: 10.1016/j.entcom.2021.100470

Kaye, L. K., Kowert, R., and Quinn, S. (2017). The role of social identity and online social capital on psychosocial outcomes in MMO players. *Comput. Hum. Behav.* 74, 215–223. doi: 10.1016/j.chb.2017.04.030

Kim, J., LaRose, R., and Peng, W. (2009). Loneliness as the cause and the effect of problematic Internet use: The relationship between Internet use and psychological well-being. *Cyberpsychol. Behav.* 12, 451–455. doi: 10.1089/cpb.2008.0327

Kim, Y. Y., Oh, S., and Lee, H. (2005). What makes people experience flow? Social characteristics of online games. *Int. J. Adv. Media Commun.* 1, 76–92. doi: 10.1504/IJAMC.2005.007724

Kim, Y., Song, J., and Shin, H. (2019). Adolescent Peer Relationships and Drinking Smoking Experiences: Application of Social Network Analysis. *Mental Health & Social Work* 47, 171–199. doi: 10.24301/MHSW.2019.09.47.3.171

Ko, C. H., Liu, T. L., Wang, P. W., Chen, C. S., Yen, C. F., and Yen, J. Y. (2014). The exacerbation of depression, hostility, and social anxiety in the course of internet addiction among adolescents: a prospective study. *Compr. Psychiatry* 55, 1377–1384. doi: 10.1016/j.comppsych.2014.05.003

Ko, C. H., Yen, Y. J., Chen, C. C., Chen, S. H., and Yen, C. F. (2005). Gender differences and related factors affecting online gaming addiction among Taiwanese adolescents. *J. Nerv. Ment. Dis.* 193, 273–277. doi: 10.1097/01.nmd.0000158373.85150.57

Kolo, C., and Baur, T. (2004). Living a virtual life: Social dynamics of online gaming. *Game Stud.* 4, 1–31.

Kwon, J., and Kim, M. S. (2019). Relationship between Peer Attachment and Cyber Bullying of Adolescents: Mediating Effect of Game Addiction. *J. of the Korean Society for Wellness* 14, 41–53. doi: 10.21097/ksw.2019.05.14.2.41

Lager, A., and Bremberg, S. (2005). Health effects of video and computer game playing: A systematic review. Swedish National Institute of Public Health.

Lee, H. R., and Jeong, E. J. (2015). The influence of players' self-esteem, game-efficacy, and social capital on life satisfaction focused on hedonic and eudaimonic happiness. *Korea Multimed. Soc.* 18, 1118–1130. doi: 10.9717/KMMS.2015.18.9.1118

Lemmens, J. S., Valkenburg, P. M., and Peter, J. (2011). Psychosocial causes and consequences of pathological gaming. *Comput. Hum. Behav.* 27, 144–152. doi: 10.1016/j.chb.2010.07.015

Lin, M. P., Wu, J. Y. W., You, J., Chang, K. M., Hu, W. H., and Xu, S. (2018). Association between online and offline social support and internet addiction in a representative sample of senior high school students in Taiwan: The mediating role of self-esteem. *Comput. Hum. Behav.* 84, 1–7. doi: 10.1016/j.chb.2018.02.007

Lo, S.-K., Wang, C.-C., and Fang, W. (2005). Physical interpersonal relationships and social anxiety among online game players. *Cyberpsychol. Behav.* 8, 15–20. doi: 10.1089/cpb.2005.8.15

McKenna, K. Y., and Bargh, J. A. (2000). Plan 9 from cyberspace: The implications of the Internet for personality and social psychology. *Personal. Soc. Psychol. Rev.* 4, 57–75. doi: 10.1207/S15327957PSPR0401_6

Nie, N. H., Hillygus, D. S., and Erbring, L. (2002). "Internet use, interpersonal relations, and sociability: a time diary study." in *The Internet in Everyday Life*, eds. C. Haythornthwaite and B. Wellman (NJ: Wiley-Blackwell), 215–243.

Niemz, K., Griffiths, M., and Banyard, P. (2005). Prevalence of pathological Internet use among university students and correlations with self-esteem, the General Health Questionnaire (GHQ), and disinhibition. *Cyberpsychol. Behav.* 8, 562–570. doi: 10.1089/cpb.2005.8.562

Pénard, T., and Poussing, N. (2010). Internet Use and Social Capital: The Strength of Virtual Ties. *J. Econ. Issues* 44, 569–595. doi: 10.2753/JEI0021-3624440301

Peng, W., and Liu, M. (2010). Online gaming dependency: a preliminary study in China. *Cyberpsychol. Behav. Soc. Netw.* 13, 329–333. doi: 10.1089/cyber.2009.0082

Perry, R., Drachen, A., Kearney, A., Kriglstein, S., Nacke, L. E., Sifa, R., et al. (2018). Online-only friends, real-life friends or strangers? differential associations with passion and social capital in video game play. *Comput. Hum. Behav.* 79, 202–210. doi: 10.1016/j.chb.2017.10.032

Putnam, R. D. (2000). *Bowling alone: America's declining social capital. Culture and politics*. Palgrave Macmillan, New York, 223–234.

Rasmussen, S. (2000). *Addiction treatment: Theory and practice*. New York: Sage.

Reer, F., and Kramer, N. C. (2019). Are online role-playing games more social than multiplayer first-person shooters? investigating how online gamers' motivations and playing habits are related to social capital acquisition and social support. *Entertain. Comput.* 29, 1–9. doi: 10.1016/j.entcom.2018.10.002

Rosenberg, M. (1965). Rosenberg self-esteem scale (RSE). Acceptance and commitment therapy. *Measures Package* 61:52. doi: 10.1037/t01038-000

Rudolph, K. D. (2020). Understanding peer relationships during childhood and adolescence through the lens of social motivation. *Adv. Motiv. Sci.* 8, 105–151. doi: 10.1016/bs.adms.2020.08.001

Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *J. Pers. Assess.* 66, 20–40. doi: 10.1207/s15327752jpa6601_2

Seay, A. F., and Kraut, R. E. (2007). "Project massive: Self-regulation and problematic use of online gaming." in *Proceedings of the SIGCHI Conference on Hum. Factors in Computing Systems,* 829–838.

Shapira, N. A., Goldsmith, T. D., Keck, P. E. Jr., Khosla, U. M., and McElroy, S. L. (2000). Psychiatric features of individuals with problematic internet use. *J. Affect. Disord.* 57, 267–272. doi: 10.1016/S0165-0327(99)00107-X

Shin, D. C., and Johnson, D. M. (1978). Avowed happiness as an overall assessment of the quality of life. *Soc. Indic. Res.* 5, 475–492. doi: 10.1007/BF00352944

Shin, M., Seo, E., Song, S., Kim, E., Whon, Y., Kno, W., et al., (2017). *Development Psychology* (*2nd Edn*). Seoul: Hakjisa.

Slater, M. D. (2007). Reinforcing spirals: The mutual influence of media selectivity and media effects and their impact on individual behavior and social identity. *Commun. Theory* 17, 281–303. doi: 10.1111/j.1468-2885.2007.00296.x

Slater, M. D., and Hayes, A. F. (2010). The influence of youth music television viewership on changes in cigarette use and association with smoking peers: A social identity, reinforcing spirals perspective. *Commun. Res.* 37, 751–773. doi: 10.1177/0093650210375953

Snodgrass, J., Lacy, M. G., and Cole, S. W. (2019). Internet gaming, embodied distress, and psychosocial well-being: a syndemic-syndaimonic continuum. *Soc. Sci. Med.* 295:112728. doi: 10.1016/j.socscimed.2019.112728

Sowislo, J. F., and Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychol. Bull.* 139, 213–240. doi: 10.1037/a0028931

Sullivan, H. S. (1953). *The Interpersonal Theory of Psychiatry*. New York: Norton.

Suznjevic, M., Dobrijevic, O., and Matijasevic, M. (2009). MMORPG player actions: Network performance, session patterns, and latency requirements analysis. *Multimed. Tools Appl.* 45, 191–214. doi: 10.1007/s11042-009-0300-1

Taylor, T. L. (2006). Does WoW change everything? How a PvP server, multinational player base, and surveillance mod scene caused me pause. *Games Cult.* 1, 318–337. doi: 10.1177/1555412006292615

Trepte, S., Reinecke, L., and Juechems, K. (2012). The social side of gaming: How playing online computer games creates online and offline social support. *Comput. Hum. Behav.* 28, 832–839. doi: 10.1016/j.chb.2011.12.003

Wang, E. S. T., Chen, L. S. L., Lin, J. Y. C., and Wang, M. C. H. (2008). The relationship between leisure satisfaction and life satisfaction of adolescents concerning online games. *Adolescence* 43, 177–184.

Wei, H. T., Chen, M. H., Huang, P. C., and Bai, Y. M. (2012). The association between online gaming, social phobia, and depression: an internet survey. *BMC Psychiatry* 12, 92. doi: 10.1186/1471-244X-12-92

Weinstein, N., Przybylski, A. K., and Murayama, K. (2017). A prospective study of the motivational and health dynamics of Internet Gaming Disorder. *PeerJ* 5:e3838. doi: 10.7717/peerj.3838

Weiss, H. E. (2011). Adolescents as a source of social control: the utility of adolescent social capital for reducing violent delinquency. *Sociol. Spectr.* 31, 554–578. doi: 10.1080/02732173.2011.589783

Williams, D. (2006). On and off the'Net: Scales for social capital in an online era. *J. Comput.-mediat. Comm.* 11, 593–628. doi: 10.1111/j.1083-6101.2006.00029.x

Wilson, K., Fornasier, S., and White, K. M. (2010). Psychological predictors of young adults' use of social networking sites. *Cyberpsychol. Behave. Soc. Netw.* 13, 173–177. doi: 10.1089/cyber.2009.0094

Yee, N. (2006). The demographics, motivations, and derived experiences of users of massively multi-user online graphical environments. *Presence: Teleoperators Virtual Environ.* 15, 309–329. doi: 10.1162/pres.15.3.309

Yoo, J. H., and Jeong, E. J. (2017). Psychosocial effects of SNS use: A longitudinal study focused on the moderation effect of social capital. *Comput. Hum. Behav.* 69, 108–119. doi: 10.1016/j.chb.2016.12.011

Young, K. S. (2007). Cognitive behavior therapy with Internet addicts: treatment outcomes and implications. *Cyberpsychol. Behav.* 10, 671–679. doi: 10.1089/cpb.2007.9971

Zhong, Z. J. (2009). Third-person perceptions and online games: a comparison of perceived antisocial and prosocial game effects. *J. Comput.-Mediat. Commun.* 14, 286–306. doi: 10.1111/j.1083-6101.2009.01441.x

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 20 September 2022
DOI 10.3389/fpsyg.2022.932838

OPEN ACCESS

EDITED BY
Iina Savolainen,
Tampere University, Finland

REVIEWED BY
Bonfiglio Natale Salvatore,
University of Pavia, Italy
Emma Claire Palmer-Cooper,
University of Southampton,
United Kingdom

*CORRESPONDENCE
Zifu Shi
shizf@hunnu.edu.cn
Yihan Zhang
zyh@hunnu.edu.cn

†These authors have contributed equally to this work

SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 30 April 2022
ACCEPTED 22 August 2022
PUBLISHED 20 September 2022

CITATION
Chen H, Ma J, Guan J, Yin L, Shi Z and Zhang Y (2022) The impact of psychological distress on problematic smartphone use among college students: The mediating role of metacognitions about smartphone use.
Front. Psychol. 13:932838.
doi: 10.3389/fpsyg.2022.932838

The impact of psychological distress on problematic smartphone use among college students: The mediating role of metacognitions about smartphone use

Huohong Chen[1,2†], Jing Ma[1,2†], Jinliang Guan[1,2], Lin Yin[1,2], Zifu Shi[1,2,3*] and Yihan Zhang[1,2,3,4*]

[1]School of Educational Science, Hunan Normal University, Changsha, China, [2]Cognition and Human Behavior Key Laboratory of Hunan Province, Changsha, China, [3]Key Laboratory of Sports Intelligence Research, Hunan Normal University, Changsha, China, [4]School of Physical Education, Hunan Normal University, Changsha, China

A mediation model was constructed to clarify the relationship and mechanisms linking psychological distress to problematic smartphone use (PSU), focusing on the mediating role of metacognitions about smartphone use. A questionnaire method was used to investigate psychological distress, metacognitions about smartphone use, and problematic smartphone use among 664 college students. The results showed that (1) psychological distress had a significant positive predictive effect on problematic smartphone use, and (2) there were differences in the underlying mechanisms linking different types of psychological distress to problematic smartphone use. Specifically, negative metacognition about smartphone use partially mediated the relationship between depression and problematic smartphone use, whereas anxiety could act on problematic smartphone use through the parallel mediation of positive metacognition about smartphone use and negative metacognition about smartphone use, with the latter having a greater positive mediating effect than the former. These findings reveal the mechanism of action linking different types of psychological distress to problematic smartphone use from the perspective of the cognitive-behavioral model of pathological Internet use, which has implications for the prevention and intervention of problematic smartphone use among college students.

KEYWORDS

depression, anxiety, metacognitions about smartphone use, problematic smartphone use, college students

Introduction

Problematic smartphone use (PSU) is a non-substance addiction or behavioral addiction that leads to impaired physical, psychological, and social functioning (Liu et al., 2017). Studies have found that individuals with problematic smartphone use have reduced learning engagement (Gao et al., 2021) and reduced sleep quality (Demirci et al., 2015). Although interventions for problematic smartphone use have been developed by scholars from different perspectives (e.g., exercise therapy and environmental interventions), they still lack a high degree of operability (Zhang et al., 2019). Moreover, college students growing up in the digital age are the main users of the smartphone, and thus problematic smartphone use is more common among this group (Qing et al., 2017). Studies have shown that 33.4% of college students have problematic smartphone use (Li et al., 2016), and 58.33% of college students are on the verge of problematic smartphone use (Chen et al., 2016). Therefore, further exploration of the influencing factors and mechanisms of problematic smartphone use among college students could provide new guidelines for the prevention and intervention of problematic smartphone use.

Psychological distress is an adverse emotional experience that occurs when individuals are unable to cope with stress on their own (Holland et al., 2007). Depression and anxiety are the most clinically focused forms of psychological distress (Lovibond and Lovibond, 1995), and prior research has found that individuals in a state of depression and anxiety often cope with their negative experiences through the use of Internet (Li et al., 2019). As the most prevalent Internet access device, smartphone use is the most likely way for individuals with psychological distress to regulate their negative experiences, even though this often does not solve the substantive problem, but rather increases the risk of problematic smartphone use (Yu et al., 2021). Yang et al. (2020) conducted a cross-sectional study with college students as subjects that confirmed this view. In addition, a 6-month follow-up study conducted by Zhou et al. (2021) using high school students as subjects also found that individuals with high depression levels were more likely to be immersed in electronic devices, such as smartphones as a way to avoid stressful events in their lives. More recently, a 10-month longitudinal study by Yu et al. (2021) demonstrated that adolescents with high levels of anxiety were more likely to use their smartphones for social support and thus had a higher likelihood of problematic smartphone use.

However, inconsistent results have also been obtained in some studies. For example, Lee et al. (2020) followed 56 problematic smartphone users and found that initial levels of depression and anxiety did not significantly predict the development of problematic smartphone use episodes 6 months later. This may be related to the statistical method used in the study, i.e., the variables were not statistically analyzed as continuous variables, thus reducing the sensitivity to subtle differences (Lee et al., 2020). Thus, forms of psychological distress, such as depression and anxiety may still be important predictors of problematic smartphone use.

It is far from sufficient to explore the correlations between variables alone. To make more direct recommendations for intervention efforts, one must further examine how psychological distress affects problematic smartphone use (i.e., the mediating mechanisms). The cognitive-behavioral model of pathological Internet use (Davis, 2001) posits that the effects of psychological distress (e.g., depression and anxiety) on individual behavior often work through cognitive factors. An individual's cognition is a sufficient condition for the emergence of addictive behaviors and is a proximal factor in addictive behaviors. Metacognition, i.e., an individual's perception of their own cognitive processes and internal states (Wells, 1995), is an alternate perspective for understanding the role of cognition in problematic smartphone use (Shi et al., 2021). Metacognitions about smartphone use have been found to be more important predictors of problematic smartphone use than general metacognition (Shi et al., 2021; Zhou et al., 2021). Therefore, the present study will focus on the mechanisms by which metacognition about smartphone use mediates the relationship between psychological distress and problematic smartphone use among college students.

First, metacognitions about smartphone use can be affected by psychological distress. Metacognitions about smartphone use are the metacognitive beliefs that individuals have about their smartphone use behavior. It includes both positive metacognition (i.e., individuals' metacognitive beliefs about the emotional and cognitive regulation and social enhancement effects of smartphone use, such as, "Using my smartphone makes me feel happy") and negative metacognition (i.e., individuals' metacognitive beliefs about the uncontrollable and harmful effects of smartphone use, such as, "Using my smartphone controls my life") (Shi et al., 2021). On the one hand, psychological distress may facilitate the activation of positive metacognition about smartphone use. Psychological distress as a negative experience can cause individuals to exhibit symptoms, such as sadness, agitation, and social avoidance (Yang and Zhang, 2021). Individuals tend to seek high-arousal solutions as a way to relieve the discomfort caused by negative experiences (Bryant and Zillmann, 1984). As smartphones are the most convenient and accessible communication tools nowadays, their versatile uses (e.g., socializing, entertainment, and shopping) enable individuals to gain pleasure from them to temporarily alleviate negative experiences (Yang et al., 2020), so college students will be more likely to experience intrusive thinking about the negative experience regulating effects of smartphone use (e.g., "Using a smartphone can reduce my negative feelings")—in other words, positive metacognition about smartphone use. On the other hand, psychological distress may also promote the activation of individuals' negative metacognition about smartphone use. When college

students with high psychological distress levels repeatedly use smartphones as a way to regulate their negative experiences, their ability to control smartphone use will gradually decrease. This will prevent them from realizing the imbalance in their behaviors and adjusting their internal needs in time so that they are unable to make behavioral adjustments (He et al., 2012). Therefore, over time, they will gradually perceive the uncontrollability of their smartphone use and its negative effects (e.g., "Smartphone use has affected my daily life")—in other words, negative metacognition about smartphone use.

Second, metacognitions about smartphone use can have an impact on problematic smartphone use. Positive metacognition was expected to play a central role in the pre-engagement of addictive behavior, with negative metacognition activated in the engagement and post-engagement phase, influencing the continuation of addictive behavior (Spada et al., 2013). Although their effects on addictive behaviors vary depending on the stage of behavior (Spada and Caselli, 2017), both the positive and negative metacognitions about smartphone use have been found to be significant predictors of problematic smartphone use (Casale et al., 2020; Shi et al., 2021). In summary, both positive and negative metacognition about smartphone use may be mediating variables in the relationship between psychological distress and problematic smartphone use among college students.

A recent study investigating 535 smartphone users aged 18–65 years found that the following variables all mediated the relationship between psychological distress and problematic smartphone use: positive metacognition about smartphone use having a prosocial role, negative metacognition about smartphone use, positive expectancy about smartphone use, and negative expectancy about smartphone use. However, positive metacognition about smartphone use, which has emotional and cognitive regulation effects, did not mediate the relationship between the two (Casale et al., 2021). Furthermore, this may be related to the overlap of content between the subscale of positive metacognition about smartphone use, which has emotional and cognitive regulation effects, and the subscale of positive expectancy about smartphone use (e.g., "I experience pleasure using my smartphone" vs. "Using my smartphone makes me feel happy"). Positive expectancy about smartphone use refers to individuals' judgments about the possible positive outcomes of smartphone use (Elhai et al., 2020), whereas positive metacognition about smartphone use is a metacognitive belief about the positive effects of smartphone use (Shi et al., 2021). There is a substantial difference between the two, with the former being a form of cognition and the latter being a form of metacognition (Casale et al., 2021). Although prior research has found that both positive metacognition about smartphone use and positive expectancy about smartphone use positively predict problematic smartphone use (Elhai et al., 2020; Shi et al., 2021), positive metacognition about smartphone use is more focused on motivating individuals to produce smartphone use behavior in the form of thought control (Spada et al., 2015a) and thus should have a more important impact on problematic smartphone use (Casale et al., 2021). However, if two are examined simultaneously, the overlap in the content of the two subscales may make it difficult to truly distinguish the variables at play. Therefore, the present study will separately examine the possible mediating role of metacognitions about smartphone use in the relationship between psychological distress and problematic smartphone use.

In addition, this study will construct a mediational model based on the cognitive-behavioral model of pathological Internet use to explore how psychological distress influences Chinese college students' problematic smartphone use behavior through metacognitions about smartphone use. The specific research hypotheses are: (1) psychological distress positively predicts problematic smartphone use and (2) metacognitions about smartphone use mediate the relationship between psychological distress and problematic smartphone use.

Materials and methods

Participants

A convenience sampling method was used to recruit students (freshmen to seniors) from three universities in Anhui, Hunan, and Sichuan provinces. All students who have taken a mental health education course and had to have used a smartphone. The research protocol was approved by the Ethics Committee of Hunan Normal University in China on 9 October 2021. Informed consent from students was obtained before collecting data. A psychology student who had undergone prior rigorous training as the main test administrator. All students were asked to complete the questionnaires during breaks and were guaranteed strict confidentiality in their answers to the questionnaire. Completing the questionnaire took approximately 15 min. Data were collected by filling out questionnaires on the spot.

Overall, a total of 724 questionnaires were collected. A total of 664 valid questionnaires (F = 49.50%, mean age = 19.25 $\pm$ 1.17 years) were obtained after eliminating invalid questionnaires containing missing data and extreme values. Among them, 2.70% of participants used smartphones for $\leq$ 2 h, 24.40% for 2–4 h, 38.60% for 4–6 h, 23.20% for 6–8 h, and 11.10% for $\geq$ 8 h per day.

Measures

Psychological distress

The depression subscale and anxiety subscale of the Depression Anxiety Stress Scales developed by Lovibond and Lovibond (1995) and revised by Wang et al.

(2016) were used. Both subscales include 7 items, and sample items are "I feel thirsty" and "I cannot feel pleasant or comfortable anymore," Each item of the questionnaire is scored from 0 to 3, and so total scores range from 0 to 21 for each of the depression and anxiety subscales. The higher the total score on each subscale, the more severe the degree of psychological distress. The subscales have shown good psychometric properties as a measure to assess depression and anxiety in Chinese college students (Wang et al., 2016). In the current study, Cronbach's alpha (α) = 0.86 for the depression subscale and α = 0.82 for the anxiety subscale.

Metacognitions about smartphone use

This self-reported measurement was developed by Casale et al. (2020) and revised by Shi et al. (2021). It comprises 24 items, including two dimensions: positive metacognition about smartphone use (14 items) and negative metacognition about smartphone use (10 items). Sample items are, "Using my smartphone makes me feel happy" and "Using my smartphone controls my life." Each item of the questionnaire is scored from 1 to 4, and so the total scores for the positive metacognition about smartphone use subscale and the negative metacognition about smartphone use subscale were 4–56 and 4–40, respectively. Higher scores indicate higher levels of dysfunctional metacognitions associated with smartphone use. This measurement demonstrated effective reliability and validity in a previous study (Shi et al., 2021). In the current study, Cronbach's alpha (α) = 0.92 for the positive metacognition about smartphone use subscale and α = 0.88 for the negative metacognition about smartphone use subscale.

Problematic smartphone use

This self-reported measurement scale was developed by Su et al. (2014). The scale comprises a total of 22 items. Participants gave their answers on a five-point Likert scale from 1 = *do not agree* to 5 = *agree very much*. A sample item is, "I keep an eye on the latest app version and download it to my smartphone." Higher scores represent higher levels of PSU. This measurement has demonstrated effective reliability and validity among Chinese college students (Su et al., 2014). In the present study, Cronbach's alpha of the scale was 0.93.

Data collection and analysis

Data were processed using SPSS 26.0 statistical software. All of the variables in this study were measured using the subjects' self-reports, which may introduce common method bias. To reduce this possibility, common method bias was reduced and examined through procedural control and statistical control with reference to previous studies (Zhou and Long, 2004). For procedural control, the following were used to design the questionnaire: (a) subjects completed the questionnaire anonymously; and (b) some entries were scored using reverse scoring. Statistically, the Harman one-way test was used to test for common method bias. An unrotated principal component factor analysis of all items revealed that a total of 10 factors had eigen root values greater than 1, and the first common factor explained only 24.22% (i.e., less than 40%) of the total variance, indicating that there was no serious common method bias in this study (Podsakoff et al., 2003).

Results

Descriptive statistics and correlation analysis

In the first step, we drew a comparison between male and female participants in relation to the variables of the study. As shown in **Table 1**, we found that the female participants scored higher on problematic smartphone use. Then correlation analysis results (in **Table 2**) showed that depression and anxiety, negative metacognition about smartphone use, and problematic smartphone use were significantly and positively correlated, but depression was not significantly correlated with positive metacognition about smartphone use. Anxiety was significantly and positively correlated with positive metacognition about smartphone use, negative metacognition about smartphone use, and problematic smartphone use. Positive metacognition about smartphone use was significantly and positively correlated with negative metacognition about smartphone use and problematic smartphone use. Negative metacognition about smartphone use and problematic smartphone use was significantly and positively correlated.

Mediated model test

First, all predictor variables in this study had variance inflation factors of no higher than 2.81, indicating that there was no problem of multicollinearity. The mediating effect of metacognitions about smartphone use between psychological

TABLE 1 Differences between male and female across variables.

	Male		Female		
	M	*SD*	*M*	*SD*	*t*
1. Depression	1.95	3.12	1.61	2.64	1.53
2. Anxiety	2.78	3.33	2.67	3.10	0.48
3. PM	32.92	8.54	32.73	7.52	0.31
4. NM	17.92	6.29	18.35	5.89	−0.91
5. PSU	53.59	16.92	57.06	15.72	−2.73**

PM, positive metacognition about smartphone use; NM, negative metacognition about smartphone use; PSU, problematic smartphone use.
**$p < 0.01$.

distress and problematic smartphone use was then analyzed using Model 4 in the SPSS macro program PROCESS, developed by Hayes (2013). The bias-corrected non-parametric percentile Bootstrap method is a test with high precision and testing power (Fang and Zhang, 2012), so it was also used to test the validity of the mediation model. The Bootstrap sampling size was set to 5,000 times and the confidence interval had a confidence level of 95%. Moreover, according to prior studies, there are significant gender and age differences in problematic smartphone use among college students (Wu et al., 2019; Shi et al., 2021), so this study used both as control variables in the mediation analysis.

The results of the study (as shown in **Figure 1**) showed that, with gender and age controlled for, depression was not a significant predictor of positive metacognition about smartphone use ($\beta = 0.07$, $p > 0.05$), but was a significant positive predictor of negative metacognition about smartphone use ($\beta = 0.37$, $p < 0.01$). With depression, positive metacognition about smartphone use, and negative metacognition about smartphone use entered into the regression equation simultaneously, they all significantly and positively predicted problematic smartphone use ($\beta = 0.09$, $p < 0.05$; $\beta = 0.14$, $p < 0.01$; and $\beta = 0.54$, $p < 0.01$). Furthermore, as shown in **Table 3**, the Bootstrap 95% confidence interval for the pathway of positive metacognition about smartphone use contained 0, whereas the Bootstrap 95% confidence interval for the pathway of negative metacognition about smartphone use did not contain 0. This indicates that only negative metacognition about smartphone use partially mediated the relationship between depression and problematic smartphone use.

In addition, the findings revealed (as shown in **Figure 1**) that, controlling for gender and age, the positive predictive effects of anxiety on both positive metacognition about smartphone use and negative metacognition about smartphone use were significant ($\beta = 0.09$, $p < 0.05$; and $\beta = 0.34$, $p < 0.01$), and the positive predictive effects of both positive metacognition about smartphone use and negative metacognition about smartphone use on problematic smartphone use was also significant ($\beta = 0.14$, $p < 0.01$; and $\beta = 0.52$, $p < 0.01$). In addition, the direct predictive effect of anxiety on problematic smartphone use was significant ($\beta = 0.19$, $p < 0.01$). Moreover, the Bootstrap 95% confidence intervals for pathways of both positive metacognition about smartphone use and negative metacognition about smartphone use did not contain 0 (as shown in **Table 3**). This suggests that anxiety not only can directly influence problematic smartphone use but also can act on problematic smartphone use through the parallel mediation of both positive metacognition about smartphone use and negative metacognition about smartphone use. In particular, the magnitude of the mediating effect of negative metacognition about smartphone use was greater than that of positive metacognition about smartphone use.

TABLE 2 Correlations between the study variables.

	1	2	3	4	5
1. Depression	–				
2. Anxiety	0.79**	–			
3. PM	0.07	0.09*	–		
4. NM	0.36**	0.33**	0.29**	–	
5. PSU	0.30**	0.38**	0.30**	0.62**	–

PM, positive metacognition about smartphone use; NM, negative metacognition about smartphone use; PSU, problematic smartphone use.
*$p < 0.05$, **$p < 0.01$.

Discussion

Based on the cognitive-behavioral model of pathological Internet use (Davis, 2001), this study examined the relationship between psychological distress and problematic smartphone use among college students, as well as the mediating role of metacognitions about smartphone use between the two. The results indicate that depression and anxiety can directly predict problematic smartphone use among college students and can also have indirect effects on problematic smartphone use through different mediating pathways. These findings further elucidate the mechanism of action by which psychological distress affects problematic smartphone use, which has implications for the prevention and intervention of problematic smartphone use among college students.

Consistent with the results of prior studies, this study found that psychological distress significantly and positively predicts problematic smartphone use among college students. On the one hand, self-determination theory suggests that the satisfaction of individuals' relationship needs, autonomy needs, and competence needs to influence the development of their adaptive behavior (Deci and Ryan, 2000). Psychological distress as a negative experience can leave college students with unmet psychological needs, such as relationships, autonomy, and competence (Wang et al., 2020). If real-life needs are not well met, individuals will find other ways to satisfy these needs, such as using the Internet (Liu et al., 2016). Previous research has found that people with lower satisfaction with psychological needs in real life are more likely to seek social connections on the Internet (Wang et al., 2015). Nowadays, smartphones, as the largest Internet-using terminal (CNNIC, 2019), can satisfy psychological needs that people cannot be satisfied in society, which may be one of the reasons for problematic smartphone use among college students (Cui et al., 2014). On the other hand, psychological distress can weaken college students' self-control and reduce their resistance to addictive objects by inhibiting the activity of executive functions (Mitchell and Phillips, 2007). The process of coping with psychological distress is essentially a process of ego depletion (Muraven and Baumeister, 2000). When self-control resources are depleted, the individual's

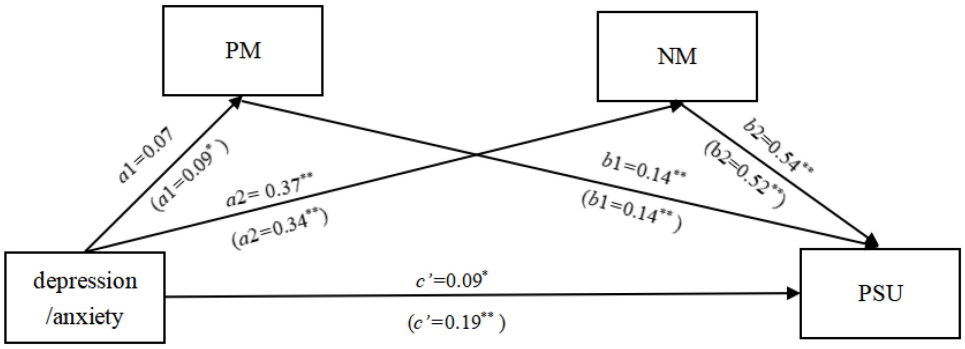


FIGURE 1
Results of the mediated model among the key study variables. The values in parentheses are the values calculated when anxiety is the independent variable; PM, positive metacognition about smartphone use; NM, negative metacognition about smartphone use; PSU, problematic smartphone use; *$p < 0.05$, **$p < 0.01$.

executive control function decreases, making it difficult to maintain normal cognitive activities, such as attention allocation and risk assessment in subsequent decision-making, which in turn can easily trigger impulsive behaviors (Dou et al., 2014), such as problematic smartphone use (Tong et al., 2019). This suggests that how to reduce the level of psychological distress among college students is an important aspect of the prevention and intervention of problematic smartphone use in the future.

Furthermore, in contrast to the results of Casale et al. (2021), the mechanisms underlying the effects of different types of psychological distress on problematic smartphone use differed. Specifically, depression has an indirect effect on problematic smartphone use primarily through negative metacognition about smartphone use, whereas anxiety can act on problematic smartphone use through a parallel mediation of both positive and negative metacognitions about smartphone use. This is an important finding that seems to suggest that anxious individuals are more likely to use smartphones as a form of self-regulation, whereas depressed individuals may use smartphones to satisfy other psychological needs, such as the acquisition of a sense of control (Cheng et al., 2013). However, these may weaken the individual's control over smartphone use, and the weakened behavioral inhibition may prevent the individual from noticing the imbalance in smartphone use and adjusting their internal needs in time (He et al., 2012), activating negative metacognition about smartphone use. The perceived failure of self-regulation and the harmful effects of imbalanced smartphone use reinforce negative repetitive thoughts and negative experiences (Casale et al., 2021), which further compel individuals to continue using the smartphone to regulate their imbalanced internal state (Spada et al., 2015b), ultimately leading to addiction (Casale et al., 2020; Shi et al., 2021). Therefore, in future practice, educators and psychologists can reduce the likelihood of problematic smartphone use by reducing the activation of metacognitions about smartphone use in college students through techniques, such as detached mindfulness and situational attention refocusing (Wells, 2000).

TABLE 3 The mediation effect test.

Pathway	Effect	BootSE	BootLLCI	BootULCI
Depression → PM → PSU	0.010	0.005	0	0.023
Depression → NM → PSU	0.199	0.024	0.153	0.247
PM – NM	−0.188	0.023	−0.234	−0.143
Anxiety → PM → PSU	0.013	0.006	0.003	0.027
Anxiety → NM → PSU	0.173	0.021	0.132	0.216
PM – NM	−0.160	0.021	−0.202	−0.119

PM, positive metacognition about smartphone use; NM, negative metacognition about smartphone use; PSU, problematic smartphone use; PM-NM, the mediating effect values of the two are subtracted.

In addition, this study found that negative metacognition about smartphone use positively mediates the relationship between anxiety and problematic smartphone use more than positive metacognition about smartphone use. This finding reaffirms that negative metacognition about smartphone use is a more important predictor of problematic smartphone use than positive metacognition about smartphone use (Casale et al., 2020; Shi et al., 2021). However, it is worth noting that the subjects selected for this study were not distinguished between normal and clinical individuals. Instead, Caselli et al. (2018), who distinguished subjects between normal gamblers and pathological gamblers, found that positive metacognition was more effective in predicting the long-term severity of addiction in normal gambler subjects compared with negative metacognition, but the opposite result was obtained in pathological gambler subjects. Therefore, future research could further examine group differences in the effects of positive and negative metacognition about smartphone use on problematic smartphone use.

The present study has some limitations that could be rectified in future studies. First, this study used a cross-sectional

research design, and thus the findings could not reveal causal relationships. Second, this study only explored the effects of depression and anxiety, two of the more common types of psychological distress, on problematic smartphone use. Stress, which is also a type of psychological distress and an intrinsic form of depression and anxiety (Lovibond and Lovibond, 1995), will need to be examined in future studies.

Conclusion

(1) Psychological distress significantly and positively predicts problematic smartphone use among college students.

(2) The mechanisms of action between different types of psychological distress and problematic smartphone use are different. Specifically, negative metacognition about smartphone use partially mediates the relationship between depression and problematic smartphone use, whereas anxiety can act on problematic smartphone use through the parallel mediation of positive metacognition about smartphone use and negative metacognition about smartphone use, with the latter having a greater positive mediating effect than former.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of Hunan Normal University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

HC and ZS designed the study and wrote the protocol. JG, LY, and JM conducted literature searches and provided summaries of previous research studies. YZ and JM conducted the statistical analysis. HC wrote the first draft of the manuscript. All authors approved the final manuscript.

Funding

This work was supported by the Major Project of Hunan Social Achievement Appraisal Committee in 2020 (XSP20ZDA004), Education Reform Project of Colleges and Universities in Hunan Province of the Republic of China [(2011)315], and Hunan Provincial Degree and Postgraduate Teaching Reform Project (2021JGYB063).

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

References

Bryant, J., and Zillmann, D. (1984). Using television to alleviate boredom and stress: Selective exposure as a function of induced excitational states. *J. Broadcast. Electron. Media* 28, 1–20. doi: 10.1080/08838158409386511

Casale, S., Caponi, L., and Fioravanti, G. (2020). Metacognitions about problematic Smartphone use: Development of a self-report measure. *Addict. Behav.* 109:106484. doi: 10.1016/j.addbeh.2020.106484

Casale, S., Fioravanti, G., and Spada, M. M. (2021). Modelling the contribution of metacognitions and expectancies to problematic smartphone use. *J. Behav. Addict.* 10, 788–798. doi: 10.1556/2006.2021.00066

Caselli, G., Fernie, B., Canfora, F., Mascolo, C., Ferrari, A., Antonioni, M., et al. (2018). The metacognitions about gambling questionnaire: Development and psychometric properties. *Psychiatry Res.* 261, 367–374. doi: 10.1016/j.psychres.2018.01.018

Chen, L., Yan, Z., Tang, W., Yang, F., Xie, X., and He, J. (2016). .Mobile phone addiction levels and negative emotions among Chinese young adults: The mediating role of interpersonal problems. *Comput. Hum. Behav.* 55, 856–866. doi: 10.1016/j.chb.2015.10.030

Cheng, C., Cheung, S. F., Chio, J. H. M., and Chan, M. P. S. (2013). Cultural meaning of perceived control: A meta-analysis of locus of control and psychological symptoms across 18 cultural regions. *Psychol. Bull.* 139:152. doi: 10.1037/a0028596

CNNIC (2019). *The 44th Statistical Report On The Development Of The Internet In China*. Beijing: CNNIC

Cui, L., Morris, A. S., Criss, M. M., Houltberg, B. J., and Silk, J. S. (2014). Parental psychological control and adolescent adjustment: The role of adolescent emotion regulation. *Parenting* 14, 47–67. doi: 10.1080/15295192.2014.880018

Davis, R. A. (2001). A cognitive-behavioral model of pathological Internet use. *Comput. Hum. Behav.* 17, 187–195. doi: 10.1016/S0747-5632(00)00041-8

Deci, E. L., and Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychol. Inquiry* 11, 227–268. doi: 10.1207/S15327965PLI1104_01

Demirci, K., Akgönül, M., and Akpinar, A. (2015). Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *J. Behav. Addict.* 4, 85–92. doi: 10.1556/2006.4.2015.010

Dou, K., Nie, Y. G., Wang, Y. J., Li, J. B., and Shen, W. B. (2014). Self-depletion facilitates impulsive decision making:Evidence from behavioral and ERPs. *Acta Psychol. Sin.* 46, 1564–1579. doi: 10.3724/SP.J.1041.2014.01564

Elhai, J. D., Yang, H., Dempsey, A. E., and Montag, C. (2020). Rumination and negative smartphone use expectancies are associated with greater levels of problematic smartphone use: A latent class analysis. *Psychiatry Res.* 285:112845. doi: 10.1016/j.psychres.2020.112845

Fang, J., and Zhang, M. Q. (2012). Point and interval estimation of mediation effects: Product distribution method, nonparametric Bootstrap and MCMC method. *J. Psychol.* 44, 1408–1420. doi: 10.3724/SP.J.1041.2012.01408

Gao, B., Zhu, S. J., and Wu, J. L. (2021). The relationship between cell phone addiction and learning engagement among college students: The mediating role of self-control and the moderating role of core self-evaluation. *Psychol. Dev. Educ.* 27, 400–406.

Hayes, A. F. (2013). "Introdution to Mediation, Moderation, and Conditional Process Analysis: A Regression - Based Approach," in *Methodology in the Social Sciences*, eds D. A. Kenny and T. D. Little (New York, NY: The Guilford Press).

He, C., Xia, A. M., Jiang, G. R., and Wei, H. (2012). The mediating role of self-esteem and online game addiction—the mediating role of self-control. *Chin. J. Clin. Psychol.* 20, 58–60.

Holland, J. C., Andersen, B., Breitbart, W. S., Dabrowski, M., Dudley, M. M., Fleishman, S., et al. (2007). Distress management: Clinical practice guidelines in Oncology™. *JNCCN J. Natl. Comp. Cancer Netw.* 5, 66–98. doi: 10.6004/jnccn.2007.0009

Lee, S. Y., Lee, H. K., Choi, J. S., Bang, S. Y., Park, M. H., Jung, K. I., et al. (2020). The Matthew effect in recovery from smartphone addiction in a 6-month longitudinal study of children and adolescents. *Int. J. Environ. Res. Public Health* 17:4751. doi: 10.3390/ijerph17134751

Li, G., Hou, G., Yang, D., Jian, H., and Wang, W. (2019). Relationship between anxiety, depression, sex, obesity, and internet addiction in Chinese adolescents: A short-term longitudinal study. *Addict. Behav.* 90, 421–427. doi: 10.1016/j.addbeh.2018.12.009

Li, Y. X., Jin, L., and Zhang, S. H. (2016). A study on the relationship between self-control ability and cell phone dependence among college students. *China Health Educ.* 32, 775–778+802.

Yang, L. F., and Zhang, R. S. (2021). A study of the characteristics of box work in college students with depressive tendencies. *Chin. J. Clin. Psychol.* 29, 205–208.

Liu, Q. X., Fang, X. Y., Wan, J. J., and Zhou, Z. K. (2016). Need satisfaction and adolescent pathological internet use: Comparison of satisfaction perceived online and offline. *Comput. Hum. Behav.* 55, 695–700. doi: 10.1016/j.chb.2015.09.048

Liu, Q. X., Yang, Y., Lin, Y., Yu, S., and Zhou, Z. K. (2017). Smartphone addiction: Concepts, measures, and influencing factors. *Chin. J. Clin. Psychol.* 25, 82–87.

Lovibond, P. F., and Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav. Res. Ther.* 33, 335–343. doi: 10.1016/0005-7967(94)00075-U

Mitchell, R. L., and Phillips, L. H. (2007). The psychological, neurochemical and functional neuroanatomical mediators of the effects of positive and negative mood on executive functions. *Neuropsychologia* 45, 617–629. doi: 10.1016/j.neuropsychologia.2006.06.030

Muraven, M., and Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychol. Bull.* 126:247. doi: 10.1037/0033-2909.126.2.247

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., and Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* 88:879. doi: 10.1037/0021-9010.88.5.879

Qing, Z. H., Wu, C. H., Cao, J. P., Liu, X. Q., and Qiu, X. Y. (2017). The effect of parental conflict on college students' cell phone addiction: The chain mediating role of cognitive evaluation and loneliness. *Chin. J. Clin. Psychol.* 25, 1083–1087.

Shi, Z., Chen, H., Guan, J., Xie, Y., Huang, S., Chen, X., et al. (2021). Psychometric properties of the metacognitions about smartphone use questionnaire (MSUQ) in Chinese college students. *Addict. Behav.* 123:107041. doi: 10.1016/j.addbeh.2021.107041

Spada, M. M., and Caselli, G. (2017). The metacognitions about online gaming scale: Development and psychometric properties. *Addict. Behav.* 64, 281–286. doi: 10.1016/j.addbeh.2015.07.007

Spada, M. M., Caselli, G., Nikèeviæ, A. V., and Wells, A. (2015a). Metacognition in addictive behaviors. *Addict. Behav.* 44, 9–15. doi: 10.1016/j.addbeh.2014.08.002

Spada, M. M., Caselli, G., and Wells, A. (2013). A triphasic metacognitive formulation of problem drinking. *Clin. Psychol. Psychother.* 20, 494–500. doi: 10.1002/cpp.1791

Spada, M. M., Giustina, L., Rolandi, S., Fernie, B. A., and Caselli, G. (2015b). Profiling metacognition in gambling disorder. *Behav. Cogn. Psychother.* 43, 614–622. doi: 10.1017/S1352465814000101

Su, S., Pan, T. T., Liu, Q. X., Chen, X. W., Wang, Y. J., and Li, M. Y. (2014). Preliminary development of a smartphone addiction scale for college students. *Chin. J. Ment. Health* 28, 392–397. doi: 10.1037/t64077-000

Tong, Y. T., Lian, S. L., Sun, X. J., and Qiu, X. W. (2019). The effect of boredom tendency on cell phone addiction: A moderated mediation effect analysis. *Chin. J. Clin. Psychol.* 27, 1115–1120.

Wang, J. P., Yu, C. F., and Li, W. C. (2020). Peer aggression and adolescent online game addiction: The mediating role of psychological need satisfaction and the moderating role of emotional intelligence. *J. Huazhong Normal Univ.* 59, 184–192.

Wang, K., Shi, H. S., Geng, F. L., Zou, L. Q., Tan, S. P., Wang, Y., et al. (2016). Cross-cultural validation of the Depression Anxiety Stress Scale–21 in China. *Psychol. Assess.* 28:e88–e100. doi: 10.1037/pas0000207

Wang, L., Tao, T., Fan, C., and Gao, W. (2015). Does psychological need satisfaction perceived online enhance well-being? *PsyCh J.* 4, 146–154. doi: 10.1002/pchj.98

Wells, A. (1995). Meta-cognition and worry: A cognitive model of generalized anxiety disorder. *Behav. Cogn. Psychother.* 23, 301–320. doi: 10.1017/S1352465800015897

Wells, A. (2000). *Emotional Disorders & Metacognition: Innovative Cognitive Therapy*. Chichester: Wiley.

Wu, Q. L., Luo, J., Bai, J. Y., Hou, M. L., and Li, X. (2019). The effect of college students' sense of security on cell phone addiction: The mediating role of avoidance of realistic socialization. *Psychol. Dev. Educ.* 35, 589–596.

Yang, X. F., Li, X. F., and Hu, P. (2020). Trait procrastination and cell phone addiction: The mediating role of negative emotional experiences. *Chin. J. Clin. Psychol.* 28, 1148–1151.

Yu, X. Q., Li, Z. N., Fang, Y., and Dong, Y. (2021). A cross-lagged analysis of problematic smartphone use and anxiety among adolescents. *Psychol. Sci.* 44, 866–872.

Zhang, M., Xiao, Q., and Zhu, L. Y. (2019). Advances in research on the antecedents, outcomes, and interventions of cell phone dependence. *Special Educ. China* 11, 88–96.

Zhou, H., Dang, L., Lam, L. W., Zhang, M. X., and Wu, A. M. (2021). A cross-lagged panel model for testing the bidirectional relationship between depression and smartphone addiction and the influences of maladaptive metacognition on them in Chinese adolescents. *Addict. Behav.* 120:106978. doi: 10.1016/j.addbeh.2021.106978

Zhou, H., and Long, L. R. (2004). A statistical test and control method for common method bias. *Adv. Psychol. Sci.* 12, 942–950.

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 28 November 2022
DOI 10.3389/fpsyg.2022.880313

OPEN ACCESS

EDITED BY
Andrew M. Lane,
University of Wolverhampton, United Kingdom

REVIEWED BY
Volkert Siersma,
University of Copenhagen, Denmark
Parisa Gazerani,
Oslo Metropolitan University, Norway

*CORRESPONDENCE
Tabea Breckwoldt
tabea.breckwoldt@outlook.com
Malte Christian Claussen
malte.claussen@pukzh.ch

SPECIALTY SECTION
This article was submitted to Movement Science and Sport Psychology, a section of the journal Frontiers in Psychology

RECEIVED 21 February 2022
ACCEPTED 14 November 2022
PUBLISHED 28 November 2022

CITATION
Breckwoldt T, Fröhlich S, Iff S, Bitar R, Spörri J, Scherr J, Seifritz E, Quednow BB and Claussen MC (2022) A stabilizing factor?–Video gaming among elite athletes during the first lockdown of the COVID-19 pandemic. *Front. Psychol.* 13:880313. doi: 10.3389/fpsyg.2022.880313

A stabilizing factor?–Video gaming among elite athletes during the first lockdown of the COVID-19 pandemic

Tabea Breckwoldt[1]*, Stefan Fröhlich[2,3], Samuel Iff[1], Raoul Bitar[1], Jörg Spörri[2,3], Johannes Scherr[2,3], Erich Seifritz[1], Boris B. Quednow[1,4] and Malte Christian Claussen[1,5,6]*

[1]Department of Psychiatry, Psychotherapy and Psychosomatics, Psychiatric University Hospital Zurich, University of Zurich, Zurich, Switzerland, [2]Sports Medical Research Group, Department of Orthopaedics, Balgrist University Hospital, University of Zurich, Zurich, Switzerland, [3]University Center for Prevention and Sports Medicine, Department of Orthopaedics, Balgrist University Hospital, University of Zurich, Zurich, Switzerland, [4]Experimental and Clinical Pharmacopsychology, Department of Psychiatry, Psychotherapy and Psychosomatics, Psychiatric University Hospital Zurich, University of Zurich, Zurich, Switzerland, [5]Private Clinic Wyss AG, Muenchenbuchsee, Switzerland, [6]Adult Psychiatry, Psychiatric Services Grisons, Chur, Switzerland

Objectives: Little is known about the extent of video gaming among elite athletes, specifically under stressful conditions like those induced by the current COVID-19 pandemic. The aim of this study was to evaluate the intensity and extent of video gaming in the context of the COVID-19 pandemic, during which the usual daily routine of many athletes was disrupted.

Methods: Overall, 203 elite athletes from Switzerland who participated in Olympic sports or in "International Olympic Committee"—approved disciplines were interviewed using an online questionnaire. They were questioned on their video game consumption during the first Swiss lockdown during the COVID-19 pandemic as well as on their athletic performance and economic circumstances. Additionally, mental and physical health were assessed by standardized questionnaires. From this questionnaire data, predictors of gaming time were evaluated using multivariable analysis.

Results: Before the lockdown, 21% of the participating athletes played video games regularly. The average playing time was 15.8 h per month within the gamer group. During the first lockdown, 29% of athletes reported gaming regularly, and within the gamer group the average gaming time increased significantly, by 164%. The mental health burden showed significant differences between gamers and non-gamers regarding existential fears during the lockdown, the ability to cope with governmental measures due to COVID-19 and total sleeping time. However, there was no statistical difference in respect to standardized scales for depressive symptoms, sleep behavior, and anxiety. Higher video gaming time during the lockdown was significantly associated with male gender and previous gaming before the COVID-19 lockdown.

Conclusion: Video gaming time increased significantly during the first lockdown. Whether video gaming among elite athletes hereby functions as an effective coping behavior remains to be shown and requires more research.

KEYWORDS

video gaming behavior, mental health, COVID-19 pandemic, elite athletes, sports psychiatry, sports medicine

1. Introduction

Video gaming is a pleasant and social form of entertainment, since more than half of all video gamers cite social factors as a reason for playing (Steadman, 2019; ESA, 2021). In the U.S. it is estimated that 74% of all households have at least one member who is a video game player (ESA, 2021). Video games can be used to socialize as well as provide mental stimulation.Video games can also function as a coping strategy to escape daily life and relieve stress (Steadman, 2019; ESA, 2021). On the other hand, like many behaviors, video gaming carries a certain risk of becoming addictive, although this only affects a small proportion of gamers (Griffiths, 2005, 2010; Ballabio et al., 2017).

Despite extensive discussion of the topic, few researchers have addressed the question of gaming behavior in elite athletes, and little is known about the extent of gaming among athletes or about their levels of possibly problematic gaming behavior. This lack of objective data was also noted by the International Olympic Committee (IOC) in 2019 (Reardon et al., 2019).

As a population, elite athletes are under high pressure due to intense training plans and the demand for competitive athletic performance. They rely on their physical achievements, mental strength, and discipline (Daumiller et al., 2021), but they are also at risk of mental health problems, substance use, and addictive behavior disorders, such as gambling problems (Håkansson et al., 2018; Reardon et al., 2019).

This high-pressure routine of many athletes was drastically altered by the recent pandemic. Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the "severe acute respiratory syndrome coronavirus 2" (SARS-CoV-2), and its outbreak at the beginning of 2020 led to worldwide restrictions of public life and freedom of movement. In Switzerland, on 16 March 2020, the Federal Council announced an "extraordinary situation" and restricted public life and events (BAG, 2020). As a result, many sport competitions were canceled or were undertaken without spectators, giving rise to uncertainty among athletes and sport clubs. Due to the COVID-19 pandemic, many typical elements of competitive sports were eliminated, potentially affecting competitive athletes on a motivational, emotional and performance level. It is plausible to assume that this situation brings enormous stress to the general population as well as to elite athletes, especially if their existence and professional prospects depend on performing (Claussen et al., 2020; de Quervain et al., 2021).

In this study, we seek to understand more about both typical gaming habits among athletes and how those habits were altered by the COVID-19 pandemic. We hypothesize an increased gaming time during the lockdown due to isolation restrictions. Therefore, the current survey aimed at evaluating the extent of video game consumption in relation to mental and physical health factors, such as athletic performance, anxiety, and depressive symptoms. In addition, the change in video gaming behavior was analyzed in response to the restrictions during the COVID-19 pandemic, during which the usual daily structure of the athletes was considerably disturbed.

2. Materials and methods

2.1. Data collection and setting

The extraordinary situation in the context of the COVID-19 pandemic—known as the "first lockdown"—was decreed by the Swiss Federal Council lasting from 17 March to 10 May 2020. This included the prohibition of all events and the closure of many public places including sport facilities. Private training was therefore still possible, but competitions and team training were not.

In the middle of this period, a REDCap-based online survey (REDCap 9.10.0 - © 2020 Vanderbilt University) was sent to different elite athletes in Switzerland who performed in Olympic sports or IOC-approved disciplines on a national or international level. This online questionnaire was shared by sports clubs for team sports, whereas for individual sports, it was distributed by the Swiss national sports federations. So that athletes could participate in their mother tongue, questionnaires were offered in German and French. Open questions were primarily designed in German. The French translation was validated by two people proficient in both languages and differences in translation were resolved by bilateral discussion. Regarding the standardized questionnaires, validated translations for both languages were used.

The survey evaluated the 4 weeks before the lockdown as well as the first 4 weeks of the lockdown. For both periods, athletes reported the frequency of video gaming, gaming time,

and parameters related to mental health. As demographic parameters, the survey queried age, gender, type of sport and time spent on educational and/or part-time occupational duties. Video game playing time was quantified by frequency (days per month [d/m]) and mean playing time (hours per month [h/m]). We also asked whether the participants were able to earn enough income from their athletic performance to make a living. Finally, we evaluated the performance in athletes (before and during the lockdown) with three different variables: the objective activity (training time hours per day [h/d]), the subjective training intensity and the subjective maximum of athletic performance (both in [%] of the respective *z*-value). Although athletic performance is usually quantified by athletic success, this was not possible in the current study due to canceled tournaments and events.

With respect to COVID-19 itself, participants were asked whether they had been infected and about their personal quarantine requirements. Furthermore, the questionnaire evaluated to what extent the athletes worried about their athletic career due to the COVID-19 pandemic and how they were personally affected by the lockdown measures.

To understand the psychological effects of the situation, depressive symptoms, sleep behavior, and anxiety characteristics were evaluated using the Patient Health Questionnaire (PHQ9), the Insomnia-Severity-Index (ISI), and certain aspects resp. questions extracted from the Pittsburgh Sleep Quality Index, as well as the Spielberger State-Trait-Anxiety-Index (STAI) (Spielberger et al., 1983; Buysse et al., 1989; Bastien et al., 2001; Kroenke et al., 2001). Also, substance use was evaluated, including alcohol and cannabis (frequency of consumption).

The aspects of fear and anxiety were evaluated in three different questions and standardized questionnaires using the STAI survey. The athletes were asked whether they experienced existential fears (4 weeks before and/or during the lockdown), whether they worried about their careers due to the pandemic, and how well they were able to cope with the restrictions established by the Swiss government. For each of these questions, participants had to choose a value on a scale from 0 to 100, where zero corresponded to "I have no existential fears," "I have no worries at all about my career due to COVID-19," and "I cannot cope at all with the measures due to the pandemic." At the other extreme, the value 100 expressed "I experience very strong existential fears," "I have major worries about my career due to COVID-19," and "I cope very well with the measures due to the pandemic." Additionally, all participants filled out the STAI questionnaire regarding their anxiety traits and states (Spielberger et al., 1983; Spielberger, 2010).

To gain an understanding of the physical complaints of the participants, current health problems like traumatic/overuse injuries or illnesses were assessed using the Oslo Sports Trauma Research Centre (OSTRC) questionnaire on health problems (Clarsen et al., 2013). For the classification of self-reported injuries or illness (yes/no), the first question of the OSTRC was used ("Did you have any difficulties participating in normal training and competition due to injury, illness or other health problems during the past 4 weeks?").

2.2. Characteristics of the sample

Inclusion criteria were training volume (before the COVID-19 lockdown) of at least 1 h/d and a minimum age of 18. Participants with incomplete data and those who did not participate in Olympic disciplines or in sports recognized by the IOC were excluded. There was no compensation for participation in this study.

2.2.1. Gamer type

Gaming time was calculated by multiplying the number of gaming days per month by the time spent gaming per day [h/d], resulting in a gaming time [h/m]. With respect to the range of gaming time within our sample, gamer types were classified as "no gamer" (<1 h/m), "occasional gamer" (between 1 h/m and <10 h/m), "moderate gamer" ($\geq$ 10 h/m) and "frequent gamer" (>30 h/m), which is similar to the classifications used in a study from Rehbein et al. (2010). In this manner, we could characterize the behavior and observe possible trends.

2.2.2. Change in gaming behavior

With respect to the change in gaming behavior before and during the first lockdown, the sample was divided into the four groups "never gamers,"same gaming time," "less gaming time" and "more gaming time." A change in gaming behavior was defined as a change of at least 20% compared to the pre-lockdown gaming time, which corresponds to –0.5 or 0.5 z-score change, rounded to the nearest 10%.

2.3. Data evaluation and measure calculations

Baseline data was expressed as mean ±SD and frequency tables for categorical data. Demographic data of the gamers and non-gamers were compared using the two-tailed independent sample *t*-test for continuous data and χ^2 tests for categorical data. In tables with more than two groups, χ^2 test was used for tables with more than four fields, one-way analysis of variance for continuous variables, and Kruskal-Wallis rank tests for variables that violated the assumptions of parametric tests. Differences between the groups were considered significant at p <0.05. For gaming behavior during the lockdown, we fitted a general linear model (GLM) using current gaming time as the dependent variable, previous gaming as the independent variable and gender, team sports, injury, activity, pandemic

measures, and occupation percentage as covariates. In an attempt to adjust for psychiatric measures, we added the scores of PHQ9, ISI, TRAIT, and STATE, as well existential fears and worries about career to the model. All explanatory variables that had an association with gaming at $P < 0.20$ in the univariable analyses were included in the multivariable-adjusted analyses. Using a stepwise backward elimination process, the least significant variables were then removed from the base model. Only variables with $P < 0.05$ remained in the final parsimonious model.

Dominance analysis was additionally performed as was the calculation of the correlation coefficients between all variables.

2.4. Ethical approval

The local ethics committee accepted this survey by a declaration of non-responsibility (KEK-ZH-NR: Req-2020-00408).

3. Results

3.1. Baseline parameters

In total, 203 athletes answered the survey, 193 of whom provided information on their gaming behavior: 87 women (45%) and 106 men (55%), with a mean age of 24.1 years (range 18–38 years). Within this sample, winter ($n = 94$, 49%) and summer ($n = 99$, 51%) sports were represented equally, and 59 athletes (31%) were active in team sports. Alongside their activity in sports 116 (60%) of these athletes were employed or studying, with an average workload of 67.5%. From their performance in sports alone, 101 (52%) earned sufficient income, meaning that 8% of the athletes were working or studying even though they earned enough money from their athletic performance alone. Three (2%) had a positive SARS-CoV-2 test during the first period of the lockdown (March and April 2020), and 10 athletes (5%) had to be in quarantine, with an average time of 10.8 days (SD 5.9).

3.2. Gaming behavior under regular circumstances

Fifty-two (27%) athletes stated "yes," when they were asked if they played video games 4 weeks before the pandemic, and 41 (21%) athletes were considered as playing regularly ($\geq$ 1 h/m), with an overall average playing time of 14.6 h/m (SD 17.1) distributed over 9 days per month. Maximum reported playing time was 93 h/m, averaging roughly 3 h/d. Thirty-six gamers (88%) were male and five (12%) were female. The proportion of individual athletes who gamed was 17.2%, whereas 30.5% of team athletes gamed, which represents a significantly higher proportion ($P < 0.05$). Athletes who gamed regularly tended to work or study more, reporting a higher workload. We found no statistical difference between gamers and non-gamers regarding athletic performance, substance use or self-reported injuries or illness.

Despite spending the same amount of time in bed, gamers reported significant 0.4 h less effective total sleep duration than non-gamers ($p = 0.027$). In the context of COVID-19 related issues, video gamers coped noticeably better with the measures of the government due to the pandemic ($P < 0.05$) and worried less about their career due to the COVID-19 pandemic. Overall, athletes who gamed regularly experienced less existential fear in general, and significantly less during the first lockdown ($P < 0.05$). Six (15%) of the gamers reported an injury or an illness compared to 42 (28%) athletes in the non-gamer group (also see Tables 1, 2).

3.3. Change of gaming behavior due to the COVID-19 pandemic

During the first period of the lockdown, 63 athletes (33%) stated "yes" to the question of whether they had played video games within the last 4 weeks, and 29% of the athletes reported playing video games regularly (>1 h/d) with a mean playing time of 21.8 h/m (SD 22.8). Playing time increased by 165% within the group of athletes who used to play video games before the isolation period.

In our sample, 41 athletes spent more time video gaming, 14 athletes less time, 18 athletes did not change their gaming time and 120 athletes never gamed, neither before nor during the first lockdown. Athletes who gamed more during the lockdown increased their gaming time from 5.5 to 21.8 h/m. and, thus spending on average 16.3 h/m more on video gaming than before. In particular, the group of "occasional" gamers increased their gaming time from 4.6 to 12.6 h/m, therefore, increased the playing time on average by 8.0 h/m [SD 14.3]. Maximum gaming time was 84 h/m.

Compared to all other athletes, those who gamed more tended to be male and used to already play video games before the lockdown (for all applies $P < 0.05$). Again, summer and winter sports were distributed evenly between the groups, and groups did not differ in their outside employment status or in earning sufficient income from sport. However, team athletes tended to spend significantly more time video gaming during the lockdown than those involved in individual sports ($P < 0.05$). While 40% (23) of the team athletes were gaming regularly, only 23% (32) of the individual athletes did so. Those who gamed "more" also reported a significantly higher workload when employed or studying (79.2% [SD 25.9]) in comparison to the groups that gamed "less" (67.8% [SD 22.8]), the "same"

TABLE 1 Characteristics of professional athletes who game regularly compared to non gaming professional athletes.

	Gamer ($n = 41$)	Non gamer ($n = 152$)	*P*-value
Age	23.4 years (SD 5.1)	24.3 years (SD 5.2)	0.355
Gender	12% women 88% men	54% women 46% men	<0.001***
Sports type[a]	44% summer 56% winter	53% summer 47% winter	0.297
	44% team 56% individual	27% team 73% individual	0.055
Paid occupation[a]	63%	59%	0.720
Workload	73% (SD 23.9)	66% (SD 29.5)	0.253
Sufficient income from sport[a]	51%	53%	1.000
Substances[a]			
Alcohol	30 (73%)	93 (61%)	0.200
Days/ month	3.3 (SD 3.6)	3.2 (SD 3.2)	0.829
Cannabis	1 athlete	2 athletes	1.000
Days/ month	<1	0.8 (SD 0.5)	0.270
COVID-19 related issues[b]			
Positive test	0%	2% ($n = 3$)	1.000
Quarantine	1 athlete	9 athletes	0.692
Duration of quarantine	14 days	10.3 days (SD 6.2)	0.595
Coping with COVID-19 restrictions	82.5% (SD 14.3)	72.3% (SD 22.0)	0.005**
Sleep[b]			
Time in bed	8.6 (SD 0.9)	8.8 (SD 1.0)	0.155
Total sleeping time	7.6 (SD 1.0)	8.0 (SD 1.1)	0.027*
Self-reported injuries or illness[b]	6 (15%)	42 (28%)	0.105

Categorization "gamer" (>1 h/month) resp. "non-gamer" (<1 h/month) was assessed in respect to the period before the lockdown; $n = 193$, 41 gamers, 152 non-gamers.
[a]Variables concerning the time before the lockdown.
[b]Variables that were assessed during the lockdown. *$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

(74.0% [SD 28.0]) or "never" (63.5% [SD 29.1]) ($P < 0.05$). Twenty-one athletes started playing video games during the first lockdown and 10 athletes stopped playing video games.

Regarding performance levels, fears, depressive symptoms, sleep, and substance use, the groups "same," "never," "more," and "less" showed no statistical difference within the context of the first lockdown (also see Table 3).

3.4. Multivariable analysis

Except for male gender and the fact that the athlete used to play before the COVID-19 lockdown, we found that video gaming time during the lockdown was not affected at a statistically significant level by any of the other variables we evaluated (type of sport, training, occupation, aspects of anxiety, and fears, depressive symptoms and disordered sleeping). In this multivariable regression of gaming time during the lockdown, the influence of male gender was significant, with $p < 0.05$, and athletes who already regularly played video games before the lockdown were very likely to also play during the lockdown ($p < 0.01$) (also see Table 4). The statistical power of the final parsimonious regression model is >0.9. Dominance analysis was additionally performed and resulted in the same model as the backwards elimination of the GLM. Results of the dominance analysis are shown in Supplementary Table S5. Due to possible unstable results of stepwise regression, we provide the correlation matrix in order to show all relations between the used variables, presented in Supplementary Table S6.

3.5. Internal and external validity

Internal validity is judged to be according to current standards and reported according to STROBE (Cuschieri, 2019). The generalisability however is only possible with professional athletes in a similar setting.

4. Discussion

With this evaluation, we were able to describe the gaming behavior of elite athletes on a quantitative level. Approximately 1/5 of elite athletes play video games regularly under normal circumstances, with an average time of 14.6 h/m (SD 17.1) and a frequency of 9 d/m (SD 8.6). During the first lockdown, which lasted from the 17th of March to 10th of May 2020, gaming time within the gamer group increased by 164.7%. In addition,

TABLE 2 Athletic performance, fears, depressive symptoms, and sleep behavior in professional athletes who gamed regularly before the lockdown.

	Gamer				Non gamer	*P*-value
	Total	**Minimal (<10 h/m)**	**Moderate (≥ 10 h/m)**	**High (>30 h/m)**		
Athletic performance before COVID-19[a]						
Training time [h/d]	2.9 (SD 1.0)	2.9 (SD 1.0)	2.6 (SD 1.1)	3.4 (SD 0.9)	3.2 (SD 1.5)	0.178
Training intensity [%]	72.5 (SD 20.2)	71.4 (SD 19.6)	83.4 (SD 13.9)	54.2 (SD 23.2)	74.7 (SD 19.2)	0.518
Training maximum [%]	79.7 (SD 15.4)	79.4 (SD 15.2)	84.1 (SD 13.3)	71.6 (SD 19.7)	77.9 (SD 16.4)	0.530
Fear and Anxiety						
Existential fears						
Before lockdown period[a]	11.2 (SD 19.5)	15.3 (SD 23.6)	3.0 (SD 6.4)	9.0 (SD 7.8)	15.1 (SD 21.7)	0.296
During lockdown[b]	14.4 (SD 24.8)	18.6 (SD 29.3)	5.5 (SD 12.9)	12.8 (SD 15.2)	24.3 (SD 26.9)	0.035*
Career worries[b]	27.4 (SD 26.9)	29.1 (SD 23.1)	27.1 (SD 34.4)	20.0 (SD 31.5)	36.6 (SD 28.8)	0.068
Coping with COVID-19 restrictions[b]	82.5 (SD 14.3)	81.9 (SD 15.4)	82.4 (SD 14.0)	86.0 (SD 10.6)	72.3 (SD 22.0)	0.005*
STAI score trait[b]	26.9 (SD 12.8)	30.4 (SD 12.9)	23.2 (SD 12.2)	17.0 (SD 5.8)	27.3 (SD 10.5)	0.865
STAI score state[b]	29.8 (SD 12.6)	33.6 (SD 12.8)	25.5 (SD 10.7)	18.8 (SD 5.0)	29.1 (SD 11.1)	0.732
Depressive symptoms, sleep, and substance use						
PHQ-9 score[b]	4.3 (SD 3.5)	4.9 (SD 3.7)	3.7 (SD 3.1)	3.0 (SD 3.0)	4.6 (SD 3.1)	0.697
ISI score[b]	5.0 (SD 4.6)	5.7 (SD 5.3)	4.4 (SD 3.5)	3.0 (SD 2.0)	5.6 (SD 4.0)	0.472
Total sleeping time [h/n][b]	7.6 (SD 1.0)	7.5 (SD 1.0)	7.7 (SD 1.3)	7.8 (SD 0.8)	8.0 (SD 1.1)	0.027*
Time in bed [h/n][b]	8.6 (SD 0.9)	8.5 (SD 0.9)	8.7 (SD 1.0)	8.8 (SD 1.1)	8.8 (SD 1.0)	0.155
Drinking alcohol[a]	27 (66%)	17	9	1	78 (51%)	0.113
Alcohol [d/m][a]	6.6 (SD 6.3)	6.9 (SD 7.0)	6.6 (SD 5.3)	2.0	5.0 (SD 3.9)	0.119

$n = 193$: "minimal"($n = 25$), "occasional" ($n = 11$), "frequent" ($n = 5$), "non-gamer" ($n = 152$). *P*-values refer to the total gamers compared to non gamers. [a]Variables concerning the time before the lockdown.
[b]Variables that were assessed during the lockdown. *$p < 0.05$.

the overall percentage of athletes consuming video games rose by 8%.

Gaming time during the lockdown was higher for males and for those athletes who had played before the lockdown, but otherwise we found no other significant influence on the time spent playing.

4.1. Video gaming behavior and the mental health of elite athletes before and during the COVID-19 pandemic

The gaming time of elite athletes is considerably low in the context of studies concerning gaming time and problematic gaming. Rehbein et al. found that 36% of the general adult population in Germany played video games for 44 h/m on average. Of these, 3.5% played occasionally (at least once in 12 months), 28.2% were "normal" players (daily gaming time up to 2.5 h) and 4.2% were classified as "frequent" (daily gaming time >2.5 h) (Rehbein et al., 2010). Other authors have defined "dedicated gamers" as those who played for approximately 30 h per week and "very excessive gaming" as up to 80 h per week, i.e., four times the maximum playing time within our sample (Chappell et al., 2006; Griffiths, 2010; Ballabio et al., 2017). Therefore, active elite athletes seem to spend less time video gaming, and fewer of them consume video games than among the general population.

Also, the gender gap is notable: only 12% of gamers in our sample were female, which does not follow the current trend of the general population, where the proportion of women is 45% (ESA, 2021).

To date, it has often been hypothesized that elite athletes may be prone to problem gaming (Håkansson et al., 2018; Reardon et al., 2019; Bitar et al., 2022) and it can in fact be challenging to distinguish between "enthusiastic" gaming and "problematic" gaming. There is as yet no clear differentiation between these behaviors, as this is still a clinical issue requiring more research (APA, 2013; Király et al., 2015). The existing orienting criteria for defining problematic gaming are dichotomous, and defined by the circumstance, that the patient is severely impaired in his performance or functionality over a time period of at least 12 months (APA, 2013). It is therefore not likely to find this level of gaming behavior among functioning elite

TABLE 3 Change in gaming behavior in the context of the first lockdown due to the COVID-19 pandemic.

	Consistent gaming behavior		Change in gaming behavior			
	Never ($n = 120$)	Same ($n = 18$)	Less ($n = 14$)	More ($n = 41$)	Total	p-value
Video gaming						
Δ gaming time in relation						
to the previous gaming time[%]	-	99.3 (SD 5.5)	21.8 (SD 30.8)	477.1 (SD 768.2)	264.7 (SD 570.4)	0.060
Δ absolute gaming time [hours/month]	-	0.9 (SD 5.5)	-5.4 (SD 9.1)	16.3 (SD 16.2)	3.2 (SD 10.6)	<0.001***
Athletic performance						
Δ training time in relation						
to the previous activity[%]	99.1 (SD 77.1)	91.1 (SD 33.3)	85.6 (SD 38.5)	105 (SD 56.7)	98.6 (SD 67.7)	0.774
Δ training intensity [%]	−12.4 (SD 26.7)	−9.2 (SD 23.7)	−12.0 (SD 29.1)	−15.1 (SD 25.0)	−12.7 (SD 26.1)	0.874
Δ training maximum [%]	−10.0 (SD 20.4)	−9.4 (SD 17.0)	−6.5 (SD 23.5)	−11.2 (SD 24.8)	−9.9 (SD 21.2)	0.916
Fears and anxiety						
Existential fears						
Before isolation period	15.8 (SD 21.9)	16.8 (SD 27.1)	7.8 (SD 16.2)	11.0 (SD 17.4)	14.3 (SD 21.2)	0.374
During the lockdown	25.9 (SD 26.8)	19.2 (SD 31.5)	10.0 (SD 23.5)	16.8 (SD 23.6)	22.2 (SD 26.7)	0.066
Career worries	36.8 (SD 28.8)	33.3 (SD 35.1)	34.5 (SD 30.0)	29.1 (SD 24.5)	34.7 (SD 28.6)	0.528
Coping with COVID-19 restrictions	72.7 (SD 22.2)	76.9 (SD 19.3)	82.3 (SD 10.8)	75.9 (SD 20.5)	74.5 (SD 21.0)	0.365
STAI score trait	27.5 (SD 10.8)	23.4 (SD 10.5)	33.8 (SD 12.1)	25.8 (SD 10.8)	27.2 (SD 11.0)	0.047*
STAI score state	28.9 (SD 11.2)	26.1 (SD 11.1)	34.9 (SD 14.7)	29.4 (SD 10.7)	29.2 (SD 11.4)	0.190
Depressive symptoms,						
Sleep and substance use						
PHQ-9 score	4,6 (SD 3,2)	4,1 (SD 2,8)	5,9 (SD 3,6)	4,0 (SD 2,8)	4.5 (SD 3.2)	0.261
ISI score	5,3 (SD 4,1)	5,8 (SD 4,8)	8,1 (SD 4,1)	4,8 (SD 3,6)	5.4 (SD 4.1)	0.071
Total sleeping time	8.0 (SD 1.1)	7.6 (SD 0.9)	7.6 (SD 1.3)	8.0 (SD 1.2)	7.9 (SD 1.1)	0.553
Time in bed	8.8 (SD 0.9)	8.5 (SD 1.2)	8.6 (SD 0.9)	8.8 (SD 1.2)	8.8 (SD 1.0)	0.610

*$p < 0.05$ and ***$p < 0.001$.

athletes. Also, in this survey, no standardized screening tool for problematic gaming was used, so we are not able to make definite statements regarding problematic gaming. However, in our sample, we detected no excessive gaming time, severe performance impairment, or higher level of mental symptoms within the gamer group.

The situation after the outbreak of the COVID-19 pandemic can be described as an unexpected and significant disruption of the athletes' lives and perspectives. Such situations require behavioral adaptations and high cognitive and emotional flexibility (Pété et al., 2022). Also, several studies showed reduced well-being, sleep quality and physical performance in team athletes during isolation period or during COVID-19 infection, arguing that awareness of the effects of COVID-19 on elite team athletes need to be established (Mon-López et al., 2020; Wagemans et al., 2021).

As expected, during the first weeks of the first lockdown, gaming time increased significantly, especially for those athletes who had only occasionally gamed before. In this particular situation, video gaming appears to be an effective part of the adaptation process; with the restrictions on movement and limitation of training possibilities, athletes could interact with friends and team colleagues through gaming. The proportion of team athletes in the sample population who increased their playing time was significantly higher than in individual sports. This may be due to the more drastic restrictions in team training and fewer limitations on individual training: team athletes had more spare time and may have been missing the social component of team training. This thesis corresponds to a study from Italy, in which athletes reported that being in contact with colleagues and coaches through the internet was helpful when managing the lockdown (di Fronso et al., 2022).

Athletes who had regularly gamed before the pandemic tended to be less anxious, had fewer depressive symptoms, and displayed lower scores regarding sleep disturbances. However, no statistical significance could be found. We did not find significant impairments in athletic performance before the pandemic and in the first period of the lockdown. Also, among athletes with a secondary employment or those who were studying alongside their sports, gamers tended to have a higher workload than non-gamers. Athletes who gamed regularly

TABLE 4 Coefficients of multivariable regression of gaming time during the lockdown.

	Univariable model	Adjusted multivariable model (AMM)	Final parsimonious (AMM)
	Gaming during [h/m]	Gaming during [h/m]	Gaming during [h/m]
Gaming before the lockdown [h/m]	1.050***	0.982***	0.973***
Gender	−10.436***	−5.378**	-
			5.226***
Team sport	7.722***	3.289	3.322*
Training activity during the lockdown [h/d]	−0.611	0.439	
Occupation	0.371	1.175	
Fears about sports career due to COVID-19	−0.057	−0.022	
Existential fears due to COVID-19	−0.062	0.011	
Coping with COVID-19 restrictions	0.049	−0.036	
STAI score trait	−0.181	−0.044	
STAI score state	−0.144	0.011	
PHQ-9 score	−0.406	0.119	
ISI score	−0.366	−0.129	
Self-reported injury/illness	−0.026	2.447	

Multivariable regression analysis was conducted with respect to gaming time before the lockdown, gender, type of sport, training, occupation, aspects of anxiety and fears, depressive symptoms, and disordered sleeping. *$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

seemed to cope significantly better with the measures of the Swiss government.

Therefore, video games may have been used as a positive coping mechanism, similar to seeking social support and to active stress coping. Elite athletes are used to deal with stressors due to their intense training and competition routine (Daumiller et al., 2021). Hence, it is likely they were able to use video gaming as a coping strategy under the circumstances of the first lockdown.

4.2. Limitations

As a key limitation of this study, the absence of a control group must be mentioned. The questionnaires were voluntary and based on self-reporting. Therefore, they may suffer from certain biases, such as selective recall due to impaired memory recall and social desirability. Also, the recruited sample of professional athletes in Switzerland may not be representative due to selection bias. Consequently, external validity could be impaired. Furthermore, the differences between the gamer types must be interpreted with caution due to small sample sizes, especially in the group of "frequent gamers." Another bias, that should not be neglected, is the constellation of the "gamers," consisting primarily of male team-athletes. Hence, any observed tendency of the "gamers" could also originate from this factor. Another note of caution, when interpreting the results, is the fact, that stepwise regression can throw out unstable results. Finally, it has to be kept in mind that athletes' careers tend to start at an early age and often last less than two decades. In our analysis we evaluated a sample of young and active elite athletes. We cannot estimate the video gaming behavior after the end of a sports career or after a major injury or illness. Also, more qualitative, contextual information would be desirable, e.g., motives and game types. Thus, further follow-up data is needed to evaluate the stability of our results with respect to the psychological symptoms.

4.3. Perspective

Our findings suggest that playing video games may have a positive functional role for active elite athletes. Especially in the context of the COVID-19 pandemic, it appears to help with an effective adaptation to the current circumstances. Pété et al. (2022) evaluated different coping profiles in different athletes during the COVID-19 pandemic in France, pointing out the importance of finding mechanisms to cope with the impact of pandemic on the mental health of elite athletes on a long-term basis. In this regard, video games could open up many helpful possibilities for sports clubs and athletes in terms of athletic training and social interaction. Since neurobiological studies have proven that some types of video games are beneficial to neuroplasticity (e.g., strategy, 3D adventure, puzzles), athletes could also continue training their fine motor skills and reaction time in order to maintain at least some of their athletic requirements (Brilliant T et al., 2019). In respect to further research and transfer of our data, prospective studies with

unexpected and sudden events, that are defined by less training, less social interaction, change in social framework and the loss of planned successes, could be promising in order to elaborate video gaming as a coping mechanism. For example, injuries, non-consideration, or end of career show these characteristics for elite athletes.

Ultimately, video gaming may act as a stabilizing factor for elite athletes in the context of the COVID-19 pandemic and similar stressful situations.

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 Local Ethics Committee of the City Zurich by a declaration of non-responsibility (KEK-ZH-NR: Req-2020-00408). The patients/participants provided their written informed consent to participate in this study.

Author contributions

MC, SF, JSp, and JSc conceptualized and designed the study. SF and MC recruited the participants and collected the data. SI and TB processed the data and performed the statistical analysis. TB, SI, MC, and BQ interpreted the results. TB drafted the first version of the manuscript, under supervision of MC, BQ, and SI. TB drafted the submitted manuscript, as well as the revision. All authors substantially contributed to the interpretation of data and revised them critically, approved the final version of the manuscript, and agreed to be accountable for all aspects of the work.

Acknowledgments

We would like to thank all participating athletes, and especially Regula Schüpbach and Christian Streng for programming and managing the online questionnaires.

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.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.880313/full#supplementary-material

References

APA (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*. Washington, DC: American Psychiatric Pub.

BAG (2020). *Coronavirus: Federal Council Declares 'Extraordinary Situation' and Introduces More Stringent Measures*. Available online at: https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-78454.html (accessed July 20, 2022).

Ballabio, M., Griffiths, M. D., Urbán, R., Quartiroli, A., Demetrovics, Z., and Király, O. (2017). Do gaming motives mediate between psychiatric symptoms and problematic gaming? an empirical survey study. *Addict. Res. Theory* 25, 397–408. doi: 10.1080/16066359.2017.1305360

Bastien, C. H., Vallières, A., and Morin, C. M. (2001). Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Med.* 2, 297–307. doi: 10.1016/S1389-9457(00)00065-4

Bitar, R., Herdener, M., and Vonmoos, M. (2022). "Glücksspiel- und Computerspielsucht," in *Lehrbuch der Sportpsychiatrie und-psychotherapie: Psychische Gesundheit und Erkrankungen im Leistungssport*, eds M. C. Claussen, E. Seifritz (Bern: Hogrefe Verlag), 417–430

Brilliant, T., D., Nouchi, R., and Kawashima, R. (2019). Does video gaming have impacts on the brain: evidence from a systematic review. *Brain Sci.* 9, 251–271. doi: 10.3390/brainsci9100251

Buysse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., and Kupfer, D. J. (1989). The pittsburgh sleep quality index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 28, 193–213. doi: 10.1016/0165-1781(89)90047-4

Chappell, D., Eatough, V., Davies, M. N., and Griffiths, M. (2006). Everquest–it's just a computer game right? an interpretative phenomenological analysis of online gaming addiction. *Int. J. Mental Health Addict.* 4, 205–216. doi: 10.1007/s11469-006-9028-6

Clarsen, B., Myklebust, G., and Bahr, R. (2013). Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the oslo sports trauma research centre (ostrc) overuse injury questionnaire. *Br. J. Sports Med.* 47, 495–502. doi: 10.1136/bjsports-2012-091524

Claussen, M. C., Zimmermann, M. S., Spörri, J., Seifritz, E., Scherr, J., Fröhlich, S. (2020). Mental health in competitive sports in times of COVID-19. *Sports Exerc. Med.* 68, 26–27.

Cuschieri, S. (2019). The strobe guidelines. *Saudi J. Anaesth.* 13(Suppl. 1), S31–34. doi: 10.4103/sja.SJA_543_18

Daumiller, M., Rinas, R., and Breithecker, J. (2021). Elite athletes' achievement goals, burnout levels, psychosomatic stress symptoms, and coping strategies. *Int. J.Sport Exerc. Psychol.* 81, 1–20. doi: 10.31234/osf.io/h7bfe

de Quervain, D., Aerni, A., Amini, E., Bentz, D., Coynel, D., Gerhards, C., et al. (2021). *The Swiss Corona Stress Study*. doi: 10.31219/osf.io/x6zu7

di Fronso, S., Costa, S., Montesano, C., Di Gruttola, F., Ciofi, E. G., Morgilli, L., et al. (2022). The effects of COVID-19 pandemic on perceived stress and

psychobiosocial states in italian athletes. *Int. J. Sport Exerc. Psychol*. 20, 79–91. doi: 10.1080/1612197X.2020.1802612

ESA (2021). *2021 Essential Facts About the Computer and Video Game Industry*. Available online at: https://www.theesa.com/resource/2021-essential-facts-about-the-video-game-industry/ (accessed July 20, 2022).

Griffiths, M. (2005). A 'components' model of addiction within a biopsychosocial framework. *J. Subst. Use* 10, 191–197. doi: 10.1080/14659890500114359

Griffiths, M. D. (2010). The role of context in online gaming excess and addiction: Some case study evidence. *Int. J. Ment. Health Addict*. 8, 119–125. doi: 10.1007/s11469-009-9229-x

Håkansson, A., Kenttä, G., and Åkesdotter, C. (2018). Problem gambling and gaming in elite athletes. *Addict. Behav. Rep*. 8, 79–84. doi: 10.1016/j.abrep.2018.08.003

Király, O., Griffiths, M. D., and Demetrovics, Z. (2015). Internet gaming disorder and the DSM-5: conceptualization, debates, and controversies. *Curr. Addict. Rep*. 2, 254–262. doi: 10.1007/s40429-015-0066-7

Kroenke, K., Spitzer, R. L., and Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *J. Gen. Intern. Med*. 16, 606–613. doi: 10.1046/j.1525-1497.2001.016009606.x

Mon-López, D., García-Aliaga, A., Bartolomé, A. G., and Solana, D. M. (2020). How has COVID-19 modified training and mood in professional and non-professional football players? *Physiol. Behav*. 227, 113148. doi: 10.1016/j.physbeh.2020.113148

Pété, E., Leprince, C., Lienhart, N., and Doron, J. (2022). Dealing with the impact of the COVID-19 outbreak: are some athletes' coping profiles more adaptive than others? *Eur. J. Sport Sci*. 22, 237–247. doi: 10.1080/17461391.2021.1873422

Reardon, C. L., Hainline, B., Aron, C. M., Baron, D., Baum, A. L., Bindra, A., et al. (2019). Mental health in elite athletes: international olympic committee consensus statement (2019). *Br. J. Sports Med*. 53, 667–699. doi: 10.1136/bjsports-2019-100715

Rehbein, F., Psych, G., Kleimann, M., Mediasci, G., and Mößle, T. (2010). Prevalence and risk factors of video game dependency in adolescence: results of a german nationwide survey. *Cyberpsychol. Behav. Soc. Network*. 13, 269–277. doi: 10.1089/cyber.2009.0227

Spielberger, C. D. (2010). State-trait anxiety inventory. *Corsini Encyclopedia Psychol*. doi: 10.1002/9780470479216.corpsy0943

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., and Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Spielberger.

Steadman, J. L. (2019). Gaming motivations as a guide to treating problematic gaming behaviors. *J. Technol. Behav. Sci*. 4, 332–339. doi: 10.1007/s41347-019-00103-z

Wagemans, J., Catteeuw, P., Vandenhouten, J., Jansen, J., De Corte, X., Ceusters, C., et al. (2021). The impact of COVID-19 on physical performance and mental health–a retrospective case series of belgian male professional football players. *Front. Sports Active Living* 3, 803130. doi: 10.3389/fspor.2021.803130

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 09 December 2022
DOI 10.3389/fpsyg.2022.1046735

OPEN ACCESS

EDITED BY
Iina Savolainen,
Tampere University,
Finland

REVIEWED BY
Lin Wang,
Hangzhou Dianzi University,
China
Eduardo Moraes Sarmento,
University of Lisbon,
Portugal

*CORRESPONDENCE
Zhang Da-yong
zhdy@hit.edu.cn

SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 17 September 2022
ACCEPTED 14 November 2022
PUBLISHED 09 December 2022

CITATION
Da-yong Z and Zhan S (2022) Short video users' personality traits and social sharing motivation.
Front. Psychol. 13:1046735.
doi: 10.3389/fpsyg.2022.1046735

Short video users' personality traits and social sharing motivation

Zhang Da-yong[1,2]* and Su Zhan[2]

[1]State Key Laboratory of Communication Content Cognition, People's Daily Online, Beijing, China, [2]Key Laboratory of Interactive Media Design and Equipment Services Innovation, Harbin Institute of Technology, Harbin, China

Purpose/significance: Studying the correlation between short video users' personality traits and their sharing motivation can enrich the theoretical research on social sharing motivation and provide a reference for short-video content management and platform construction.

Methods/process: Based on uses and gratifications theory and personality traits theory, a structural model affecting short-video users' sharing motivations was proposed. A total of 579 valid questionnaires were collected from a social network, and the proposed hypotheses were tested using SPSS and Amos software.

Results/conclusion: The results show that the personality traits of short-video users affect their sharing motivation and that their specific sharing motivation also differ due to their personality traits. At the same time, the research results also confirm the Matthew effect of "the rich getting richer" and the social compensation effect of "the poor getting richer" in the context of social platforms that host short videos.

KEYWORDS

short video, social sharing, motivation, personality traits, uses and gratifications theory

Introduction

Given universal access to the internet and the wide popularity of smart terminals, various social applications have become important channels for people to meet their needs for information, entertainment and interpersonal communication. There are more than 3.8 billion social media users worldwide (Gupta et al., 2021). Many daily activities, such as sharing, communicating, commenting, liking, etc., take place on social media. According to relevant research, on average, users spend 2.4 h a day on social media (Shen et al., 2020). The 47th China Statistical Report on the Internet Development (CNNIC, 2021) shows that China's internet penetration rate reached 70.4% in 2020 and that the number of internet users in the country reached 989 million; within this group, the number of short-video users was 873 million, accounting for 88.3% of all internet users. While short video use is

increasing rapidly in China, short-video application platforms represented by Kuaishou and TikTok are also expanding rapidly in overseas markets, with global downloads of TikTok reaching 626 million in the first half of 2020, making it the most downloaded application in the world. The overseas version of Kuaishou launched during the same period performed outstandingly in Brazilian, South Korean, Russian and Southeast Asian markets, reaching an average of 481 million active users per month in 2020, a number that increased to 519.8 million in the first quarter of 2021; the app also experienced significant growth in the viscosity of active users.

Social sharing can direct large volumes of traffic to content providers and social media, which is key to determining the success or failure of social media. The question of how to motivate users to participate in content sharing and thus enhance the value of content providers and social media alike has become a hot topic in both industry and academia (Barbera et al., 2009). The current research focuses on user profiles to investigate ways of improving the recommendation accuracy of content products and thus enhancing user viscosity (Li et al., 2006). The process of constructing user profiles is essentially based on the collection and analysis of user data to develop a labelling system that can describe user characteristics and accurately model user needs (Teixeira et al., 2015). Personality is a stable and habitual way of thinking and style of behaviour that conveys an overall picture of the individual's unique psychological characteristics; motivation, on the other hand, is the driving factor that inspires users to engage in specific behaviours. These two factors constitute the basis and foundation for constructing user profiles. However, to date, few studies have investigated the correlation between users' personality traits and sharing motivations, and the intrinsic motivational factors that drive users' participation in sharing require further exploration (Barrick, 2005). The study of short-video users' sharing motivations can enrich the theoretical research concerning motivations for social sharing behaviour motivation and thus serve as a reference for short-video content management and platform construction.

Literature review

User personality traits in social networks

Personality is the dynamic organization of one's internal psychophysical system that is reflected in one's thoughts and behaviours and determines one's unique behaviours and thoughts in response to the environment. Traits are neuropsychological structures that enable many stimuli to be equally effective in triggering certain behaviours and can create and guide a variety of behavioural expressions that are functionally equivalent and consistent. G.W. Allport, the founder of the trait theory of personality in modern psychology, claimed that personality is composed of various traits, that traits can be treated as persistent (exhibiting temporal continuity) and stable (exhibiting situational consistency) patterns of behaviour and that experiments can produce an understanding of individual personality traits and allow us to predict individual behavioural responses (Allport, 1943). Based on Allport's research, R.B. Cattell introduced factor analysis into personality research, extracted 16 root traits from human behaviour, and developed the "16 personality factors test" method (Cattell, 1948). Since that time, as research has progressed, scholars have found that the five-factor model, including extroversion, conscientiousness, neuroticism, openness, and agreeableness, is widely representative and has been extensively validated across cultures (Mccrae and Costa, 1997) and times (Hampson and Goldberg, 2006).

Early research on the five-factor model and user behaviour focused only on a limited number of aspects, such as personality and interpersonal relationships, personality and purchase propensity, and personality and career choice, with extraversion and conscientiousness being the most frequently studied personality traits (Forret and Dougherty, 2001; Robles-Granda et al., 2020). Due to the development of online technologies, especially the emergence of social networks, interpersonal communication has changed. Compared to offline modes of face-to-face communication, online interactions lead to a wider range of interpersonal connections that are not limited to maintaining one's original social relationships (Ellison et al., 2007). In addition, without the constraints of face-to-face conversations, users who engage in online interactions are better able to talk about or disclose deeply personal issues; therefore, online interactions generate more self-expression and self-presentation (Lee et al., 2014). According to Amichai-Hamburger, personality traits are a major factor influencing how people behave online, and without understanding the personalities of online users, it is impossible to understand how the internet operates in depth (Amichai-Hamburger and Vinitzky, 2010). The link between personality traits and the extent of internet use has since been demonstrated by many psychological experiments. For example, the study by Correa et al. showed that extraversion and openness to experience were positively associated with the frequency of social media use, whereas emotional stability was negatively associated with the frequency of social media use (Correa et al., 2010). Liu and Campbell (2017) found that highly conscientious users maintain strict control over their online behaviours and present themselves with caution. It was found that the personality trait that has the greatest effect on online information-seeking strategies is conscientiousness. Agreeableness and neuroticism are related to several dimensions of social media-specific beliefs (Uslu and Durak, 2022). In addition, users' preferences for specific features of social networks vary with their personality traits. Openness to experience is the personality factor that is most likely to be associated with trying new modes of communication and seeking novel experiences (Butt and Phillips, 2008). Users with extroversion and openness to experience participate in significantly more groups on social networks and use social features more frequently than introverted users (Ross et al., 2009). Similarly, users with high levels of neuroticism use the message

board function of social networks more often, whereas those who are low in neuroticism prefer to upload photos; this difference can be attributed to the fact that people with neuroticism-related traits are better at controlling textual content than visual content (Kuss and Griffiths, 2011). There are some studies on personality traits and inappropriate use of social media. It was demonstrated that agreeableness, openness to experience and conscientiousness are negatively related to Facebook addiction, while loneliness, narcissism, impulsivity and shyness are significantly correlated with Facebook addiction (Rajesh and Rangaiah, 2022).

Some studies have focused on how the interaction of personality traits and social media affects certain aspects of life and society. The analysis of nationally representative survey data from the United States indicated that the interaction effects of social media use and the Big Five personality traits determined the formation of attitudes towards political compromise (Choi and Shin, 2017). Astleitner pointed out that personality traits and social media experiences are linked to mental health in a variety of ways (Astleitner et al., 2022).

User sharing motivation in social networks

Motivation is the psychological tendency or internal drive that inspires and sustains an organism's action and leads it towards a certain goal (Kleinginna and Kleinginna, 1981; Schunk, 1990). Modern motivation theory suggests that complete motivation should include three aspects: intrinsic needs, external inducements, and self-regulation (Osterloh and Frey, 2000). Social influence theory suggests that online users' sharing behaviours are influenced by external factors; specifically, factors such as group norms and social identity affect individuals' social perceptions, social attitudes and social behaviours. Social exchange theory suggests that users participate in sharing to obtain certain benefits, including both tangible rewards and intangible gains such as a sense of accomplishment or spiritual rewards (Cropanzano and Mitchell, 2005). From the perspective of users' utility increment brought by the increase of network product users, the network externality theory discusses the positive impact of product user scale on the adoption intention or behavior of social networks (Gao and Bai, 2014). Uses and gratifications (U&G) theory adopts a psychological perspective to study media audiences and argues that audiences' media choices depend on the level of satisfaction that they can derive from media use (Katz et al., 1973). In particular, when audiences are faced with more media choices, the satisfaction of their social or psychological needs is key to using those media. The key point that distinguishes U&G theory from traditional theory is that the former shifts from the traditional study of media effects, which focuses on "what the media does to people," to an analysis of media audiences that asks "what people do to the media."

Early studies of media use motivation viewed users as recipients rather than creators of media content; thus, studies of user motivations focused on need satisfaction in terms of entertainment, time-wasting, information acquisition, emotional expression or emotional release, and interpersonal dialog (Ruggiero, 2000). Social media provides a broad platform for users to create more original content, and the process of media selection is driven by a strong need for personalization. Interaction and sharing have become the main functions of social media, and users' abilities to obtain wider social recognition or external connections *via* interaction and sharing has become the main motivation for internet use (Park et al., 2009; Hofmann and Nadkarni, 2012). Motivations for internet use can be classified into internal and external motivations, in which context internal motivations involve the pleasure and internal satisfaction that users can enjoy due to sharing or delivering content, while external motivations involve the personal image enhancement and positive social impact that users can have when they share or deliver content. Falgoust categorized six sharing motivations on TikTok consistent with U&G theory analysis: entertainment, convenience and utility for widespread communication, increasing social interaction, finding social support, seeking and sharing information, and escaping from everyday life (Falgoust et al., 2022). Some scholars have also introduced motivational predictors, such as sex, belongingness, self-presentation, and personality traits, to U&G theory studies. For example, Hofmann and Nadkarni argued that satisfying the need for belongingness and self-presentation are motivations for the continued use of social network (Hofmann and Nadkarni, 2012) and that the influence of personality traits on sharing motivation is mostly focused on three dimensions: extraversion, conscientiousness and neuroticism (Błachnio et al., 2013).

Some researchers have discussed the motivation of information-sharing activities in social media by classifying information into various types: personal, sensational, political, casual, and experience. Finally, they conclude that users' motivations in sharing information tend to be consistent for each type of information, that is, to share the impression of social media users on a matter (Ghaisani et al., 2017). Some studies focus on sharing motivation in specific scenarios. Zhang proposes four important tourist photosharing motivations (enjoyment, altruism, self-expression, and social relationship) based on the two dimensions of extrinsic-intrinsic and self-centred-community-related motivation (Zhang et al., 2022). Interestingly, another study showed that recognition and status-seeking were more important motivations for sharing travel photos for Chinese tourists than for Western users (Li, 2020). Moreover, perceived enjoyment is the most important motivation for travel experience sharing, and security and privacy reasons are the biggest inhibitors of sharing information (Oliveira et al., 2020). Among the motivations for information sharing in the advertising business, in addition to the motivations of pleasure, altruism and social interaction, the research also analyses the specific motivations for such situations, such as liking/helping the brand (Lee et al., 2019), self-brand identity (Anggraeni and Diandra, 2017), and brand engagement (Ilich and Hardey, 2018).

Relationship between users' personality traits and sharing motivation for short videos

Short videos have received increasing attention from users and researchers due to their short durations and the large amounts of information they convey, which fully match users' fragmented consumption habits. Most studies have focused on analyzing social network users' adoption behaviors and continued usage intentions in terms of two aspects: intrinsic factors and external environmental factors. However, few studies have focused on the motivations underlying users' sharing on social media. This study takes short-video users as its research object, integrates U&G theory and personality trait theory, and proposes a structural model of short-video users' sharing motivations, intending to highlight the intrinsic connection between personality traits and short-video users' sharing motivations and explore a clearer and more comprehensive causal chain leading from personality to behavior research. The study also intends to explore the causal relationship between users' personality traits and sharing motivations for short videos. This study is conducted to address the following three research questions. (1) How can the typical personality traits of short-video users be measured? (2) What are the social sharing motivations of short-video users? (3) What influence do the personality traits of short-video users have on their sharing motivations?

To answer the first question, in terms of personality trait selection, this study explores the associations among the three personality traits of conscientiousness, extraversion and neuroticism, which exhibit significant differentiation concerning users' motivations to share. Social media users' motivations to use is not a single variable, and users' engagement in sharing behaviours is reflected not only in the varying degrees of engagement motivation among individuals but also in their types of motivation for engagement. Some users are influenced in their sharing decisions by intrinsic motivations such as their interests, curiosity, and values, while others are influenced by their external environments or groups. To address the second question, studies have shown that first, the pleasure and satisfaction derived from contributing knowledge to help others can be a form of intrinsic motivation and that reciprocity can lead to intangible rewards (e.g., online reputation or influence), which can further motivate users to participate in information sharing (Wei, 2009); second, releasing emotions, clarifying positions or opinions, correcting self-judgements, and gaining social recognition are the main motivations for users to participate in such groups (Berger and Buechel, 2012); third, active social engagement enhances the user's recognition in the group, which in turn enhances their online presence (Błachnio et al., 2013); and fourth, research based on uses and satisfaction theory suggests that media, especially social media, is used to pass the time rather than to satisfy a specific need (Ruggiero, 2000). Both content generators and social media cultivate the usage habits of users *via* content creation and the development of an online ecology to produce a stable user base. Based on the comprehensive consideration of existing research results and the characteristics exhibited by users' sharing behaviours, this study summarizes short-video users' sharing motives in terms of four aspects: image management, altruism, emotional expression and pastime and conformity. Concerning the third issue, this study conducts hypothesis testing as follows.

Among the Big Five personality traits, conscientiousness is used to describe a personality's degree of control, self-management and effort in task performance, such as in terms of a sense of mission or the responsibility to accomplish certain tasks and goals. Responsible people control their impulses, are organized, self-disciplined, cautious, diligent, and planning-focused, and make great efforts to achieve their goals (Ashton and Lee, 2001), while people who lack responsibility tend to act on impulse, procrastinate and be unorganized. It has been shown that people who are not responsible use social networks more frequently and are more likely to become addicted to them (Ross et al., 2009); in contrast, highly conscientious users have significantly more friends but share less information online (Karl et al., 2010) because they may perceive that the time they spend on social media distracts them from pursuing their own goals and reduces their efforts to achieve those goals. In addition, research has suggested that highly conscientious users are less likely to exhibit emotional problems associated with social media use (Glass et al., 2014). In summary, the intensity of conscientiousness is inversely related to motivations such as image management, altruism, emotional expression, and pastime and conformity; i.e., the more responsible an individual is, the weaker his or her motivation for short-video sharing. Therefore, it is proposed that conscientiousness negatively affects users' social sharing motivations, as expressed in the following hypotheses:

> *H*1-a: Conscientiousness negatively influences users' motivation for image management.
> *H*1-b: Conscientiousness negatively affects users' motivation for altruism.
> *H*1-c: Conscientiousness negatively affects users' motivation for emotional expression.
> *H*1-d: Conscientiousness negatively influences users' motivation for pastime and conformity.

Among the Big Five personality traits, extroversion represents the degree to which a person is social and outgoing. Extroverts tend to approach people and things energetically, enjoy contact with people, are friendly, talkative, confident, and energetic, seek social interaction, and enable those with whom they interact to feel positive emotions (Amichai-Hamburger et al., 2002); they also stimulate and direct interactive activities among members of the group (Lemoine et al., 2016). Introverts may be described as withdrawn and inactive, and they express fewer positive emotions. Two contrasting perspectives on the relationship between high and low scores on extroverted personality traits and social media use have emerged. On the one hand, some research has suggested that extroverts are expected to spend more time on social media because it creates a platform on which they can interact with their

friends (Barbera et al., 2009). On the other hand, introverts may prefer to use social media to communicate, which can compensate for their lack of offline interpersonal skills (Muscanell and Guadagno, 2012) In addition, research has also shown that extroverts are more likely to join online groups and have a higher number of friends on the internet than introverts (Nicole and Winter, 2008). Therefore, it is proposed that extroversion as a personality trait positively influences-users' motivation to share socially, as hypothesized below:

> *H*2-a: Extroversion positively influences users' motivations for image management.
> *H*2-b: Extroversion positively influences users' motivations for altruism.
> *H*2-c: Extroversion positively influences users' motivations for emotional expression.
> *H*2-d: Extroversion positively influences users' motivations for pastime and conformity.

Neuroticism is the antonym of emotional stability. Individuals with high levels of neuroticism are emotionally unstable and encounter difficulty coping with stress. They often feel anxious, angry and sad and prefer to be alone in real life rather than to interact with other people (John et al., 2008). It has been reported that users with neurotic traits generally use message board features that allow them to receive and post comments, while users with low neuroticism prefer to upload photos (Ross et al., 2009). This difference can be attributed to the fact that people with neuroticism-related traits are better at controlling textual content than visual content. Individuals with neuroticism-related traits present as anxious and sensitive and are less likely to display their original message in a virtual environment. However, other studies have obtained opposite findings, indicating that people who score high on neuroticism are more likely to post photos to their home pages (Amichai-Hamburger and Vinitzky, 2010). In addition, some studies have suggested that people who score high on neuroticism may be more inclined to spend time on social networks because using the internet allows them to avoid the discomfort of face-to-face communication, and they try to look as attractive as possible and may therefore spend longer thinking about what to say or how to disguise themselves (Ryan and Xenos, 2011; Muscanell and Guadagno, 2012). Overall, the findings concerning neuroticism suggest that people who score high on this trait tend to reveal information because they seek confidence online, while those who score low are emotionally stable and tend to express their thoughts by sharing information. In summary, the following hypotheses are proposed:

> *H*3-a: Neuroticism positively influences users' motivation for image management.
> *H*3-b: Neuroticism positively influences users' motivation for altruism.
> *H*3-c: Neuroticism positively influences users' motivation for emotional expression.
> *H*3-d: Neuroticism positively influences users' motivation for pastime and conformity.

After analysis and verification of the above hypotheses, we can further explore the Matthew effect and the social compensation effect in the context of social platforms that host short videos. The Matthew effect was originally used to explain a social phenomenon: "For to him who has shall be given and he shall have abundance; but from him who does not have, even that which he has shall be taken away" (Tang et al., 2000, p. 687). The term was later borrowed by economists to reflect the inequality of income distribution in winner-takes-all economics. The Matthew effect can powerfully explain and demonstrate many phenomena in the medical, economic and social fields (Fernández-Villaverde et al., 2021; Peters and Roose, 2022; Zhou et al., 2022). The compensation effect is an economic concept that holds that money needs to be compensated to maintain the original utility after the price increases. Gradually, the compensation effect has been applied to various fields of sociology. The social compensation effect is the mechanism by which the subject of an unbalanced allocation of interests can receive compensation in the face of social unfairness. In general, the Matthew effect increases inequality, while the social compensation effect reduces inequality.

Materials and methods

Measure

In this paper, an online questionnaire is used to investigate user personality traits and motivation for sharing short videos. The measure ask participants to imagine the short video they recently see online, rather than requiring them to watch a specific short video live. To ensure the quality of the questionnaire, this paper draws on the research of Karim et al. (2009) and Kim and Chung (2014) to select three typical personality traits, i.e., extroversion, conscientiousness and neuroticism (see Table 1), which are scored on a five-point Likert scale that includes five options for each variable ranging from "strongly disagree" to "strongly agree." To investigate sharing motivation, an 18-question measure of the sharing motivation of short-video users was developed by reference to four aspects: image management, altruism, emotional expression and pastime and conformity (see Table 2); this measure also uses a five-point Likert scale and references the studies conducted by Syn and Oh (2015), Zhang et al. (2017) and Moghavvemi et al. (2018).

Procedure and participants

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. There were not

TABLE 1 User personality traits scale.

Variable	Number	Measurement issues	Source (of information etc.)
Extroversion	EX1	I think I can liven up the environment I'm in.	Karim et al. (2009)
	EX2	I feel relaxed when socializing with others	
	EX3	I talk to people all the time.	
	EX4	I do not mind being the centre of attention.	
Conscientious-ness	CO 1	I usually do things with thorough preparation.	Karim et al. (2009)
	CO 2	I'm very detail-oriented.	
	CO 3	I like to make plans.	
Neuroticism	NE 1	I always worry too much.	Kim and Chung (2014)
	NE 2	I get angry easily.	
	NE 3	I'm often emotionally unstable.	
	NE 4	I get depressed easily.	

TABLE 2 User motivation to share measurement scale.

Variable	Number	Measurement issues	Source (of information etc.)
Image management	XX1	Sharing that video will help me shape the image I want to build on social media.	Syn and Oh (2015)
	XX2	Sharing that video will allow others to get to know me better.	
	XX3	Sharing that video will help me show my personality.	
	XX4	I want to get recognition and positive comments from others by sharing that video.	
	XX5	I want to increase my reach by sharing that video.	
	XX6	I want to strengthen my connections with others by sharing that video.	
	XX7	I want to share that video to strengthen connections with like-minded people with similar interests.	
Altruism	LT1	I thought it might be useful to others to share the video.	Zhang et al. (2017),
	LT2	I thought the video was interesting/useful, so I shared it with my circle.	(Moghavvemi et al., 2018)
	LT3	I take the initiative to share interesting/useful short videos in the hope that others will share interesting/useful short videos with me in the future.	
Emotional expression	QG1	I wanted to confirm my judgement by sharing that video.	Syn and Oh (2015)
	QG2	I would like to express my attitudes and opinions by sharing that video.	
	QG3	I want to influence the attitudes and opinions of others by sharing that video.	
	QG4	I would like to gain social support by sharing that video.	
Pastime and conformity	XQ1	That video is shared for fun and entertainment and to pass the time.	Syn and Oh (2015)
	XQ2	Sharing videos is a habit of mine.	
	XQ3	I shared the video because it is popular to share videos in my social circle.	
	XQ4	I shared the video to receive certain rewards (such as special offers, etc.).	

specific invitations to the research included and any inclusion criteria. The research targeted people who use smartphones and like to access information on social platforms.

The questionnaires were distributed online *via* Wechat between March 1, 2021, and March 31, 2021; a total of 602 questionnaires were returned. The list deletion method was adopted to account for missing items, i.e., if one or more items were missing from each record of the questionnaire, the record was considered invalid and marked for deletion. A total of 579 valid questionnaires were obtained in this survey. The sample statistics are shown in Table 3. Among the participants, 281 were male, accounting for 48.53% of the total, while 298 were female, accounting for 51.47% of the total. The number of the respondents surveyed was equal across both genders. The study included 165 respondents aged 19 or below, accounting for 28.5% of the total; 317 respondents aged between 20 and 29, accounting for 54.75% of the total; 25 respondents aged between 30 and 39, accounting for 4.32% of the total; 43 respondents aged between 40 and 49, accounting for 7.43% of the total; and 29 respondents aged 50 or older, accounting for 5.01% of the total.

Structural equation model, a statistical method of analyzing the relationship between variables based on the covariance matrix of variables, was used as the analytical method in this research. Structural equation model has the advantages of processing multiple dependent variables at the same time, allowing independent variables and dependent variables to contain measurement errors, estimating factor structure and factor relationship at the same time, allowing greater elasticity of the

TABLE 3 Descriptive statistics and correlations.

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Age	25.56	10.36629										
2. Sex	1.51	0.5	0.090*									
3. Degree of Education	2.98	0.355	−0.011	−0.101*								
4. Participation Frequency	2.52	0.958	0.084*	0.047	0.024							
5. Conscientiousness	3.77	0.89627	0.167**	−0.074	0.124**	0.021						
6. Extroversion	3.43	0.93442	0.027	−0.175**	0.135**	0.066	0.730**					
7. Neuroticism	2.44	0.99615	−0.073	−0.064	0.017	−0.028	0.011	0.102*				
8. Image Management	2.82	1.06313	0.042	−0.147**	0.014	0.164**	0.352**	0.438**	0.252**			
9. Altruism	3.28	0.99608	0.120**	−0.089*	0.093*	0.192**	0.410**	0.451**	0.195**	0.727**		
10. Emotional Expression	2.83	1.07078	0.063	−0.182**	0.019	0.148**	0.335**	0.419**	0.289**	0.790**	0.718**	
11. Pastime and conformity	2.62	1.04415	−0.107**	−0.235**	0.123**	0.156**	0.251**	0.439**	0.367**	0.703**	0.567**	0.760**

*At 0.05 level (two-tailed), the correlations are significant. **At 0.01 level (two-tailed), the correlations are significant.

measurement model, and estimating the fit degree of the whole model. Therefore, structural equation models are often used in confirmatory factor analysis, higher-order factor analysis, path and causality analysis, multi-period design, uniform model and multi-group comparison, etc. (Cheung, 2015; Al-Rahmi et al., 2022). In this study, the load factors were weighted to obtain the independent variables (personality traits), and through factor analysis and path analysis, the direct effect, indirect effect and total effect of the independent variables on the dependent variables (social sharing motivation) were obtained.

Results

Table 3 reports the means, standard deviations, and correlations of the variables. Prior to testing our hypotheses, we first conducted a reliability analysis and validity analysis. The results showed an appropriate fitness between the model and data.

To analyse the reliability of the sample used in this survey, the valid data collected were tested to ascertain their reliability and validity. In this paper, reliability tests were first conducted using Cronbach's α coefficient and composite reliability (CR). The test results showed that the Cronbach's α coefficient and CR values of all variables were higher than 0.7 (as shown in Table 4), indicating that the measurement model exhibited a high degree of internal consistency and reliability. The validity tests were conducted mainly using convergent validity and discriminant validity. Convergent validity indicates whether the measurement terms of a variable are highly correlated with each other, and the main measures are factor loadings and average variance extracted (AVE). The test results show that all factor loadings were greater than the critical value of 0.7, and that the AVE values of all variables were greater than 0.5, thus indicating that the measurement model aggregated well. Discriminant validity indicates whether the correlation between the measurement terms of variables is as small as possible, which can be tested by reference to the relationship between the square root of the AVE value of each variable and the magnitude of the correlation coefficients among the variables. The test results showed that the square root of the AVE value for each variable was greater than the correlation coefficient between that variable and the other variables, thus indicating that the measurement model exhibited good discriminant validity.

According to Tables 5, 6, the KMO value is greater than 0.7, so the data are valid. The KMO test is used to check the correlation and partial correlation between variables, and its value ranges from 0 to 1. The closer the KMO statistic is to 1, the stronger the correlation between variables, the weaker the partial correlation, and the better the effect of factor analysis. In the actual analysis, when the KMO statistic is above 0.7, the effect is better. When the KMO statistic is below 0.5, it is not suitable to apply the factor analysis method. It is necessary to redesign the variable structure or adopt other statistical analysis methods. The commonality value of all research items is greater than 0.4, so there is no need to eliminate information, and all information can be effectively extracted. Commonality represents the amount of information that can be extracted from a certain item. The higher the commonality value is, the higher the index that can be explained by the principal components, and the more information that can be extracted. Generally, 0.4 is taken as the standard.

In this paper, the research models were tested using SPSS 23.0 and AMOS 23.0 software, and the results are shown in Table 7. All the model fit indicators were better than the recommended values, indicating a good fit. SPSS is the first statistical software in the world to adopt a graphical menu-driven interface. Its most prominent feature is that the operation interface is very friendly and the output results are beautiful. It displays almost all functions in a unified and standardized interface. It uses Windows to display various functions of data management and analysis methods, and dialog boxes to display various functional options.

Image management motivation is users' desire to shape a rationalized self-image through short-video sharing to gain a sense of self-satisfaction and social identity. The specific characteristics of the online environment provide the possibility for individuals to escape from the shackles of their real identities

TABLE 4 Reliability analysis indicators and results.

Variable	Measurement item	Standard factor loadings	Cronbach's α	AVE value	CR value
Extraversion	EX1	0.801	0.893	0.686	0.897
	EX2	0.888			
	EX3	0.914			
	EX4	0.728			
Conscientiousness	CO 1	0.798	0.894	0.740	0.895
	CO 2	0.903			
	CO 3	0.879			
Neuroticism	NE 1	0.741	0.883	0.656	0.884
	NE 2	0.77			
	NE 3	0.856			
	NE 4	0.87			
Image Management	XX1	0.894	0.952	0.743	0.953
	XX2	0.916			
	XX3	0.929			
	XX4	0.902			
	XX5	0.796			
	XX6	0.795			
	XX7	0.784			
Altruism	LT1	0.794	0.839	0.642	0.842
	LT2	0.739			
	LT3	0.858			
Emotional Expression	QG1	0.911	0.932	0.774	0.932
	QG2	0.873			
	QG3	0.894			
	QG4	0.843			
Pastime and Conformity	XQ1	0.675	0.891	0.686	0.896
	XQ2	0.91			
	XQ3	0.916			
	XQ4	0.78			

and material conditions, and internet users tend to conceal unfavourable information and convey an image that is favourable to themselves. Simultaneously, although social media provides a channel for sharers to experience emotional catharsis, users can confide with other users *via* the network and thus obtain comfort and seek social support. According to Table 8, conscientiousness is not significantly correlated with users' image management motivations or emotion expression motivations, but it is positively correlated with altruism motivations; therefore, Hypotheses H1-a, H1-b, and H1-c are rejected. This research on the effects of extroversion on social sharing motivation showed that extroversion as a personality trait has significant positive effects on image management, altruism, emotional expression, and pastime and conformity, especially with respect to the latter motivation. Hypotheses H2-a, H2-b, H2-c and H2-d are confirmed. Highly neurotic individuals tend to be highly motivated by image management, altruism, emotional expression, and pastime and conformity; accordingly, Hypotheses H3-a, H3-b, H3-c, and H3-d are confirmed.

Discussion

Theoretical implications

From the study, we concluded that individuals who exhibit high levels of conscientiousness are organized, disciplined, and responsible, and this personality trait reduces the likelihood of posting problematic content and the need to engage in online catharsis or emotional expression. In addition, conscientiousness is negatively related to users' pastimes and conformity motivations, thus suggesting that highly conscientious individuals are able to effectively control their needs in virtual environments, especially by avoiding information-sharing behaviours that are aimed at killing time and following new trends. These findings are consistent with those reported by Lee et al. (2014).

The research proves that extroverted users are more likely to approach others and to participate by sharing more content when using short-video platforms; they also tend to use the internet to enhance their social skills while engaging in many offline social relationships. For extroverted users, online information sharing

TABLE 5 Validity analysis indicators and results of personality trait scale.

Variable	Measurement item	Subject	Standard factor loadings			Commonality
			1	2	3	
Conscientiousness	CO1	-	−0.006	0.236	0.862	0.799
	CO2	-	0.013	0.376	0.833	0.836
	CO3	-	−0.032	0.382	0.822	0.822
Extraversion	EX1	-	0.04	0.612	0.576	0.709
	EX2	-	−0.005	0.82	0.395	0.829
	EX3	-	0.036	0.834	0.396	0.853
	EX4	-	0.117	0.823	0.222	0.74
Neuroticism	NE1	-	0.814	0.219	−0.014	0.711
	NE2	-	0.844	0.031	−0.065	0.718
	NE3	-	0.886	−0.026	0.051	0.789
	NE4	-	0.894	−0.047	0.03	0.802
-	-	Characteristic root value (before rotation)	4.855	2.962	0.79	-
-	-	Variance explanation rate % (before rotation)	44.139%	26.923%	7.183%	-
-	-	Cumulative variance explanation rate % (before rotation)	44.139%	71.062%	78.244%	-
-	-	Characteristic root value (after rotation)	2.977	2.815	2.814	-
-	-	Variance explanation rate % (after rotation)	27.068%	25.591%	25.585%	-
-	-	Cumulative variance explanation rate % (after rotation)	27.068%	52.659%	78.244%	-
-	-	KMO value		0.878		-
-	-	Bartlett's test		4381.737		-
-	-	*df*		55		-
-	-	*p* Value		0		-

not only expands offline social contact but also provides a broader means of offline social contact. Since extroverts are social, outgoing, talkative and energetic, they tend to seek more social interaction both online and offline. This mode of social contact facilitated by online and offline interaction provides evidence for the Matthew effect of "the rich get richer." This conclusion is in line with the findings of Ross et al. (2009) and Zywica and Danowski (2008). In addition, we found that users with high extroversion exhibit altruistic motivation and that users with altruistic perceptions tend to participate in social sharing in a spirit of reciprocity and altruism and freely make sacrifices of their personal time and energy to contribute their knowledge to help others solve problems. There is a significant correlation between extroversion and altruism, a finding that has not been reported by extant studies on the correlations of social sharing motivations.

In addition, our study suggests that users with high levels of neuroticism have a stronger need to engage in video sharing and prefer to express themselves *via* online platforms; this behaviour is the opposite of the anxious, repressed, and sensitive behaviours that they present offline, where they do not actively engage with others. Virtual interactions tend to compensate for the psychological distress experienced by individuals with high levels of neuroticism in the context of social exposure, so individuals with high levels of neuroticism tend to express themselves on the internet, attract the attention of others, communicate online through comments and achieve emotional connection, which can compensate for their deficiencies concerning real social interactions. This finding further confirms the social compensation effect of "the poor getting richer" in the context of the internet and is consistent with the findings of Mehdizadeh (2010) and Ross et al. (2009). Additionally, individuals with high levels of neuroticism have strong motivations for image management, altruism, emotional expression, and pastime and conformity, thus suggesting that such users have a strong need to belong and a desire to gain social acceptance.

Practical implications

Our study provides valuable practical implications for users, short-video content providers, and short-video media. Regarding users, once information has been shared with others on short-video media, it is almost impossible for users to fully control the flow of information. Therefore, the privacy risks associated with the use of short-video media should be constantly communicated to users, especially those who prefer to share short videos. In addition, due to the uniqueness of the big data era, users should consciously think outside the box to avoid being trapped in an "information-isolated island" when sharing and receiving information.

Short video content providers can design and package video content for various sharing motivations and psychological needs of users to stimulate their sharing behaviours. For example, for users' image management motivations, they can try to "tag" the content so that users can attribute the tagging information

TABLE 6 Validity analysis indicators and results of sharing motivation scale.

Variable	Measurement item	Subject	Standard factor loadings						Commonality
			1	2	3	4	5	6	
Image	XX1	-	0.794	0.258	0.154	0.298	0.205	0.025	0.853
Management	XX2	-	0.844	0.239	0.229	0.205	0.196	−0.044	0.903
	XX3	-	0.829	0.261	0.231	0.242	0.172	0.002	0.897
	XX4	-	0.784	0.213	0.265	0.251	0.159	0.173	0.848
	XX5	-	0.616	0.337	0.117	0.282	0.223	0.402	0.798
	XX6	-	0.583	0.29	0.39	0.179	0.137	0.438	0.819
	XX7	-	0.521	0.188	0.533	0.245	0.246	0.27	0.784
Altruism	LT1	-	0.462	0.098	0.572	0.307	0.139	0.326	0.769
	LT2	-	0.141	0.139	0.859	0.171	0.127	0.009	0.823
	LT3	-	0.278	0.231	0.656	0.169	0.452	0.093	0.803
Emotional	QG1	-	0.411	0.299	0.284	0.645	0.299	0.058	0.849
Expression	QG 2	-	0.31	0.218	0.455	0.674	0.229	−0.022	0.858
	QG 3	-	0.321	0.391	0.216	0.688	0.264	0.135	0.864
	QG 4	-	0.325	0.391	0.193	0.657	0.2	0.235	0.822
Pastime and	XQ1	-	0.12	0.776	0.414	0.148	−0.063	−0.023	0.815
Conformity	XQ2	-	0.322	0.763	0.128	0.258	0.28	0.004	0.847
	XQ3	-	0.384	0.716	0.133	0.219	0.333	0.089	0.845
	XQ4	-	0.274	0.685	−0.003	0.355	0.173	0.283	0.780
-	-	Characteristic root value(before rotation)	13.689	1.376	1.242	0.769	0.626	0.538	-
-	-	Variance explanation rate % (before rotation)	62.221%	6.254%	5.646%	3.497%	2.844%	2.448%	-
-	-	Cumulative variance explanation rate % (before rotation)	62.221%	68.475%	74.120%	77.618%	80.462%	82.909%	-
-	-	Characteristic root value (after rotation)	5.283	3.551	3.42	3.166	1.965	0.854	-
-	-	Variance Explanation rate % (after rotation)	24.013%	16.142%	15.547%	14.390%	8.933%	3.883%	-
-	-	Cumulative variance Explanation rate % (After Rotation)	24.013%	40.155%	55.702%	70.093%	79.026%	82.909%	-
-	-	KMO value	0.963						-
-	-	Bartlett's test	12964.045						-
-	-	df	231						-
-	-	*p*-value	0						-

TABLE 7 Model fit indices.

Fit index	Recommendation value	Actual value
χ2 /df	<3	2.748
AGFI	>0.8	0.878
RMSEA	<0.08	0.073
IFI	>0.9	0.92
NNFI	>0.9	0.908
CFI	>0.9	0.92

χ^2/df is the ratio of cardinal values to degrees of freedom, AGFI is the adjusted goodness-of-fit index, RMSEA is the root mean square of the error of approximation, IFI is the incremental fitness index, NNFI is the nonnormative fit index, and CFI is the comparative fit index.

conveyed by the content to personal and group characteristics and then show the information to the public through social sharing to build a virtual image and seek social recognition; for users' altruism motivations, content providers can emphasize its communication value in content design so that users with altruistic motivations realize that the content is useful to others and thus are stimulated to share.

Short video media should develop personalized functions and services for users with different personality traits to meet their motivation for sharing. For example, conscientious users will focus on the authenticity and traceability of the shared content when sharing short videos, so short-video media should make an official judgement on the authenticity of the video content and allow each video to be traced back to its source through a link; users with the trait of extroversion will participate in sharing more content when using short-video platforms, so a short-video medium can allow them to embed multiple types of expressions in the sharing process, such as text, pictures, audio, etc., to effectively stimulate their interest in sharing.

TABLE 8 Test results.

X	-	*Y*	Nonstandard path coefficient	S.E.	*Z*	*p*	Marker coefficient
Conscientiousness	→	Image management	0.106	0.103	1.026	0.305	0.077(ns)
Conscientiousness	→	Altruism	0.204	0.094	2.160	0.031	0.171*
Conscientiousness	→	Emotional expression	0.113	0.101	1.120	0.123	0.084(ns)
Conscientiousness	→	Pastime and conformity	−0.180	0.075	−2.398	0.016	−0.180*
Extroversion	→	Image management	0.473	0.094	5.014	0.000	0.379***
Extroversion	→	Altruism	0.392	0.086	4.534	0.000	0.362***
Extroversion	→	Emotional expression	0.430	0.092	4.672	0.000	0.355***
Extroversion	→	Pastime and conformity	0.530	0.073	7.250	0.000	0.586***
Neuroticism	→	Image management	0.276	0.051	5.429	0.000	0.221***
Neuroticism	→	Altruism	0.212	0.046	4.580	0.000	0.196***
Neuroticism	→	Emotional expression	0.336	0.050	6.691	0.000	0.279***
Neuroticism	→	Pastime and conformity	0.288	0.039	7.312	0.000	0.319***

*$p = 0.05$, **$p = 0.01$, ***$p = 0.001$, ns indicates not significant.

Limitations and future directions

The current study has limitations in certain aspects, which will inform and guide future research. First, the current study explored the relationships between user personality traits (conscientiousness, extraversion, and neuroticism) and short-video sharing motivations (image management, altruism, emotional expression, and pastime and conformity). The relationship between the Big Five personality traits of openness and agreeableness and short-video sharing motivation was not examined. Additionally, the current study did not address other short-video sharing motivations, such as information-seeking and convenience. Future research will examine the intrinsic link between a wider variety of personality traits and a more comprehensive range of sharing motivations.

Second, the group in this research was young. Nearly 80 % of the people were under 30 years old, and these people may be more inclined to interact and express themselves on short-video media. In the future, a larger number of samples should be used to provide full coverage of all age groups.

Third, because the participants were recruited from the WeChat platform, the sample may also be biased towards those who enjoy social interaction on the internet and sharing on short-video media. Traditional offline recruitment methods could be used in future research.

Fourth, because all of the participants were Chinese, there may be significant differences when the study is applied to other countries. In future studies, we will expand the scope of participants to other countries in Asia and the globe.

Conclusion

Overall, our findings suggest that users' personality traits influence their motivations to share and that individuals' motivations to share short videos vary depending on their personality traits. Highly responsible users tend to share short videos for altruistic reasons rather than to fulfil their image management and emotional expression needs, and such users strictly manage their own online time, which is negatively related to their pastime and conformity motivations. In contrast, extraversion and neuroticism had a very significant positive effect on image management, altruism, emotional expression and pastime and conformity. This finding, which suggests that personalities that feature extraversion and neuroticism can be predictors of users' sharing motivations, should therefore be considered in the context of both short-video content creation and short-video social platform construction with regard to factors related to users' intrinsic personality traits. In addition, our study confirms not only the Matthew effect of "the rich getting richer" in the context of short-video social media but also the social compensation effect of "the poor getting richer," which provides a more adequate theoretical basis and additional empirical evidence for future research on users' sharing behaviours.

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

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

ZD-Y conceived and designed the experiments and wrote the main manuscript. SZ performed the numerical analysis. All authors contributed to the article and approved the submitted version.

Funding

This study received funding from State Key Laboratory of Communication Content Cognition, Phase I (Project No. A12001) and Heilongjiang Returnee Science Foundation (Project No. LC2018031).

Conflict of interest

ZD-Y was employed by People's Daily Online.

The remaining 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.

References

Allport, G. W. (1943). Personality: a psychological interpretation. *Br. J. Med. Psychol.* 13, 48–50. doi: 10.1111/j.2044-8279.1943.tb02719.x

Al-Rahmi, A. M., Shamsuddin, A., Wahab, E., Al-Rahmi, W. M., Alyoussef, I. Y., and Crawford, J. (2022). Social media use in higher education: building a structural equation model for student satisfaction and performance. *Front. Public Health* 10, 1003007. doi: 10.3389/fpubh.2022.1003007

Amichai-Hamburger, Y., and Vinitzky, G. (2010). Social network use and personality. *Comput. Hum. Behav.* 26, 1289–1295. doi: 10.1016/j.chb.2010.03.018

Amichai-Hamburger, Y., Wainapel, G., and Fox, S. (2002). On the internet no one knows i\m an introvert: extroversion neuroticism, and internet interaction, cyberpsychology & behavior the impact of the internet multimedia & virtual reality. *Behav. Soc.* 5, 125–128. doi: 10.1089/109493102753770507

Anggraeni, A., and Diandra, S. (2017). Self-expressiveness as Consumers' motivation to share online video advertisements in Jakarta. *Int. J. Asian Bus. Inform. Manag.* 8, 38–50. doi: 10.4018/IJABIM.2017010103

Ashton, M. C., and Lee, K. (2001). A theoretical basis for the major dimensions of personality. *Eur. J. Personal.* 15, 327–353. doi: 10.1002/per.417

Astleitner, H., Bains, A., and Hörmann, S. (2022). The effects of personality and social media experiences on mental health: examining the mediating role of fear of missing out, ghosting, and vaguebooking. *Comput. Hum. Behav.* 138:107436. doi: 10.1016/j.chb.2022.107436

Barbera, D. L., Paglia, F. L., and Valsavoia, R. (2009). Social network and addiction. *Stud. Health Technol. Inform.* 2, 33–36. doi: 10.3389/conf.neuro.14.2009.06.054

Barrick, M. (2005). Yes, personality matters: moving on to more important matters. *Hum. Perform.* 18, 359–372. doi: 10.1207/s15327043hup1804_3

Berger, J. A., and Buechel, E. (2012). Facebook therapy? Why do people share self-relevant content online? *ACR North Am. Adv.* doi: 10.2139/ssrn.2013148

Błachnio, A., Przepiórka, A., and Rudnicka, P. (2013). Psychological determinants of using Facebook: a research review. *Int. J. Hum. Comput. Interact.* 29, 775–787. doi: 10.1080/10447318.2013.780868

Butt, S., and Phillips, J. G. (2008). Personality and self reported mobile phone use. *Pers. Self Report.* 24, 346–360. doi: 10.1016/j.chb.2007.01.019

Cattell, R. B. (1948). Primary personality factors in the realm of objective tests. *J. Pers.* 16, 459–486. doi: 10.1111/j.1467-6494.1948.tb02301.x

Cheung, M. W. L. (2015). Meta SEM: an R package for meta-analysis using structural equation modeling. *Front. Psychol.* 5. doi: 10.3389/fpsyg.2014.01521

Choi, D. H., and Shin, D. H. (2017). Exploring political compromise in the new media environment: the interaction effects of social media use and the big five personality traits. *Personal. Individ. Differ.* 106, 163–171. doi: 10.1016/j.paid.2016.11.022

CNNIC. (2021). The 47th China statistical report on the internet development Available at: https://www.gov.cn/xinwen/2021-02/03/5584518/files/bd16adb558714132a829f43915bc1c9e.Pdf (Accessed February 3, 2021).

Correa, T., Hinsley, A. W., and Zúñiga, H. G. D. (2010). Who interacts on the web?: the intersection of users' personality and social media use. *Comput. Hum. Behav.* 26, 247–253. doi: 10.1016/j.chb.2009.09.003

Cropanzano, R., and Mitchell, M. S. (2005). Social exchange theory: an interdisciplinary review. *J. Manag.* 31, 874–900. doi: 10.1177/0149206305279602

Ellison, N. B., Steinfield, C., and Lampe, C. (2007). The benefits of Facebook "friends:" social capital and college Students' use of online social network sites. *J. Comput.-Mediat. Commun.* 12, 1143–1168. doi: 10.1111/J.1083-6101.2007.00367.X

Falgoust, G., Winterlind, E., Moon, P., and Parker, A., Zinzow, H., and Madathil, K. C. (2022). Applying the uses and gratifications theory to identify motivational factors behind young adult's participation in viral social media challenges on TikTok, *Hum. Fact. Healthcare*, 2,:100014, doi:10.1016/j.hfh.2022.100014

Fernández-Villaverde, J., Mandelman, F., Yu, Y., and Zanetti, F. (2021). The "Matthew effect," and market concentration: search complementarities and monopsony power. *J. Monet. Econ.* 121, 62–90. doi: 10.1016/j.jmoneco.2021.04.005

Forret, M. L., and Dougherty, T. W. (2001). Correlates of networking behavior for managerial and professional employees. *Group Org. Manag.* 26, 283–311. doi: 10.1177/1059601101263004

Gao, L., and Bai, X. (2014). An empirical study on continuance intention of mobile social networking services. *Asia Pac. J. Mark. Logist.* 26, 168–189. doi: 10.1108/apjml-07-2013-0086

Ghaisani, A. P., Handayani, P. W., and Munajat, Q. (2017). Users' motivation in sharing information on social media. *Proc. Comput. Sci.* 124, 530–535. doi: 10.1016/j.procs.2017.12.186

Glass, R., Li, S., and Pan, R. (2014). Personality, problematic social network use and academic performance in China. *J. Comput. Inf. Syst.* 54, 88–96. doi: 10.1080/08874417.2014.11645726

Gupta, S., Nawaz, N., Alfalah, A. A., Naveed, R. T., Muneer, S., and Ahmad, N. (2021). The relationship of CSR communication on social media with consumer purchase intention and brand admiration. *J. Theor. Appl. Electron. Commer. Res.* 16, 1217–1230. doi: 10.3390/jtaer16050068

Hampson, S. E., and Goldberg, L. R. (2006). A first large cohort study of personality trait stability over the 40 years between elementary school and midlife. *J. Pers. Soc. Psychol.* 91, 763–779. doi: 10.1037/0022-3514.91.4.763

Hofmann, S. G., and Nadkarni, A. (2012). Why do people use Facebook? *Personal. Individ. Differ.* 52, 243–249. doi: 10.1016/j.paid.2011.11.007

Ilich, K., and Hardey, M. (2018). 'It's all about the packaging': investigation of the motivations, intentions, and marketing implications of sharing photographs of secondary packaging on Instagram. *Inf. Commun. Soc.* 23, 1–19. doi: 10.1080/1369118X.2018.1478983

John, O. P., Naumann, L. P., and Soto, C. J. (2008). *Paradigm Shift to the Integrative Big Five Trait Taxonomy: History, Measurement, and Conceptual Issues. Handbook of Personality: Theory and Research (3rd edition)*. Guilford Press. 114–158

Karim, N. S. A., Zamzuri, N. H. A., and Nor, Y. M. (2009). Exploring the relationship between internet ethics in university students and the big five model of personality. *Comput. Educ.* 53, 86–93. doi: 10.1016/j.compedu.2009.01.001

Karl, K., Peluchette, J., and Schlaegel, C. (2010). Who's posting Facebook faux pas? A cross-cultural examination of personality differences. *Int. J. Select. Assess.* 18, 174–186. doi: 10.1111/j.1468-2389.2010.00499.x

Katz, E., Blumler, J. G., and Gurevitch, M. (1973). Uses and gratifications research. *Public Opin. Q.* 37, 509–523. doi: 10.1086/268109

Kim, H., and Chung, Y. W. (2014). The use of social networking services and their relationship with the big five personality model and job satisfaction in Korea. *Cyberpsychol. Behav. Soc. Network.* 17, 658–663. doi: 10.1089/cyber.2014.0109

Kleinginna, P. R., and Kleinginna, A. M. (1981). A categorized list of emotion definitions, with suggestions for a consensual definition. *Motiv. Emot.* 5, 345–379. doi: 10.1007/BF00992553

Kuss, D. J., and Griffiths, M. D. (2011). Addiction to social networks on the internet: a literature review of empirical research. *Int. J. Environ. Public Health* 8, 3528–3552. doi: 10.3390/ijerph8093528

Lee, E., Ahn, J., and Kim, Y. J. (2014). Personality traits and self-presentation at Facebook. *Pers. Individ. Differ.* 69, 162–167. doi: 10.1016/j.paid.2014.05.020

Lee, M., Lee, J., and Quilliam, E. (2019). Motivations for sharing marketer-generated content on social media: a comparison between American and Korean college students. *J. Consum. Mark.* 36, 206–217. doi: 10.1108/JCM-07-2016-1875

Lemoine, G. J., Aggarwal, I., and Steed, L. B. (2016). When women emerge as leaders: effects of extraversion and gender composition in groups. *Leadersh. Q.* 27, 470–486. doi: 10.1016/j.leaqua.2015.12.008

Li, F. (2020). Understanding Chinese tourists' motivations of sharing travel photos in WeChat, tourism management. *Perspectives* 33:100584. doi: 10.1016/j.tmp.2019.100584

Li, D., Browne, G. J., and Wetherbe, J. C. (2006). Why do internet users stick with a specific web site? A relationship perspective. *Int. J. Electron. Comm.* 10, 105–141. doi: 10.2753/JEC1086-4415100404

Liu, D., and Campbell, W. K. (2017). the big five personality traits big two metatraits and social media: a meta-analysis. *J. Res. Personal.* 70, 229–240. doi: 10.1016/j.jrp.2017.08.004

Mccrae, R. R., and Costa, P. T. (1997). Personality trait structure as a human universal. *Am. Psychol.* 52, 509–516. doi: 10.1037//0003-066X.52.5.509

Mehdizadeh, S. (2010). Self-presentation 2.0: narcissism and self-esteem on Facebook. *Cyberpsychol. Behav. Soc. Network.* 13, 357–364. doi: 10.1089/cyber.2009.0257

Moghavvemi, S., Sharabati, M. M. N., Sulaiman, A., and Klobas, J. E. (2018). Effect of trust and perceived reciprocal benefit on Students' knowledge sharing via Facebook and academic performance. *Electron. J. Knowl. Manage.* 16, 23–35. doi: 10.1109/icriis.2017.8002518

Muscanell, N. L., and Guadagno, R. E. (2012). Make new friends or keep the old: gender and personality differences in social networking use. *Comput. Hum. Behav.* 28, 107–112. doi: 10.1016/j.chb.2011.08.016

Nicole, C. K., and Winter, S. (2008). Impression management 2.0: the relationship of self-esteem, extraversion, self-efficacy, and self-presentation within social networking sites. *J. Media Psychol. Theor. Method. Appl.* 20, 106–116. doi: 10.1027/1864-1105.20.3.106

Oliveira, T., Araujo, B., and Tam, C. (2020). Why do people share their travel experiences on social media? *Tour. Manag.* 78:104041. doi: 10.1016/j.tourman.2019.104041

Osterloh, M., and Frey, B. (2000). Motivation, knowledge transfer, and organizational forms. *Organ. Sci.* 11, 538–550. doi: 10.1287/orsc.11.5.538.15204

Park, N.，Kee, K. F., and Valenzuela, S. (2009). Being immersed in social networking environment: Facebook groups uses and gratifications, and social outcomes, *Cyberpsychol. Behav.*, 12, 729–733, doi:10.1089/cpb.2009.0003

Peters, J., and Roose, H. (2022). The Matthew effect in art funding how reputation affects an artist's chances of receiving government support. *Poetics* 92:101578. doi: 10.1016/j.poetic.2021.101578

Rajesh, T., and Rangaiah, B. (2022). Relationship between personality traits and facebook addiction: a meta-analysis. *Heliyon* 8:e10315. doi: 10.1016/j.heliyon.2022.e10315

Robles-Granda, P., Lin, S., Wu, X., D'Mello, S., and Martinez, G. J., Saha, K., et al. (2020). Jointly predicting job performance, personality, cognitive ability, affect, and well-being, *IEEE Comput. Intell. Mag.*, 16, 46–61, doi: 10.48550/arXiv.2006.08364

Ross, C., Orr, E. S., Sisic, M., Arseneault, J. M., Simmering, M. G., and Orr, R. R. (2009). Personality and motivations associated with Facebook use. *Comput. Hum. Behav.* 25, 578–586. doi: 10.1016/J.CHB.2008.12.024

Ruggiero, T. E. (2000). Uses and gratifications theory in the 21st century. *Mass Commun. Soc.* 3, 3–37. doi: 10.1207/S15327825MCS0301_02

Ryan, T., and Xenos, S. (2011). Who uses Facebook? an investigation into the relationship between the big five, shyness, narcissism, loneliness, and Facebook usage. *Comput. Human Behav.* 27, 1658–1664. doi: 10.1016/j.chb.2011.02.004

Schunk, D. H. (1990). Introduction to the special section on motivation and efficacy. *J. Educ. Psychol.* 82, 3–6. doi: 10.1037/h0092681

Shen, T., Jia, J., Li, Y., Wang, H., and Chen, B. (2020). Enhancing music recommendation with social media content: an attentive multimodal autoencoder approach. *Int. Joint Conf. Neural Netw.* 2020, 1–8. doi: 10.1109/IJCNN48605.2020.9206894

Syn, S. Y., and Oh, S. (2015). Why do social network site users share information on Facebook and twitter? *J. Inform. Sci.* 41, 553–569. doi: 10.1177/0165551515585717

Tang, T. L.-P., Furnham, A., and Davis, G. M.-T. W. (2000). A cross cultural comparison of pay differentials as a function of rater's sex and money ethic endorsement: the Matthew effect revisited, *Personal. Individ. Differ.*, 29, 685–697, doi:10.1016/S0191-8869(99)00225-1

Teixeira, C., Pinto, J. S., and Martins, J. A. (2015). User profiles in organizational environments campus-wide. *Inform. Syst.* 25, 128–144. doi: 10.1108/10650740810886312

Uslu, N. A., and Durak, H. Y. (2022). The relationships between university students' information-seeking strategies, social-media specific epistemological beliefs, information literacy, and personality traits, library & amp. *Inf. Sci. Res.* 44:101155. doi: 10.1016/j.lisr.2022.101155

Wei, K. K. (2009). What drives continued knowledge sharing? An investigation of knowledge-contribution and-seeking beliefs. *Decis. Support Syst.* 46, 826–838. doi: 10.1016/j.dss.2008.11.007

Zhang, X., Liu, Z., Deng, Z., and Chen, X. (2017). Knowledge sharing motivations in online health communities. *Comput. Hum. Behav.* 75, 797–810. doi: 10.1016/j.chb.2017.06.028

Zhang, H., Yang, Y., and Bai, B. (2022). The effects of photo-sharing motivation on tourist well-being: the moderating role of online social support. *J. Hosp. Tour. Manag.* 51, 471–480. doi: 10.1016/j.jhtm.2022.05.004

Zhou, Y., Zhu, L., and Wu, C.，Huang, S., and Wang, Q. (2022). Do the rich grow richer? An empirical analysis of the Matthew effect in an online healthcare community, *Electron. Commer. Res. Appl.*, 52:101125, doi:10.1016/j.elerap.2022.101125

Zywica, J., and Danowski, J. (2008). The faces of Facebookers: investigating social enhancement and social compensation hypotheses; predicting Facebook and offline popularity from sociability and self-esteem, and mapping the meanings of popularity with semantic networks. *J. Comput.-Mediat. Commun.* 14, 1–34. doi: 10.1111/j.1083-6101.2008.01429.x

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 22 February 2023
DOI 10.3389/fpsyg.2023.1129769

OPEN ACCESS

EDITED BY
Yukiori Goto,
Kyoto University,
Japan

REVIEWED BY
Kunhua Lee,
National Tsing Hua University,
Taiwan
Angela Costabile,
Università della Calabria,
Italy

*CORRESPONDENCE
Laura Bottel
laura.bottel@ruhr-uni-bochum.de

SPECIALTY SECTION
This article was submitted to Addictive Behaviors, a section of the journal Frontiers in Psychology

RECEIVED 22 December 2022
ACCEPTED 31 January 2023
PUBLISHED 22 February 2023

CITATION
Bottel L, Brand M, Dieris-Hirche J, Pape M, Herpertz S and te Wildt BT (2023) Predictive power of the DSM-5 criteria for internet use disorder: A CHAID decision-tree analysis. *Front. Psychol.* 14:1129769. doi: 10.3389/fpsyg.2023.1129769

Predictive power of the DSM-5 criteria for internet use disorder: A CHAID decision-tree analysis

Laura Bottel[1]*, Matthias Brand[2,3], Jan Dieris-Hirche[1], Magdalena Pape[1], Stephan Herpertz[1] and Bert Theodor te Wildt[1,4]

[1]LWL-University Hospital, Department of Psychosomatic Medicine and Psychotherapy, Ruhr University Bochum, Bochum, Germany, [2]General Psychology: Cognition and Center for Behavioral Addiction Research (CeBAR), University of Duisburg-Essen, Duisburg, Germany, [3]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany, [4]Psychosomatic Hospital Diessen Monastery, Diessen am Ammersee, Germany

Introduction: Although the majority of internet users enjoy the internet as a recreational activity, some individuals report problematic internet use behaviors causing negative psychosocial consequences. Therefore, it is important to have precise and valid diagnostic criteria to ensure suitable treatment for those affected and avoid over-pathologization.

Methods: The aim of the present study was to determine which of the nine DSM-5 criteria of internet gaming disorder (IGD) are crucial in distinguish pathological from non-pathological internet use based on the questionnaire-based response behavior of the participants by applying the Chi-squared automatic interaction detection (CHAID) decision tree analysis. Under consideration of the nine DSM-5 criteria for IGD and according to the short-form scale to assess Internet Gaming Disorder (IGDS-SF9) the DSM-5 criteria were formulated as questions and applied to the broader concept of Internet Use Disorder (IUD). The nine questions were answered on a 5-point Likert scale from "never" to "very often." In accordance with the IGDS-SF9 participants were assigned to IUD-5plus if at least 5 of the 9 criteria were answered with "very often." The study was conducted in Germany (N=37,008; *mean age*: 32years, SD=13.18, 73.8% male).

Results: Although "loss of control," "continued overuse" and "mood regulation" were the most endorsed criteria, the analysis indicated that the criterion "jeopardizing" was found as the best predictor for IUD-5plus, followed by "loss of interest" and "continued overuse." Overall 64.9% of all participants who were in the IUD-5plus, could been identified by the fulfillment of the three criteria mentioned above.

Discussion: The results found support for adjustment of the DSM-5 criteria of IGD in accordance to ICD-11. If the predictive power of the three criteria can be replicated in future representative studies, such a decision tree can be used as guidance for diagnostics to capture the particularly relevant criteria.

KEYWORDS

internet use disorder, diagnostic criteria, DSM-5, ICD-11, gaming disorder, internet gaming disorder, CHAID, decision tree analysis

1. Introduction

Although the majority of internet users enjoy the internet as a recreational activity and use internet applications in a functional manner, some individuals report uncontrolled and problematic internet use behaviors that results in negative psychosocial consequences (Rumpf et al., 2018; Brand, 2022). According to epidemiological studies, an average of 7.02% of individuals worldwide are affected by (unspecified) internet use disorders (IUD; Pan et al., 2020) and 1.96–3.05% of adolescents by gaming disorder (GD; Stevens et al., 2021), with increasing prevalence for younger age groups (Rumpf et al., 2014; Pan et al., 2020).

Building on the large number of studies on GD, the American Psychiatric Association included internet gaming disorder (IGD) as a specific type of IUD in the research appendix of the fifth edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; American Psychatric Association, 2013). In 2018 GD has then been included in the 2022 published International Statistical Classification of Diseases and Related Health Problems (ICD-11) by the World Health Organization within the category "disorders due to addictive behaviors" (World Health Organization, 2022b).

In addition to IGD, there is growing evidence that other internet activities such as excessive use of internet pornography, online shopping or the use of social networking sites can lead to similar addictive behavioral patterns and may be considered as "other specific disorders due to addictive behavior" in the ICD-11 under the condition that functional impairment is present (Brand et al., 2020, 2022). Therefore, IUD is used as an umbrella term for several subtypes (Montag et al., 2021). Furthermore Müller and colleagues were able to demonstrate in a clinical study, that no particular differences were found for the applicability of IGD criteria to IUD (Müller et al., 2019). Based on this and following the approach of an epidemiological study in Germany (Bischof et al., 2013), the DSM-5 criteria for IGD were related to the broader concept of IUD in the present study.

According to the DSM-5, a diagnosis of IGD is given when five (or more) of the following nine criteria are met: (1) preoccupation with internet games, (2) withdrawal symptoms when internet gaming is taken away, (3) tolerance – the need to spend increasing amounts of time engaged in internet games, (4) loss of control - unsuccessful attempts to control the participation in internet games, (5) loss of interests in previous hobbies and entertainment as a result of, and with the exception of, internet games, (6) continued overuse – excessive use of internet games despite knowledge of psychosocial problems, (7) deceived family members, therapists or others regarding the amount of internet gaming, (8) mood regulation – use of internet games to escape or relieve a negative mood (e.g., feelings of helplessness, guilt, anxiety), (9) jeopardized or loss of a significant relationship, job or educational or career opportunity because of participation in internet games (American Psychatric Association, 2013; Petry et al., 2015). The inclusion of IGD in the DSM-5 in 2013 provided standardized diagnostic criteria for this relatively new disorder as a guidance for research and practice. The validity of the specific criteria, however, is still discussed controversially (Castro-Calvo et al., 2021).

A prevalence study conducted in Germany with adolescents showed that "loss of interest" (called "give up other activities" in the respective paper) and "tolerance" were the best predictors of IGD and that "mood regulation" (called "escape adverse moods" in the respective paper) and "preoccupation" were less likely to predict IGD (Rehbein et al., 2015). Results from a study of online gamers (average age 22 years) in Hungary showed that "preoccupation" and "mood regulation" (called "escape" in the respective paper) provided very little information to the estimation of IGD severity (Király et al., 2017). These findings are in line with Besser et al. (2019), who identified that the "mood regulation" criterion (called "escape from a negative mood" in the respective paper) may be insufficient to distinguish between problematic and non-problematic internet use. A survey of nearly 30,000 students in China indicated that "loss of interest" (called "give up other activities" in the respective paper), "jeopardizing" (called "negative consequences" in the respective paper) and "continued overuse" (called "continue despite problems" in the respective paper) best predict a diagnosis of IGD (Luo et al., 2021).

Although the validity of specific DSM-5 criteria has been demonstrated in studies across different cultures with divers findings, there are only a few clinical studies, in which the IGD diagnostic criteria have been investigated. In those few studies that applied the criteria in a clinical setting satisfactory diagnostic validity of specific DSM-5 criteria was shown, whereas the criteria "mood regulation" (called "escape" in the respective paper) and "deception" had lower diagnostic validity (diagnostic accuracy <80%; Ko et al., 2014; Müller et al., 2019). The DSM-5 diagnostic criteria of IGD are close to those of disorders due to substance use (World Health Organization, 2022a), which was criticized and there is a growing consensus that certain criteria (e.g., tolerance, preoccupation) cannot be applied to such behaviors and may lead to inappropriate diagnosis and over-pathologization (Kass, 1980; Kardefelt-Winther, 2015; Starcevic, 2016; Billieux et al., 2019).

In contrast to the DSM-5 criteria, GD is defined as behavioral addiction in the ICD-11 and the criteria are defined by only three core criteria: (1) impaired control over gaming behaviors, (2) increasing priority of gaming to the extent that gaming takes precedence over other life interests and daily activities, (3) continuation or escalation of gaming despite the occurrence of negative consequences. In addition, the gaming behavior must result in marked distress or significant impairments in important areas of functioning to justify the diagnosis of GD (World Health Organization, 2022b). Contrary to the DSM-5 criteria, all of the above-mentioned ICD-11 criteria must be present to diagnose a GD. Besides the required ICD-11 criteria to diagnose GD, additional clinical features such as increase of duration or frequency of gaming behavior, cravings to engage in gaming during other activities and/or substantial disruptions in diet, sleep, exercise and other health-related behaviors that result in negative physical and mental health outcomes were listed in the ICD-11. These additional clinical features outline further potential characteristics of this disorder, but the features are not essential for the diagnosis of GD (World Health Organization, 2022b).

In an initial study comparing the DSM-5 criteria and ICD-11 criteria among high-risk adolescents in Korea, 32.4% of participants met the DSM-5 criteria, whereas only 6.4% of the same sample met ICD-11 criteria (Jo et al., 2019). Although evidence for the ICD-11 criteria is currently lacking, these results already suggest that the strict ICD-11 criteria of GD may prevent false positive diagnoses (Billieux et al., 2017, 2019; Jo et al., 2019). These results are consistent with an international Delphi-study, in which an expert panel of scientific and/or clinical experts in the field of GD concluded that "mood regulation" (called "escapism/mood regulation" in the respective paper) and "tolerance" as diagnostic criteria were incapable of distinguishing

between problematic and non-problematic gaming (Castro-Calvo et al., 2021). Based on the expert panel, all ICD-11 criteria for GD were judged as presenting high diagnostic validity, clinical utility and prognostic value. Whether these criteria may be useful to diagnose other types of IUD or even unspecified IUD is unclear so far.

Thus, there seem to be similarities, but also significant differences between the two classification systems for diagnosis of (I)GD. In order to achieve a common understanding of the disorder and the diagnostic criteria, a detailed review of the criteria and comparison is essential. A growing number of researchers and practitioners are encouraging to differentiate between core symptoms and motivations, mechanisms and processes, in order to distinguish between IUD and non-pathological use (Billieux et al., 2019; Brand et al., 2020).

Due to the high discrepancy between the number of recreational internet users worldwide and individuals who use the internet to a pathological extent with significant negative consequences in their daily life and under consideration of the existing different nosological classifications it is important to have precise and valid diagnostic criteria to ensure suitable treatment for those affected and avoid over-pathologization. In order to capture all subtypes of an IUD and following a large-scale German epidemiological study (Bischof et al., 2013) together with a study which showed that no particular differences were found for the applicability of the IGD criteria to IUD (Müller et al., 2019), the aim of the present study was to analyze which of the nine DSM-5 criteria of IGD are crucial in distinguishing between IUD and unproblematic internet use using a large dataset with over 37,000 participants.

2. Methods

2.1. Participants and procedure

Between September 2016 and December 2019, the telemedicine study "Online-Ambulatory Service for Individuals with Internet Use Disorder and their Relatives" (OASIS; Bottel et al., 2021) was conducted in Germany and funded by the German Federal Ministry of Health (ZMVI1-2516DSM207). The self-test represented the first part of the OASIS project.

The intention was to create a freely accessible, low-threshold offer for interested persons with direct feedback regarding their own internet use. Interested persons had the opportunity to anonymously fill out an online questionnaire (self-test) assessing their internet use *via* the project homepage. Immediately after completing the questionnaire, participants received feedback regarding their usage behavior and whether participation in the OASIS-project was recommended.

Recruitment took place at various levels. The cooperation partner Fachverband Medienabhängigkeit e.V. (largest German association regarding IUD) drew attention to the project and the online self-test through its network of professionals, (former) person affected, relatives and interested person. At the same time, media interest in the project and the topic of IUD was very high, resulting in numerous newspaper articles, blog posts, interviews on radio and television about the project and the possibility of a freely available online self-test. Furthermore, the project had its own social media account and was presented with its own stand at the largest computer game convention, where interested person had the opportunity to fill out the self-test on site. Recruitment was further supported by project-presentations in schools, companies, as well as presentations at congresses and in treatment institutions. Based on the answers in the self-test, two groups were defined. The first group was defined as "IUD-5plus" with participants who answered five or more of the nine questions representing the DSM-5 criteria with "very often." The second group "IUD-4minus" was defined by participants who answered four or less questions of the nine questions representing the DSM-5 criteria with "very often."

2.2. Measures

2.2.1. Assessment of IUD according to DSM-5

Under consideration of the nine DSM-5 criteria for IGD and according to the short-form scale to assess Internet Gaming Disorder (IGDS-SF9; Pontes and Griffiths, 2015) the DSM-5 criteria were formulated as questions and applied to the broader concept of IUD ("gaming" was replaced by "internet activities"). Following a German epidemiological study (Bischof et al., 2013) IUD was captured instead of IGD to provide the opportunity of an online self-test for as many people as possible and since no particular differences were found for the applicability of IGD criteria to IUD in a clinical study (Müller et al., 2019). The nine questions were answered on a 5-point Likert scale from "never" to "very often." In line with the DSM-5 guidelines to determine IGD and following the cut-offs of the IGDS-SF9 (Pontes and Griffiths, 2015), individuals were assigned to the IUD-5plus group, if five (or more) questions were answered with "very often." The nine questions representing the DSM-5 criteria in German and the English translation can be found in the Supplementary material.

2.2.2. Sociodemographic

In addition to age and gender, the federal state in which the persons in Germany lived, were recorded.

Since the study aim was to determine which of the DSM-5 criteria distinguish between pathological and non-pathological internet use based on the questionnaire-based response behavior of the participants, only the most important data to reach this aim were collected.

2.2.3. Statistical analysis

Descriptive statistical analyses were calculated to describe the study population. Percentages were used for categorical variables and means and standard deviation for continuous variables. Independent-sample t-tests (2-sided) were conducted to compare the group of "IUD-4minus" with "IUD-5plus" and Chi2-tests for nominal variables. As effect size for Chi2-test the Cramer's V was calculated with $V = 0.1$ indicating small, $V = 0.3$ medium and $V = 0.5$ large effects and for the t-tests with Cohen's d indicating $d = 0.2$ small; $d = 0.5$ medium; $d = 0.8$ large – effects (Cohen, 1988, 2013). Median split was used to include the variable "age" as a dichotomous variable in the decision tree model [younger age group: 18–29 years ($n = 19{,}125$) and older age group: 30–79 years ($n = 17{,}883$)].

Chi-squared automatic interaction detection (CHAID) algorithm (Kass, 1980; Song and Ying, 2015) was used to perform the decision tree analyses with the response variable IUD-5plus. Predictive variables were age (median split younger/older age group), gender and the nine DSM-5 criteria of IGD modified for IUD. Multiple contingency tables between the dependent and each independent variable were created and the most significant Chi-squared

independent variable was selected to branch out the decision tree. To avoid overfitting, the decision tree was set to have a maximum of 3 levels and a significance level was set at ≤0.05 (IBM, 2022). The cross-validation was used as decision tree validation method. The original study cohort was randomly assigned to 10 subsets of equal sizes. The cross-validation process was repeated 10 times with the same procedure for all subsets. The first tree was calculated on all datasets except those in the first subset, the second tree was calculated on all datasets except those in the second subset and so on. Every subset was only used once and the cross-validated risk for the final tree was calculated based on the average value of the 10 results (IBM, 2022).

In the course of the decision tree analysis, the criterion was classified as "applicable" if the respective question was answered with "very often" by the participants. The criterion was classified as "not applicable" if the respective question was answered with "never," "rarely," "sometimes" or "often" by the participants.

A careless responder analysis was conducted to identify unrealistic values in age data and, based on this, 262 participants were excluded from the analysis.

Statistical analysis were performed and figures build using IBM SPSS Statistics for Windows, version 26.0.

2.2.4. Ethics statement

The study was carried out in accordance with the Declaration of Helsinki. The Institutional Review Board approved the study (16–5,734) and participants were informed about the study procedure and consented.

3. Results

3.1. Sample characteristics

Based on participants' self-report, 3.2% of the sample met the criteria for an IUD-5plus which means that they have answered five or more of the nine questions, capturing the DSM-5 criteria, with "very often" (see Table 1). The demographic characteristics of the two groups IUD-4minus and IUD-5plus are shown in Table 1. Participants in the IUD-5plus group were on average 3 years younger and the proportion of males in this group was two percentage points lower than in the IUD-4minus group. In general, there was a significantly higher proportion of male than female participants with 73.9% male participants and an average age of 32 years ($SD = 13.20$, *range* 18–79 years) in the entire sample. Based on the median split two groups of younger- and older age were defined. Bonferroni-adjusted post-hoc tests reveal that in the younger age group the proportion of persons assigned to the IUD-5 plus group is significantly higher (4.1%) than in the older age group (2.3%).

3.2. Endorsement rates

As shown in Table 2, the three criteria "loss of control" (entire sample: 9.6%, IUD-4minus: 7.0%, IUD-5plus: 88.1%), "continued overuse" (entire sample: 8.2%, IUD-4minus: 5.4%, IUD-5plus: 92.0%) and "mood regulation" (entire sample: 6.6%, IUD-4minus: 4.0%, IUD-5plus: 84.0%) were the three most frequently endorsed criteria

TABLE 1 Comparison of the two groups IUD-4minus and IUD-5plus regarding sex and age for the entire sample and the two subgroups younger- and older age group based on mediansplit.

	IUD-4minus	IUD-5plus	Statistics
Entire sample ($N = 37,008$)			
Male gender – *% (n)*	73.9 (26,465)	71.1 (853)	$Chi^2(2) = 283.565$, $p < 0.001$, $V = 0.088$
Age – *M (SD)*	32.34 (13.20)	28.81 (12.26)	$T(37,006) = 9.127$, $p < 0.001$, $d = 0.277$
Subgroups based on mediansplit			
Younger age group (18–29 years; $n = 19,125$) – *% (n)*	95.9 (18,342)	4.1 (783)	$Chi^2(1) = 92.137$, $p < 0.001$, $V = 0.050$
Older age group (30–79 years; $n = 17,883$) – *% (n)*	97.7 (17,467)	2.3 (416)	

TABLE 2 Endorsement rates (answered question with "very often") of the DSM-5 criteria separately for the entire sample, IUD-4minus and IUD-5plus.

Criterion	Endorsement rates					
	Entire sample ($N = 37,008$)		IUD-4minus ($n = 35,809$)		IUD-4minus ($n = 1,199$)	
	%	*n*	*%*	*n*	*%*	*n*
Tolerance	3.7	1,378	1.6	584	66.2	794
Withdrawal	3.7	1,384	1.6	583	66.8	801
Deceiving	4.4	1,613	2.1	748	73.6	883
Jeopardizing	4.4	1,631	1.9	671	80.1	960
Loss of interest	5.2	1,921	2.6	921	83.4	1,000
Preoccupation	5.2	1,922	3.0	1,089	69.5	833
Mood regulation	6.6	2,442	4.0	1,435	84.0	1,007
Continued overuse	8.2	3,019	5.4	1,916	92.0	1,103
Loss of control	9.6	3,570	7.0	2,514	88.1	1,056

(answered with "very often") across the entire sample and the two subgroups IUD-4minus and IUD-5plus. The most rarely endorsed criteria were "tolerance "(entire sample: 3.7%, IUD-4minus: 1.6%, IUD-5plus: 66.2%) and "withdrawal" (entire sample: 3.7%, IUD-4minus: 1.6%, IUD-5plus: 66.8%). The criteria "deceiving" was among the three most rarely endorsed criteria (4.4%) in the entire sample, "jeopardizing" in the IUD-4minus (1.9%) and "preoccupation" in the IUD-5plus subsample (69.5%).

3.3. CHAID decision tree analysis

In the decision tree analysis, the three best predictive variables for IUD-5plus, meaning that the participants answered five or more of the nine DSM-5 criteria with "very often," were "jeopardizing ", "loss of interest" and "continued overuse." The model concluded with a total of eight subgroups and the overall accuracy of the model was 98.8% (see Figure 1).

To improve the comprehensibility of the results, three paths (dashed, dotted and bold line) are described in more detail below.

3.3.1. Dashed line

The dashed line in Figure 1 shows the path from the first splitting variable to node 7, which subsample is defined by the highest percentage proportion of participants who fulfilled five or more out of nine DSM-5 criteria (IUD-5plus).

As seen in node 0 the criterion "jeopardizing "was defined as the first splitting variable based on the highest Chi2 value to predict IUD-5plus. The risk to be assigned to the IUD-5plus group, meaning that five or more out of nine DSM-5 criteria were answered with "very often," was 58.9% ($n = 960$ IUD-5plus/$n = 1{,}631$ subsample of node 1) for the subsample of node 1. Following the dashed line in Figure 1, those participants who answered the criterion "jeopardizing" with "very often" and therefore the criterion was applicable, the criterion "loss of interest" was statistically determined as the second splitting variable with the highest predictive value within this subsample (node 1). If the second criterion "loss of interest" was applicable (answered with "very often") within this subsample of node 1, the risk to be assigned to the group of participants who fulfilled five or more out of nine DSM-5 criteria (IUD-5plus), was 86.5% (see node 3; $n = 821$ IUD-5plus/$n = 949$ subsample node 3). Within the subsample of node 3, the third splitting variable with the highest predictive value based on the respective Chi2 values for IUD-5plus, was "continued overuse." Among the subsample of node 7 with participants who fulfilled the three criteria "jeopardizing," "loss of interest" and "continued overuse" (node 7), the risk of IUD-5plus based on their questionnaire-based answers was 93.6% (see node 7; $n = 778$ IUD-5plus/$n = 831$ subsample node 7).

In relation to the total number of participants who fulfilled five or more out of nine DSM-5 criteria ($n = 1{,}199$ IUD-5plus), 64.9% ($n = 778$ IUD-5plus in node 7/$n = 1{,}199$ IUD-5plus entire sample) of all participants who answered "very often" to five or more of the nine

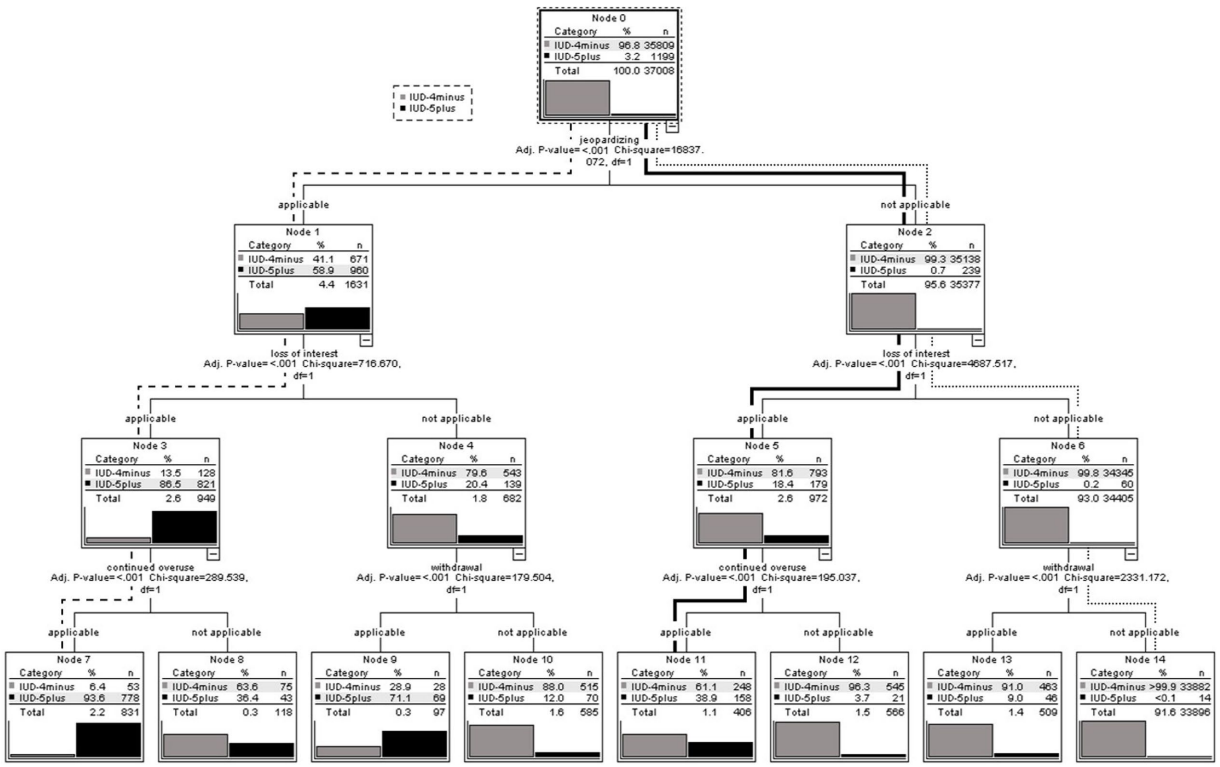


FIGURE 1
CHAID decision tree analysis with the predictive variables: gender, age (median split: younger/older age group) and the nine DSM-5 criteria for IGD on the risk of IUD-5plus for persons who were interested to receive feedback regarding their internet use behavior based on their questionnaire-based response behavior.

DSM-5 criteria were already been identified by the fulfillment of the criteria "jeopardizing," "loss of interest" and "continued overuse."

3.3.2. Dotted line

In contrast to the dashed line, the dotted line in Figure 1 shows the path to node 14, which contains the lowest proportion of participants who answered five or more of the nine DSM-5 criteria with "very often" (IUD-5plus). Following the dotted line, it can be seen that if the criteria "jeopardizing," "loss of interest" and "withdrawal" were not applicable (answered with "never," "rarely," "sometimes," "often") the risk of being assigned to the IUD-5plus group based on the questionnaire-based answers within the subsample of node 14 was 0.0004% ($n = 14$ IUD-5plus/$n = 33{,}896$ subsample of node 14).

3.3.3. Bold line

Within the 8 subgroups at the end of the decision tree, the second highest number of participants who answered five or more out of nine DSM-5 criteria with "very often" (IUD-5plus) was found in node 11 (bold line).

Following the bold line, it can be seen, that if the criterion "jeopardizing" was not applicable, the risk of being assigned to IUD-5plus, meaning five or more out of nine criteria were answered with "very often," was 0.7% (see node 2). Within this subsample of node 2 the criterion with the highest predictive value to identify participants who answered five or more out of nine DSM-5 criteria with "very often" (IUD-5plus) based on the Chi2 values, was "loss of interest." Following the bold line to node 5 it can be seen, that if the criterion "loss of interest" was applicable (answered with "very often"), the risk of fulfilling five or more out of nine DSM-5 criteria within the subsample of node 5, was 18.4% (see node 5; $n = 179$ IUD-5plus/$n = 972$ subsample node 5). The third best predictive variable to identify those who answered five or more out of nine DSM-5 criteria with "very often" (IUD-5plus) based on the Chi2 values, was "continued overuse." If the criterion "continued overuse" was applicable (answered with "very often"), the risk of IUD-5plus within the subsample of node 11, was 38.9% (see node 11; $n = 158$ IUD-5plus/$n = 406$ subsample node 11).

The results revealed that 19.9% of node 2 ($n = 239$ IUD-5plus subsample node 2/$n = 1{,}199$ IUD-5plus entire sample) and 13.2% of node 11 ($n = 158$ IUD-5plus subsample node 11/$n = 1{,}199$ IUD-5plus entire sample) of all participants who fullfilled five or more of the nine criteria (IUD-5plus) did not answer "jeopardizing" with "very often."

4. Discussion

Which diagnostic criteria distinguish between IUD and non-pathological internet use is highly debated in science and practice (Billieux et al., 2019; Brand et al., 2020; Castro-Calvo et al., 2021). The key finding of the present study is that the criterion "jeopardizing" was found as the best predictor to identify participants who have answered five or more out of nine DSM-5 criteria with "very often" (IUD-5plus), followed by "loss of interest" and "continued overuse." If these three criteria were applicable, the risk within this subsample to be assigned to IUD-5plus, was 93.6%.

Within the group of all participants who have answered five or more out of nine questions representing the DSM-5 criteria with "very often," 64.9% were already correctly assigned to IUD-5plus by fulfilling the three DSM-5 criteria based on their questionnaire-based response behavior mentioned above.

The highest endorsement rates in the IUD-4minus, IUD-5plus and entire sample were shown for the criteria "loss of control," "continued overuse" and "mood regulation." However, only one of these criteria with the highest endorsement rates was included in the decision tree, which emphasizes that high endorsement of a criterion does not necessarily indicate good diagnostic validity. Especially for the criterion "mood regulation" a high endorsement rate has already been reported in various studies with different samples (Király et al., 2017; Besser et al., 2019; Luo et al., 2021), but it has already been concluded that the criterion "mood regulation" is not well suited to distinguish between pathological and non-pathological internet use (Besser et al., 2019; Castro-Calvo et al., 2021). The reported high endorsement rates for the criteria "loss of control" and "continued overuse" in the present study are in line with studies from Hungarian (Király et al., 2017) and Germany (Besser et al., 2019). In contrast to previous studies (Király et al., 2017; Besser et al., 2019; Luo et al., 2021), the endorsement rate of the criterion "preoccupation" was not among the three highest endorsement rates in the present study. Possible explanations for the different results could be due to various samples and/or different underlying methods to capture the DSM-5 criteria of IGD.

Based on the decision tree analysis, the criterion "jeopardizing" had the highest predictive value to distinguish between participants who fulfilled, based on their questionnaire-based response behavior, the requirements of an IUD following the DSM-5 approach (five and more out of nine criteria were answered with "very often") and those who did not. The results found are consistent with two clinical studies of patients with IGD (Ko et al., 2014) and IUD (Müller et al., 2019) as well as a questionnaire-based study (Luo et al., 2021). Furthermore an expert panel of practitioners and scientists concluded during a Delphi study that the criterion "jeopardizing" represents a decisive criterion with regard to diagnostic validity, clinical utility and prognostic value (Castro-Calvo et al., 2021). Thus, the results of the present study support the important role of functional impairment and that this criterion is crucial for the diagnosis. If this criterion is not present, no diagnosis should be made to prevent over-pathologization (Billieux et al., 2017; World Health Organization, 2022b).

The second criterion best predicting an IUD based on the questionnaire-based response behavior of the participants is "loss of interest." The relevance as a predictor for an IUD of this criterion has already been highlighted in studies with large sample sizes of online gamers and/or students in Germany and China (Rehbein et al., 2015; Király et al., 2017; Luo et al., 2021), as well as in clinical studies (Ko et al., 2014; Müller et al., 2014). The expert panel also classified this criterion as relevant in diagnosis, although there was no agreement on inclusion/exclusion with regard to clinical utility and prognostic value (Castro-Calvo et al., 2021).

As already shown in previous studies (Ko et al., 2014; Luo et al., 2021), the criterion "continued overuse" also emerged in the present study as an important predictor to forecast pathological internet users based on their questionnaire-based response behavior following the DSM-5 regulations. The expert panel also rated this criterion as important on all three levels (diagnostic validity, clinical utility, prognostic value) and supported the inclusion of this criterion (Castro-Calvo et al., 2021). In contrast, the study of Király and

colleagues showed that "continued overuse" was associated with lower severity of IGD and also in the study of Rehbein and colleagues this criterion was not found to be a decisive predictor (Rehbein et al., 2015; Király et al., 2017). Possible explanations for the different results could be the different operationalization of the diagnostic criteria and/or diversity of samples (i.e., age, gender, IGD vs. IUD).

Overall, all three criteria which were identified within the decision tree analysis as best predictors to forecast IUD based on the questionnaire-based response behavior of the participants following the DSM-5 approach are included not only in the DSM-5 but in the ICD-11 as well (American Psychatric Association, 2013; World Health Organization, 2022b). Additionally, all three criteria are defined as core symptoms of a behavioral addiction (Brand et al., 2020). With regard to the ICD-11 criteria of GD (World Health Organization, 2022b) only the criterion "loss of control" had no high relevance in the present analysis to predict IUD based on the questionnaire-based response behavior of the participants following the DSM-5 approach, even though the expert panel (Castro-Calvo et al., 2021) as well as clinical studies (Ko et al., 2014; Müller et al., 2019) assigned high relevance to this criterion. One hypotheses might be that "loss of control" is a very early feature of IUD (and therefore very sensitive, but not specific), which may develop before other criteria are fulfilled. Therefore, it is important to differentiate between those criteria which seem to be a general warning signal for problematic internet use and those which cover noticeable negative consequences due to internet use (Billieux et al., 2019; Brand et al., 2020).

Thus, the results of the present study support the classification of IUD as behavioral addiction, since core symptoms of addictive behaviors were identified as criteria with the highest predictive power. Therefore, it can be assumed that DSM-5 criteria such as "mood regulation" represent potential processes in the development of behavioral addictions, but these criteria are not suitable to distinguish between IUD and non-pathological behavior (Brand et al., 2020). In others words, the use of the internet for changing mood or alleviating boredom should not be a sign of pathological internet use, but can be an additional clinical feature once the required diagnostic criteria are fulfilled (World Health Organization, 2022b).

The results of the present study emphasize the differences in diagnosing (I)GD depending on the underlying catalog. The DSM-5 regulations are defined by the requirement that arbitrary five or more of the nine DSM-5 criteria need to be fulfilled for an IGD diagnosis (American Psychatric Association, 2013). In contrast, the three ICD-11 criteria and the underlying functional impairment must be present for a diagnosis of GD in ICD-11 (World Health Organization, 2022b). The findings of the present study show that almost 20% of participants who fulfilled five or more out of nine DSM-5 criteria, based on their questionnaire-based response behavior, did not fulfill the criterion "jeopardizing," which most closely corresponds to the crucial "functional impairment" criterion for diagnosing an GD in ICD-11 (World Health Organization, 2022b). This means that based on the ICD-11 criteria, these individuals would not meet the criteria for a GD diagnosis, even if other relevant criteria such as "loss of interest" and "continued overuse" were fulfilled (answered with "very often") by the majority of these participants based on their questionnaire-based response behavior. These results indicate that the DSM-5 regulations provide a larger range for different phenotypes including processes underlying the engagement in gaming in early stages of the development of addictive behaviors and core symptoms of GD associated with later stages of the process contributed to the maintenance of addictive behaviors (Brand, 2020). For the more stringent ICD-11 criteria the core symptoms of GD are used as basis to prevent over-pathologization. Therefore, the DSM-5 criteria could be used to determine different stages of addiction development and to relate them to the underlying processes and core symptoms. For the diagnosis of addictive behavior the ICD-11 criteria should be used. Overall, some DSM-5 and almost all ICD-11 criteria seem to be valid to identify IUD based on the questionnaire-based response behavior of the participants. The results support the relevance of the ICD-11 criteria, which may be superior to the DSM-5 criteria in diagnosing individuals with IUD and in preventing false positive diagnoses (Jo et al., 2019). Important to consider when diagnosing IUD are boundaries with other disorders and conditions like disorders due to substance use, bipolar or related disorders (World Health Organization, 2022b).

In addition, the underlying data provides an indication of the particular relevance of the different criteria, which can be used as guidance in screenings and diagnostics. If these results can be replicated in future studies with clinical samples and standardized screenings, this prioritization of diagnostic criteria could be particularly useful for screenings and/or settings in which only a limited amount of time is available for initial assessment. The criterion jeopardizing in particular seems to be the most relevant criterion and should therefore be assessed with particular caution and priority in the diagnostic process. Especially the association to the internet use should always be determined in order to ensure that the harmful behavior results from internet use. Otherwise, potential comorbidities must be identified and taken into account accordingly in the further course of treatment.

In addition to the implications for diagnosing an IUD, such a decision tree can be integrated in the course of treatment. The decision tree can be used during psychoeducation in order to identify individual warning signals together with the patient or within counseling and prevention in order to determine the current internet use behavior considering which criteria are already present.

4.1. Limitations

Since the self-test was freely available on the internet, our results are based on a selected sample of people who were interested in receiving feedback regarding their internet use and therefore no conclusions regarding the whole population can be drawn. Clearly more men than women participated in the study and the age range was very broad. To capture the effect of these two variables, those variables were included in the CHAID decision tree analysis. Nevertheless, future studies should pay attention on equal distribution of gender and an evidence-based age range. Due to the intention to reach as many interested persons as possible and to avoid high dropout rates, only the most important questions were collected with regard to the study aim. Further information on internet usage time, specific internet use and/or existing comorbidities should be collected in future studies.

Even though the questionnaire was created following standardized questionnaires and the DSM-5 criteria of IGD, the questionnaire was not validated and therefore first interpretations and directions can be pointed out, but no final conclusions can be drawn. Furthermore,

the questionnaire was completed by the participants themselves and there was no structured interview to capture the diagnostic criteria in a third party rating. To strengthen the validity of the results found in this study, future studies should use standardized questionnaires and structured interviews for diagnosis.

5. Conclusion

The main finding of the present study is that the criterion "jeopardizing," "loss of interest" and "continued overuse" best predict participants who fulfilled based on their questionnaire-based response behavior the requirements of an IUD following the DSM-5 approach (five and more out of nine criteria were answered with "very often"), which is widely consistent with the ICD-11 criteria of GD and therefore the use of ICD-11 criteria should be the better option to prevent over-pathologization. One particular topic for future studies may be to apply the DSM-5 diagnostic criteria to specific stages of IUD (e.g., risky versus pathological use) since diminished control, priority, and continuation may be differently related to specific driving paths to addiction and reduced self-control (Brand et al., 2020).

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 Ruhr University Bochum. The patients/participants provided their written informed consent to participate in this study.

Author contributions

LB conducted literature research, created manuscript concept, ran statistical analyses, interpreted the results, and wrote the manuscript. MB and BW contributed to the manuscript concept and refinements. BW conceived the study and acquired funding. LB, BW, and JD-H conducted and coordinated the study. MB, BW, JD-H, SH, and MP contributed to the style of reporting and writing and approved the final version of the manuscript.

Funding

This publication was funded by the German Federal Ministry of Health under grant number ZMVI1-2516DSM207.

Acknowledgments

We acknowledge support by the Open Access Publication Fund of the Ruhr-University Bochum. Our thanks go to the German Federal Ministry of Health for sponsoring the study and to the cooperation partners Centre for Telematics and Telemedicine (ZTG) GmbH for assistant in the conception and development of the study platform as well as to the German Fachverband Medienabhängigkeit e.V. for the support within the recruitment phase. The organisations listed were not involved in the study design, collection, analysis, interpretation of data, the writing of this article or the decision to submit it for publication.

Conflict of interest

The authors declare that this study received funding from the German Federal Ministry of Health under grant number ZMVI1-2516DSM207. The study design was approved by the funder. The funder supported recruitment by drawing attention to the project. The funder was not involved in the study analysis, interpretation of data, the writing of this article or the decision to submit it for publication.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1129769/full#supplementary-material

References

American Psychatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. Washington, DC: American psychiatric association.

Besser, B., Loerbroks, L., Bischof, G., Bischof, A., and Rumpf, H.-J. (2019). Performance of the DSM-5-based criteria for internet addiction: a factor analytical examination of three samples. *J. Behav. Addict.* 8, 288–294. doi: 10.1556/2006.8.2019.19

Billieux, J., Flayelle, M., Rumpf, H.-J., and Stein, D. J. (2019). High involvement versus pathological involvement in video games: a crucial distinction for ensuring the validity and utility of gaming disorder. *Curr. Addict. Rep.* 6, 323–330. doi: 10.1007/s40429-019-00259-x

Billieux, J., King, D. L., Higuchi, S., Achab, S., Bowden-Jones, H., Hao, W., et al. (2017). Functional impairment matters in the screening and diagnosis of gaming disorder: commentary on: scholars' open debate paper on the World Health Organization ICD-11 gaming disorder proposal (Aarseth et al.). *J. Behav. Addict.* 6, 285–289. doi: 10.1556/2006.6.2017.036

Bischof, G., Bischof, A., Meyer, C., John, U., and Rumpf, H.-J. (2013). *Prävalenz der Internetabhängigkeit--Diagnostik und Risikoprofile (PINTA-DIARI)*. In Lübeck: Kompaktbericht an das Bundesministerium für Gesundheit.

Bottel, L., Brand, M., Dieris-Hirche, J., Herpertz, S., Timmesfeld, N., and Te Wildt, B. T. (2021). Efficacy of short-term telemedicine motivation-based intervention

for individuals with internet use disorder--a pilot-study. *J. Behav. Addict.* 10, 1005–1014. doi: 10.1556/2006.2021.00071

Brand, M. (2022). Can internet use become addictive? *Science* 376, 798–799. doi: 10.1126/science.abn4189

Brand, M., Rumpf, H.-J., Demetrovics, Z., Mueller, A., Stark, R., King, D. L., et al. (2020). Which conditions should be considered as disorders in the international classification of diseases (ICD-11) designation of "other specified disorders due to addictive behaviors"?. J. Behav. Addict. 11, 150–159. doi: 10.1556/2006.2020.00035

Brand, M., Rumpf, H.-J., Demetrovics, Z., Mueller, A., Stark, R., King, D. L., et al. (2022). Which conditions should be considered as disorders in the international classification of diseases (ICD-11) designation of "other specified disorders due to addictive behaviors"? *J. Behav. Addict.* 11, 150–159. doi: 10.1556/2006.2020.00035

Brand, M., Rumpf, H.-J., King, D. L., Potenza, M. N., and Wegmann, E. (2020). Clarifying terminologies in research on gaming disorder and other addictive behaviors: distinctions between core symptoms and underlying psychological processes. *Curr. Opin. Psychol.* 36, 49–54. doi: 10.1016/j.copsyc.2020.04.006

Castro-Calvo, J., King, D. L., Stein, D. J., Brand, M., Carmi, L., Chamberlain, S. R., et al. (2021). Expert appraisal of criteria for assessing gaming disorder: an international Delphi study. *Addiction* 116, 2463–2475. doi: 10.1111/add.15411

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ, USA: Lawrence Erlbaum associates Inc. (Vol. *13*).

Cohen, Jacob. (2013). *Statistical power analysis for the behavioral sciences*. Cambridge: Academic press.

IBM. (2022). IBM SPSS Decision Tree. 25. Available online: https://www.ibm.com/docs/en/SSLVMB_25.0.0/pdf/en/IBM_SPSS_Decision_Trees.pdf (Accessed July 2, 2023).

Jo, Y. S., Bhang, S. Y., Choi, J. S., Lee, H. K., Lee, S. Y., and Kweon, Y.-S. (2019). Clinical characteristics of diagnosis for internet gaming disorder: comparison of DSM-5 IGD and ICD-11 GD diagnosis. *J. Clin. Med.* 8:945. doi: 10.3390/jcm8070945

Kardefelt-Winther, D. (2015). A critical account of DSM-5 criteria for internet gaming disorder. *Addict. Res. Theory* 23, 93–98. doi: 10.3109/16066359.2014.935350

Kass, G. V. (1980). An exploratory technique for investigating large quantities of categorical data. *J. Royal Statistical Society: Series C (Applied Statistics)* 29, 119–127. doi: 10.2307/2986296

Király, O., Sleczka, P., Pontes, H. M., Urbán, R., Griffiths, M. D., and Demetrovics, Z. (2017). Validation of the ten-item internet gaming disorder test (IGDT-10) and evaluation of the nine DSM-5 internet gaming disorder criteria. *Addict. Behav.* 64, 253–260. doi: 10.1016/j.addbeh.2015.11.005

Ko, C.-H., Yen, J.-Y., Chen, S.-H., Wang, P.-W., Chen, C.-S., and Yen, C.-F. (2014). Evaluation of the diagnostic criteria of internet gaming disorder in the DSM-5 among young adults in Taiwan. *J. Psychiatr. Res.* 53, 103–110. doi: 10.1016/j.jpsychires.2014.02.008

Luo, T., Wei, D., Guo, J., Hu, M., Chao, X., Sun, Y., et al. (2021). Diagnostic contribution of the DSM-5 criteria for internet gaming disorder. *Front. Psych.* 12, 1–7. doi: 10.3389/fpsyt.2021.777397

Montag, C., Wegmann, E., Sariyska, R., Demetrovics, Z., and Brand, M. (2021). How to overcome taxonomical problems in the study of internet use disorders and what to do with "smartphone addiction"? *J. Behav. Addict.* 9, 908–914. doi: 10.1556/2006.8.2019.59

Müller, K. W., Beutel, M. E., Dreier, M., and Wölfling, K. (2019). A clinical evaluation of the DSM-5 criteria for internet gaming disorder and a pilot study on their applicability to further internet-related disorders. *J. Behav. Addict.* 8, 16–24. doi: 10.1556/2006.7.2018.140

Müller, K. W., Beutel, M. M., and Wölfling, K. (2014). A contribution to the clinical characterization of internet addiction in a sample of treatment seekers: validity of assessment, severity of psychopathology and type of co-morbidity. *Compr. Psychiatry* 55, 770–777. doi: 10.1016/j.comppsych.2014.01.010

Pan, Y.-C., Chiu, Y.-C., and Lin, Y.-H. (2020). Systematic review and meta-analysis of epidemiology of internet addiction. *Neurosci. Biobehav. Rev.* 118, 612–622. doi: 10.1016/j.neubiorev.2020.08.013

Petry, N. M., Rehbein, F., Ko, C.-H., and O'Brien, C. P. (2015). Internet gaming disorder in the DSM-5. *Curr. Psychiatry Rep.* 17, 1–9. doi: 10.1007/s11920-015-0610-0

Pontes, H. M., and Griffiths, M. D. (2015). Measuring DSM-5 internet gaming disorder: development and validation of a short psychometric scale. *Comput. Hum. Behav.* 45, 137–143. doi: 10.1016/j.chb.2014.12.006

Rehbein, F., Kliem, S., Baier, D., Mößle, T., and Petry, N. M. (2015). Prevalence of internet gaming disorder in German adolescents: diagnostic contribution of the nine DSM-5 criteria in a state-wide representative sample. *Addiction* 110, 842–851. doi: 10.1111/add.12849

Rumpf, H.-J., Achab, S., Billieux, J., Bowden-Jones, H., Carragher, N., Demetrovics, Z., et al. (2018). Including gaming disorder in the ICD-11: the need to do so from a clinical and public health perspective: commentary on: a weak scientific basis for gaming disorder: let us err on the side of caution (van Rooij et al., 2018). *J. Behav. Addict.* 7, 556–561. doi: 10.1556/2006.7.2018.59

Rumpf, H.-J., Vermulst, A. A., Bischof, A., Kastirke, N., Gürtler, D., Bischof, G., et al. (2014). Occurence of internet addiction in a general population sample: a latent class analysis. *Eur. Addict. Res.* 20, 159–166. doi: 10.1159/000354321

Song, Y.-Y., and Ying, L. U. (2015). Decision tree methods: applications for classification and prediction. *Shanghai Arch. Psychiatry* 27, 130–135. doi: 10.11919/j.issn.1002-0829.215044

Starcevic, V. (2016). Tolerance and withdrawal symptoms may not be helpful to enhance understanding of behavioural addictions. *Addiction* 111, 1307–1308. doi: 10.1111/add.13381

Stevens, M. W. R., Dorstyn, D., Delfabbro, P. H., and King, D. L. (2021). Global prevalence of gaming disorder: a systematic review and meta-analysis. *Australian \& New Zealand J. Psychiatry* 55, 553–568. doi: 10.1177/0004867420962851

World Health Organization. (2022a). ICD-11: disorders due to substance use. Available online: https://icd.who.int/browse11/l-m/en#/http%3a%2f%2fid.who.int%2ficd%2fentity%2f590211325 (Accessed July 2, 2023).

World Health Organization. (2022b). *ICD-11: Gaming disorder*. Available online: https://icd.who.int/browse11/l-m/en#/http%3a%2f%2fid.who.int%2ficd%2fentity%2f1448597234 (Accessed July 2, 2023).

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 01 March 2023
DOI 10.3389/fpsyg.2023.1112810

OPEN ACCESS

EDITED BY
Kwanghee Jung,
Texas Tech University, United States

REVIEWED BY
Danni Li,
Texas A&M University, United States
Berhanu Yeshanew,
Dire Dawa University, Ethiopia

*CORRESPONDENCE
Daniela Romero Reyes
✉ dromero240@alumno.uned.es

SPECIALTY SECTION
This article was submitted to Quantitative Psychology and Measurement, a section of the journal Frontiers in Psychology

RECEIVED 30 November 2022
ACCEPTED 06 February 2023
PUBLISHED 01 March 2023

CITATION
Romero Reyes D, Moriano León JA and Ybarra Sagarduy JL (2023) Development and validation of the help-seeking intention scale in university students with hazardous and harmful consumption of alcohol. *Front. Psychol.* 14:1112810. doi: 10.3389/fpsyg.2023.1112810

Development and validation of the help-seeking intention scale in university students with hazardous and harmful consumption of alcohol

Daniela Romero Reyes[1]*, Juan Antonio Moriano León[2] and José Luis Ybarra Sagarduy[3]

[1]International Doctoral School, Universidad Nacional de Educación a Distancia (UNED), Madrid, Spain, [2]Department of Social and Organizational Psychology, Faculty of Psychology, Universidad Nacional de Educación a Distancia (UNED), Madrid, Spain, [3]Academic Unit of Social Work and Sciences for Human Development, Universidad Autónoma de Tamaulipas, Ciudad Victoria, Tamaulipas, Mexico

Introduction: The Theory of Planned Behavior (TPB) has been proposed as suitable to study help-seeking intentions. This paper aims to develop the IH-RHAC scale (Help-seeking intention in young adults with hazardous and harmful alcohol consumption) with the TPB. The objectives of the study were: (a) to analyze the structure, reliability, and validity of the instrument, (b) to identify whether attitude, subjective norm, self-efficacy, and past help-seeking would predict help-seeking intention, and (c) to assess concurrent validity.

Methods: From a total of 2,011 students who responded to the surveys, the sample was made up of 263 university students aged 18 to 29 with hazardous and harmful alcohol consumption practices, who responded to an online questionnaire including the AUDIT, IH-RHAC, and a scale of barriers and resources for alcohol consumption. Partial least squares structural equations (PLS-SEM) were used to test the hypotheses about reliability, validity of the scales, and prediction of the constructs: attitude, subjective norms, self-efficacy, and help-seeking in the past about intention. Pearson's correlations were used to obtain evidence of concurrent validity.

Results: The results displayed favorable psychometric characteristics. The internal measurement model showed that attitude, self-efficacy, and prior help-seeking predicted a 27% help-seeking variance. Subjective norm did not predict intention.

Discussion: It has been concluded that this is an instrument with psychometric support that can contribute to designing and/or evaluating interventions that promote the students' search for help.

KEYWORDS

Theory of Planned Behavior, hazardous consumption of alcohol, harmful consumption of alcohol, university students, help-seeking

Introduction

Hazardous and harmful consumption of alcohol in university students is a public health problem (Davoren et al., 2016; Charles et al., 2021) that can have serious consequences in the lives of young adults (Krieger et al., 2018). A systematic review reported a median

prevalence of harmful alcohol use in Latin American students of 26.2 (Rangel et al., 2017). In Mexico, young adults between the ages of 18 and 29 have the highest per capita alcohol consumption (7.6 liters) (Villatoro-Velázquez et al., 2017). In another study carried out with 19,815 Mexican university students, the prevalence of alcohol consumption was 55.5%. These young adults showed a greater probability of consuming illegal drugs (Gogeascoechea-Trejo et al., 2021).

Hazardous alcohol consumption expresses a pattern that leads to the risk of harmful physical, mental, and/or social consequences for the user (Babor and Higgins-Biddle, 2001). The International Classification of Diseases (ICD-11) states that a pattern of harmful use of alcohol can be continuous or episodic, causing damage to the mental and physical health of that person and/or other people. This type of classification seeks to help identify the negative impact of substance use early (Bobes et al., 2019).

Hazardous and harmful consumption of alcohol can be addressed through brief interventions aimed at reducing harmful consumption (Babor et al., 2001); however, in the university context, few young adults seek help (Codd and Cohen, 2003; Cellucci et al., 2006; Caldeira et al., 2009; Lowinger, 2012). Given this situation, carrying out research on the psychosocial factors that predict help-seeking is highly relevant.

Seeking help for health issues is a planned behavior. Furthermore, the attempt to solve the problem involves interacting with a healthcare professional (Cornally and McCarthy, 2011). According to Belló et al. (2008) help-seeking is the request for assistance from a person or institution to discuss alcohol consumption problems. Early help-seeking leads to early exposure to healthcare services that can alter the progression of use and prevent unfavorable consequences (Bhochhibhoya et al., 2015; Mota et al., 2019).

Instruments have been developed from various approaches to identify variables related to seeking help for alcohol consumption in university students. Some of them have addressed the stigma associated with seeking psychological help (Cellucci et al., 2006; Vogel et al., 2006), willingness to seek help (Lowinger, 2012), the probability of participating in treatment options (Buscemi et al., 2010), and the barriers to and resources for seeking help (Salazar et al., 2020).

The search for help for alcohol consumption in university students has been linked to numerous variables, however, these links have not been studied under a unified theoretical model (Salazar et al., 2020). A psychological aspect of the help-seeking process is intention (Tomczyk et al., 2020). For White et al. (2018), the help-seeking intention can be defined as a plan that implies an effort to express a problem in an attempt to get support to reduce one's discomfort. The authors recognize that the Theory of Planned Behavior (TPB) is a complete model that covers the elements mentioned in the definition of the construct, so it is useful to study the help-seeking intention of young adults with hazardous and harmful alcohol consumption.

Moreover, the TPB is strongly supported by empirical evidence (Armitage and Conner, 2001; Cooke and French, 2008). It is highly accurate in predicting intentions of behavior through: attitude, subjective norm, and perceived behavioral control. The attitude refers the degree to which a person has a favorable or unfavorable evaluation of a behavior, and its antecedent is the behavioral beliefs that are beliefs about the possible consequences and experiences related to the behavior; the subjective norm indicates the perceived social pressure of important referents to perform or not perform a certain behavior, and it is preceded by normative beliefs that are beliefs about the normative expectations of significant other people; perceived behavioral control is described as the perceived ease or difficulty of performing a behavior and its antecedent are the control beliefs that are beliefs about the presence of factors that facilitate or impede the execution of the behavior (Ajzen, 1991).

The TPB is a reformulation of the Theory of Reasoned Action (Ajzen and Fishbein, 1980), and it includes perceived behavioral control, which is like self-efficacy and can be operationalized as such according to the needs of the study (Ajzen, 2002b) since that both refer to the perceived ability to perform a specific behavior (Bandura, 1982). The TPB proposes that the more favorable the attitude and the subjective norm and the greater the perceived behavioral control, the stronger the intention to perform the behavior, (Ajzen, 1991). In this way we can hypothesize that the intention to seek help would be preceded by attitudes, subjective norms, and perceived behavioral control (operationalized as self-efficacy). According to this theory, the intention represents the immediate antecedent of the behavior (Ajzen, 2002a), in this case the help-seeking behavior. Since the TPB was originally formulated, studies have been carried out to predict treatment seeking or retention in substance use disorder patients (Kleinman et al., 2002; Kelly et al., 2011, 2016; Vederhus et al., 2015; Zemore et al., 2021). Codd and Cohen (2003) worked from the Theory of Reasoned Action with university students, finding that the attitude and the subjective norms predicted a 12% variance in help-seeking intentions. However, they recommended using the TPB by integrating perceived behavioral control, a variable that could have a greater influence on help-seeking intention.

According to the literature, one predictor of treatment seeking in alcoholism is prior help seeking (Finney and Moos, 1995). Freyer et al. (2007) found that people who sought help in the past were 4.6 times more likely to attend self-help groups, 7.6 times more likely to go through detoxification, and 8.7 times more likely to be involved in outpatient treatment. Although their study covered a broad spectrum of users, the authors recommended conducting research on at-risk or harmful users to design timely early interventions. Based on the TPB, a measure of past behavior can be included to improve prediction of future actions (Ajzen, 2002c; Hagger et al., 2018).

The TPB offers a convenient conceptual framework: its constructs shed light on specific behaviors in particular contexts (Ajzen, 1991). Therefore, this study aims to develop a psychometric scale called IH-RHAC (Help-seeking intention in young adults with hazardous and harmful alcohol consumption) based on the TPB that assesses attitudes, subjective norms, perceived behavioral control (assessed through self-efficacy), and the help-seeking intention of young adults with hazardous alcohol consumption. The objectives of this study are (a) to analyze the structure, reliability, and validity of the instrument's scales and (b) to identify if attitude, subjective norms, and self-efficacy will predict help-seeking intention. To do so, the work was guided by the following hypotheses (see **Figure 1**).

> Hypothesis 1. Attitude will be positively related to help-seeking intentions.

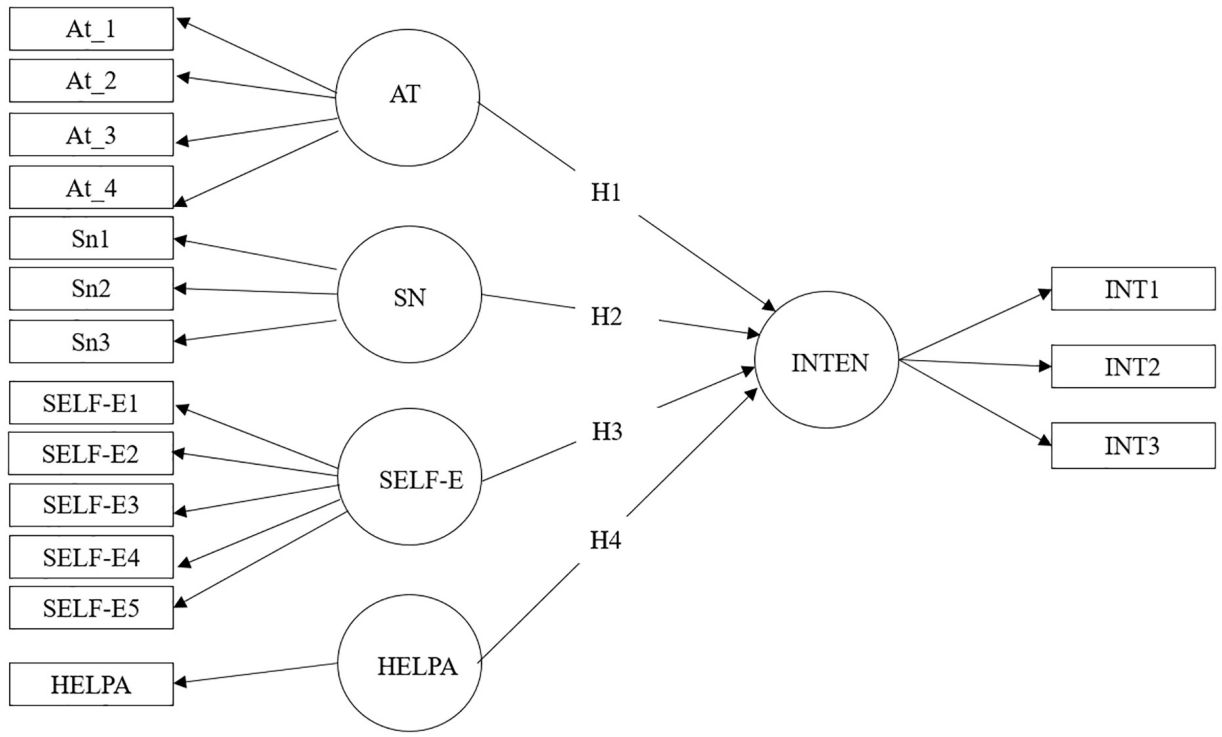


FIGURE 1
Theoretical model and hypothesis. At_1 = attitude 1 [(item 1 × item 5)/5], At_2 = attitude 2 [(item 2 × item 6)/5], At_3 = attitude 3 [(item 3 × item 7)/5], At_4 = attitude 4 [(item4 × item8)/5]; SN1 = subjective norm 1 [(item 1 × item 4)/5], SN2 = subjective norm 2 [(item 2 × item 5)/5], SN3 = subjective norm 3 [(item 3 × item 6)/5]; AT, attitude; SN, subjective norm; SELF-E, self-efficacy; HELPA, help-seeking in the past; INT, intention.

> Hypothesis 2. Subjective norm will be positively related to help-seeking intention.

> Hypothesis 3. Self-efficacy will be positively related to help-seeking intention.

> Hypothesis 4. Past help-seeking will be positively related to help-seeking intention.

Materials and methods

Design

The aim of this instrumental study is to develop a scale to assess help-seeking and emphasis its psychometric properties (Ato et al., 2013).

Sample

From a total of 2,011 students who responded to the surveys, we worked with a convenience sample of 263 students from two public universities in northeastern Mexico: 135 men and 128 women with an average age of 20.89 (SD = 2.24). The inclusion criteria were: (a) being 18 to 29 years old, (b) being a Mexican university student, (c) voluntary participation, (d) obtaining a score equal to or greater than five points in the Alcohol Use Disorders Identification Test (AUDIT, Saunders et al., 1993). The exclusion criteria were: (a) young adults who did not agree to participate in the study and (b) young adults with an AUDIT score below 5. Most of the participants (95.8%) reported being single, 39.2% reported studying a degree in the humanities and behavioral sciences, 85.2% indicated they lived with their parents, 48.7% mentioned they work in addition to studying. The median family monthly income was $424.90 (USD).

Procedure

The corresponding permission was requested from the university authorities who in the academic committee approved the study. From 8 February 2021 to September 27 of that same year data was collected electronically by sharing the instruments on social media such as WhatsApp. A total of 2,011 students answered the surveys, of which 184 (9.14%) did not agree to participate in the study. Of the remaining 1,827 participants, only 318 met the hazardous and harmful consumption of alcohol criteria (AUDIT $\geq$ 5), of which 41 (12.89%) were cases with missing data, leaving a base of 277 complete cases. These were adjusted to the age criterion (18 to 29 years old), resulting in 263 complete cases suitable for statistical analysis.

Instruments

Sociodemographic data sheet

The data sheet was built *ad hoc* by the researchers to obtain sociodemographic information for a detailed description of the sample.

Alcohol Use Disorders Identification Test (AUDIT)

This instrument is for international use and is validated in Mexico (Medina-Mora et al., 1998). This test identifies hazardous, harmful consumption and possible alcohol dependence through a 10-item questionnaire (Saunders et al., 1993). Each question has a series of options that are scored from 0 to 4. Scores equal to or greater than 8 indicate harmful consumption. A more rigorous interpretation can be made when analyzing the scored answers: a score equal to or greater than 1 in items 2 and 3 indicates hazardous consumption and a score above 0 in items 4–6 suggests the beginning of dependency (Babor et al., 2001). In this study, a score of 5 or more was considered to identify young adults with hazardous and harmful alcohol consumption. In research with students, this instrument has shown adequate internal consistency of up to 0.92 (Moral et al., 2017).

Help-seeking intention in young adults with hazardous and harmful alcohol consumption questionnaire (IH-RHAC)

The IH-RHAC measure is based on the TPB (Ajzen, 1991). The instrument was elaborated following the conceptual and methodological guidelines of Ajzen (2002a) for the construction of TPB questionnaires. The author establishes that measures based on beliefs can be designed, which contribute to explain the behavior not only to predict it. Theoretically the outstanding beliefs will be the determinants of a person's intentions and actions: behavioral beliefs (precede attitude), normative beliefs (precede the subjective norm), and control beliefs (integrate perceived behavioral control) (Ajzen, 1991). For the creation of measures based on beliefs, Ajzen (2002a) recommends carrying out a pilot study to identify the salient beliefs of a sample of the target population; not doing so would imply the risk of arbitrarily including beliefs in the instruments that are not necessarily they would represent the beliefs of that population and compromise the quality of the scales (Ajzen, 1991).

Therefore, in a previous study, the behavioral, normative, and control beliefs underlying the help-seeking intention of college students with hazardous and harmful alcohol use were identified Following Ajzen's (2002a) proposal, respondents from the previous study were given a description of the help-seeking behavior, followed by a series of open-ended questions about the advantages and disadvantages they considered about help-seeking (to obtain the behavioral beliefs), about the identity of the relevant referent individuals or groups that could approve or disapprove of their help-seeking (in this way the normative beliefs were obtained) and finally the factors or circumstances that would facilitate or hinder their behavior help-seeking (thus obtaining control beliefs).

Continuing with the procedure, those beliefs that were more frequent or that were significantly related to the intention to seek help were used to elaborate the items of the subscales of attitude, subjective norm, and perceived behavioral control. In this way the outstanding beliefs of the university students provided the basis for the formation of the preliminary questionnaire. Behavioral and normative beliefs were measured using the expectation-value model (Ajzen, 1991, 2002a) where the strength of the items that measure behavioral beliefs are combined in a multiplicative manner with the evaluation of the results, which generates a single attitude score. The strength of normative beliefs was multiplied by the motivation to comply resulting in the subjective norm. Perceived behavioral control was operationalized as self-efficacy. Then a pilot study was carried out where the preliminary scale was applied to 27 university students. The results of the piloting allowed us to identify the need to adjust the response options of the subjective norm scale, changing "strongly disagree-strongly agree" to "not at all agree–totally agree" to help participants understand the options better.

The final instrument aims to measure help-seeking intention and attitude, subjective norm, and perceived behavioral control (operationalized as self-efficacy) based on the beliefs underlying these constructs: behavioral beliefs, normative beliefs, respectively, including the variable seeking help in the past. The scale is composed of five sections: (a) attitude, (b) subjective norm, (c) self-efficacy, (d) help-seeking intentions, and (e) past help-seeking. Responses were scored on a Likert-type scale from 1 to 5 (see **Supplementary material** and **Table 1**).

(a) Attitude was assessed by means of eight items on beliefs about the consequences of seeking help and their assessment. This subscale had two dimensions: the four items of the first block measured the strength of the behavioral belief, for example: "Indicate to what extent you consider that seeking help to solve problems with alcohol consumption would help you learn to regulate consumption" with a Likert-type response scale from 1 (not at all) to 5 (a lot). The second dimension consisted of the evaluation of the results of these beliefs through four items, for example: "Now please indicate to what extent the following aspects are important to you in your life: learning to regulate consumption." They were measured with a Likert-type response scale from 1 (not important at all) to 5 (very important). In this way, two people can have the same strength in a belief–"learn to regulate consumption"–, but they will be able to assess its result in a different way. For one it may be very important to learn to regulate consumption and for another it may not. The two dimensions were combined multiplicatively to obtain a single score, as can be seen in the following formula:

$$Attitude = (\sum_{1}^{n} Attitude_n)/(n.items) = \quad (1)$$
$$[(item1 \times item5)/5 + (item2 \times item6)/5 +$$
$$(item3 \times item7)/5 + (item4 \times item8)/5]/4$$

(b) The subjective norms were composed of two dimensions. The first was the strength of normative beliefs regarding the expectations of people close to the respondent: parents, siblings, friends, or partners. It consisted of three items, for example: "Please now think about the people who are closest to you. To what degree would they agree if you sought help for your alcohol consumption?" measured on a five point Likert type scale: 1 (do not agree) to 5 (totally agree). The

TABLE 1 Dimensions and items of the IH-RHAC scale.

Dimensions	Items	Contents
Attitude		Section A. Indicate to what extent you consider that seeking help to solve problems with alcohol consumption would help you to:
	1	Learn to regulate alcohol consumption
	2	Improve my quality of life
	3	Stop drinking alcohol
	4	Make better decisions
		Now please indicate to what extent the following aspects are important to you in your life:
	5	Learn to regulate alcohol consumption
	6	Improve my quality of life
	7	Stop drinking alcohol
	8	Make better decisions
Subjective norm		Section B. Now please think about the people who are closest to you, to what degree would they agree if you sought help for your alcohol consumption?
	1	My parents and siblings
	2	My close friends
	3	My partner
		And how do you rate the opinion of these people in relation to seeking help for your alcohol consumption? I consider it…
	4	My parents and siblings
	5	My close friends
	6	My partner
Self-efficacy		Section C. To what degree do you think you would be able to perform each of the following behaviors?
	1	Obtain information about centers specialized in treating alcohol consumption
	2	Attend centers specialized in treating alcohol consumption
	3	Participate in an online program to treat alcohol consumption
	4	Contact a healthcare professional (psychologist, therapist) to treat alcohol consumption
	5	Seek support from my family and/or friends to help me with my alcohol use problem.
Intention		Section D.
	1	Do you intend to seek help for your alcohol consumption during the next month?
	2	Do you plan to seek help for your alcohol consumption?
	3	If you had the opportunity, would you want to seek help for your alcohol consumption?
		Section E.
Help-seeking in the past	1	Have you sought help in the past for your alcohol consumption?

second dimension was the motivation to meet normative expectations, made up of three items, for example: "How much do you value the opinion of these people in relation to seeking help for your alcohol consumption?" This was also evaluated with a five point Likert scale, where 1 represented not at all important and 5 very important. These dimensions were combined multiplicatively to obtain a single score, as shown in the following formula:

$$Subjetive\_norm = (\sum_{1}^{n} SN_N)/(n.items) = \quad (2)$$

$$[(item1 \times item4)/5 + (item2 \times item5)/5 +$$

$$(item3 \times item6)/5]/3$$

(c) Auto-efficacy for help-seeking was composed of five items which sought to find out the degree in which young adults felt capable of carrying out certain behavioral tasks, like "obtaining information on treatment centers specializing in alcohol abuse." For the evaluation we used a five point Likert scale where 1 represented incapable and 5 fully capable.

(d) Help-Seeking intention was composed of three items with the aim of identifying help-seeking intentions for alcohol consumption, like, for example, "If you had the opportunity, would you want to seek help for your alcohol consumption?" Its evaluation was measured using a five point Likert scale, where 1 meant definitely not and 5 -definitely.

(e) Help-Seeking in the past was evaluated by means of the question "Have you sought help in the past for your alcohol consumption?" with a dichotomous response of "yes" or "no."

Barriers and resources for help-seeking in changing alcohol consumption by university students

The instrument was used to measure concurrent validity. This Mexican-designed test evaluates the barriers and environmental resources related to help-seeking in university students with excessive alcohol consumption (Salazar et al., 2020). It consists of two scales. The first is barriers, composed of nine items distributed into three factors: standard of morality, lack of social support from parents/social stigma, and lack of social support from peers. The second is scale of resources, composed of 12 items distributed in four factors: health systems and social support, negative consequences, parent/friend rejection, and parent/partner rejection. In young Mexican university students, the instrument obtained Cronbach's Alpha of 0.86 for the barriers scale and 0.84 for the resources scale.

Data analysis

The descriptive analysis of the data was carried out using SPSS version 21 to obtain the means, standard deviations, correlations, asymmetry, and kurtosis. Robust methods were used due to the non-normality of the distribution of the variables (Hair et al., 2019). The missing data were analyzed with Little's MCAR test, which showed that the missing data were completely random (X2 = 394.358, gl. 521, $p > 0.05$). Therefore, the listwise deletion method was used, not including the records with missing data (Bentler, 2006). Next, partial least squares structural equations (PLS-SEM) were used to test hypotheses 1–4 raised in the study. PLS-SEM is a non-parametric technique for analyzing pathway models that are based on compounds. This method is recommended when the analysis is attempting to test the prediction of a theoretical framework, when the structural model is complex, i.e., composed of a considerable number of constructs and/or model relations, or when the route model is made up of one or more constructs formatively measured. It is also a robust method that offers solutions to small or large sample sizes and with abnormal distributions (Hair et al., 2019). The SmartPLS version 3 software was used.

The PLS-SEM analyzes are carried out in two phases. First, the external measurement model is evaluated where reliability is obtained through Cronbach's Alpha, internal and convergent validity through the average variance extracted (AVE), and discriminant validity with the Fornell-Larcker criterion and the ratio HTML. The second phase consisted of evaluating the internal model, where the proposed hypotheses are tested (Martínez and Fierro, 2018; Hair et al., 2019). To obtain concurrent validity of the IH-RHAC scales with the barriers and resources scales, Pearson's correlations were used through SPSS.

Transparency and openness

We report how the sample was formed, data exclusions, all study measures, and follow the Journal Article Reporting Standards (JARS) recommendations (Appelbaum et al., 2018; Kazak, 2018). Data, analysis code, and research materials are available to applicants by writing an email to the author. Data were analyzed using SPSS version 21 and SmartPSL version 3. The design of this study and its analysis were not registered previously.

Ethical considerations

The protocol was reviewed and accepted by an academic committee made up of the directors, research secretaries, and academic secretaries of the universities who authorized the instruments to be disseminated among the young adults. The participants read an informed consent beforehand in which the purpose of the study was explained to them, emphasis was placed on their freedom to stop or abandon the study at any time during the application without any consequence, and they were informed that the data collected would only be used within the context of the research.

Results

External measurement model

The measurement model shows the relationships between the latent variables and their indicators. The external measurement model consisted of the constructs of attitude, subjective norms, self-efficacy, past help-seeking, and intention. The individual reliability of each indicator was obtained by analyzing the loads with their latent variable. The relationships of all the indicators with their variables showed loads greater than 0.86, representing strong loads, since standardized external loads (λ) greater than 70 are considered adequate (Carmines and Zeller, 1979). Internal consistency using Cronbach's Alpha was favorable for the latent variables: attitude (0.93), subjective norms (0.92), self-efficacy (0.95), intention (0.90). The average variance extracted (AVE) shows evidence of internal and convergent validity: the AVE must be = or >0.50 and indicates the variance that each construct acquires from its indicators in relation to the variance caused by the measurement error. The constructs obtained an adequate AVE of 0.83 for attitude, 0.87 for subjective norms, 0.87 for self-efficacy, 1.00 for help-seeking in the past, and 0.83 for intention (see **Table 2**).

The Fornell-Larcker criterion was used to obtain discriminant validity, which considers that the square root of the AVE of an item should be greater than its correlation with other items. In this instrument, the loads of the indicators in their corresponding construct were greater than the cross loads with other constructs and the square root of the AVE of each construct is greater than the correlations with the others, as can be seen in **Table 3**.

According to Henseler et al. (2015), the HTMT ratio better identifies the lack of validity. There are discriminant validity problems when the HTMT value is above the 0.90 threshold. In this study, all the constructs obtained a HTMT value below 0.85, which is an even more conservative limit, thus showing adequate discriminant validity (see **Table 4**).

Finally, the maximum values of the variance inflation factor (VIF) were 8.18 for indicator 2 of self-efficacy, so the decision was made to eliminate it from the instrument, after which 5.60 was

TABLE 2 Factor loadings and reliability.

Latent variable	Item	λ	AVE	Composite reliability	Cronbach's Alpha
Attitude	At_1	0.92	0.83	0.95	0.93
	At_2	0.88			
	At_3	0.93			
	At_4	0.90			
Subjective norms	SN1	0.93	0.87	0.95	0.92
	SN2	0.94			
	SN3	0.92			
Self-efficacy	SELF-E1	0.93	0.87	0.96	0.95
	SELF-E3	0.94			
	SELF-E4	0.94			
	SELF-E5	0.92			
Help-seeking	HELPA	1	1	1	1
Intention	INT1	0.94	0.83	0.93	0.92
	INT2	0.93			
	INT3	0.86			

λ = factor loadings, AVE = average variance extracted; At_1 = attitude 1 [(item 1 × item 5)/5], At_2 = attitude 2 [(item 2 × item 6)/5], At_3 = attitude 3 [(item 3 × item 7)/5], At_4 = attitude 4 [(item 4 × item 8)/5]; SN1 = subjective norm 1 [(item 1 × item 4)/5], SN2 = subjective norm 2 [(item 2 × item 5)/5], SN3 = subjective norm 3 [(item 3 × item 6)/5]; SELF-E, self-efficacy; HELPA, help-seeking in the past; INT, intention.

obtained for indicator 4 of self-efficacy, and 5.26 for indicator 3 of self-efficacy. All the others remained under five so it was concluded that there were no multicollinearity problems.

Descriptive results and correlations between variables

Descriptive statistics related to means and standard deviations are shown in Table 5. Pearson's correlation matrix reveals provisional support for the hypotheses. Attitude, subjective norm, self-efficacy, and help-seeking in the past were positively associated with help-seeking intention ($r = 0.32$, $p < 0.05$; $r = 0.28$, $p < 0.05$; $r = 0.35$, $p < 0.05$, $r = 0.33$, $p < 0.05$).

Internal measurement model: Hypothesis test

The relationships between all the variables proposed in the model can be seen in Figure 2. Attitude is significantly related to intention (ß = 0.22, $p < 0.001$), admitting H1. Subjective norms were not significantly related to intention so H2 was rejected, self-efficacy was significantly associated with intention (ß = 0.20, $p < 0.001$) supporting H3, past help-seeking was significantly associated with intention (ß = 0.32, $p < 0.001$) affirming H4. This general model explained 27% of the variance in help-seeking intention (see Table 6).

The predictive relevance of the PLS route model was evaluated with the Stone-Geisser calculations, obtaining the Q2 (Hair et al., 2019). The Blindfolding procedure ($D = 7$) and the redundancy approach with cross validation were applied and it was found that self-efficacy presented Q2 = 0.77, being the highest value, followed by attitude and subjective norm with Q2 = 0.69, followed by intention with Q2 = 0.63. The results show that the model has predictive relevance for these constructs as they are values greater than 0.

Finally, effect sizes were evaluated using f2. The effect sizes of attitude and self-efficacy on intention were small (f2 = 0.04) and the effect size of past help-seeking on intention was medium (f2 = 0.14) (see Table 7).

TABLE 3 Discriminant validity (Fornell-Larcker criterion).

Latent constructs	Self-efficacy	Attitude	HELPA	Intention	Sn
Self-efficacy	(0.93)				
Attitude	0.43	(0.91)			
HELPA	0.05	0.01	(1.00)		
Intention	0.34	0.34	0.34	(0.91)	
Subjective norms	0.52	0.53	0.01	0.28	(0.93)

The square root of the AVE is shown diagonally in parentheses.
HELPA, help-seeking in the past, Sn, subjective norm.

TABLE 4 The HTMT ratio with SmartPLS algorithm.

Construct	Self-efficacy	Attitude	HELPA	Intention
Self-efficacy				
Attitude	0.44			
HELPA	0.05	0.02		
Intention	0.37	0.35	0.36	
Subjective norm	0.55	0.57	0.03	0.30

HELPA, help-seeking in the past.

TABLE 5 Descriptive and Pearson's correlations between constructs.

Constructs	Mean	SD	1	2	3	4	5	6
1. Age	20.89	2.24						
2. Sex	1.51	0.50	0.00					
3. Attitude	2.11	1.39	0.00	0.03				
4. Subjective norm	2.64	1.57	0.01	0.12*	0.53**			
5. Self-efficacy	3.07	1.42	0.00	0.00	0.41**	0.52**		
6. HELPA	0.09	0.28	0.01	0.05	0.00	0.01	0.05	
7. Intention	1.89	1.19	0.10	0.01	0.32**	0.28**	0.35**	0.33**

*$p < 0.05$, **$p < 0.01$.
SD, standard deviation; HELPA, help-seeking in the past.

Evidence of concurrent validity of IH-RHAC with barrier and resource scales

The Pearson correlation coefficient was used to obtain concurrent validity. Attitude and intention showed significant correlation with help-seeking barriers; attitude, subjective norm,

10.3389/fpsyg.2023.1112810

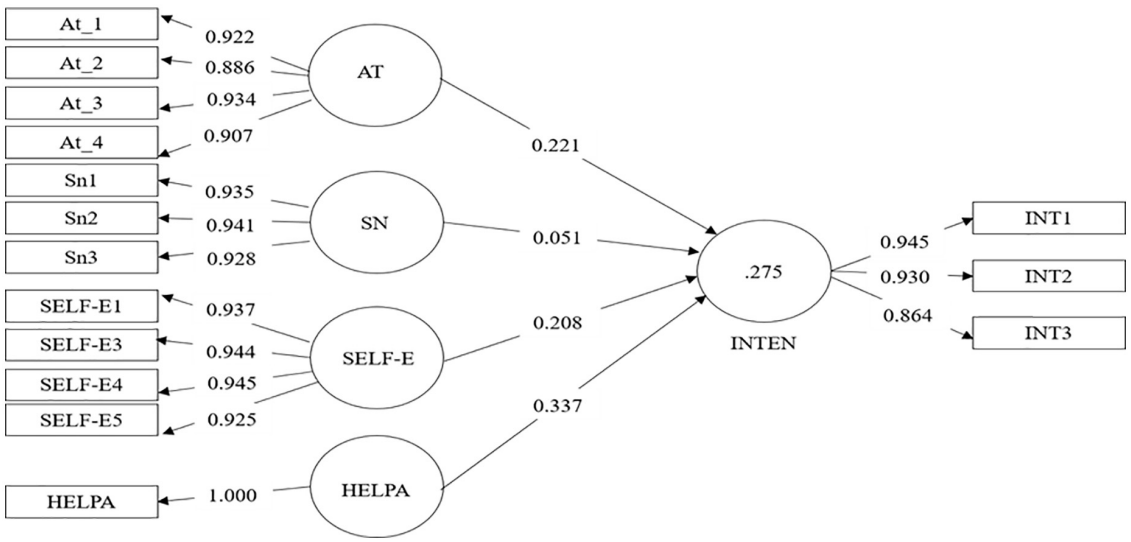


FIGURE 2
Path model estimation. At_1 = attitude 1 [(item 1 × item 5)/5], At_2 = attitude 2 [(item 2 × item 6)/5], At_3 = attitude 3 [(item 3 × item 7)/5], At_4 = attitude 4 [(item 4 × item 8)/5]; SN1 = subjective norm 1 [(item 1 × item 4)/5], SN2 = subjective norm 2 [(item 2 × item 5)/5], SN3 = subjective norm 3 [(item 3 × item 6)/5]; AT, attitude; SN, subjective norm; SELF-E, self-efficacy; HELPA, help-seeking in the past; INT, intention.

TABLE 6 Path coefficients (standardized regression coefficients).

Hypothetical relationships	Path coefficients (Standardized ß)	Student's *t*-statistic	*p*-value
At →IN	0.22	3.23	0.001
Sn →IN	0.05	0.77	0.436
Self-e →IN	0.20	3.75	0.001
HELPA →IN	0.32	4.58	0.001

At, attitude; Sn, subjective norm; Self-e, self-efficacy; HELPA, help-seeking in the past; IN, intention.

TABLE 7 f^2 effect sizes.

Exogenous constructs	Endogenous construct intention	
	Path coefficients	f^2 effects
Attitude	0.22	0.04
Self-efficacy	0.20	0.04
HELPA	0.32	0.14

HELPA, help-seeking in the past.

TABLE 8 Pearson correlations of IH-RHAC scales with barrier and resource scales.

	Attitude	Sn	Self-efficacy	HELPA	Intention
Barriers	0.15*	0.09	0.12	0.11	0.26**
Resources	0.28**	0.40**	0.41**	−0.04	0.11

*$p < 0.05$, **$p < 0.01$.
Sn, subjective norm; HELPA, help-seeking in the past.

and self-efficacy showed significant correlation with help-seeking resources (see Table 8).

When correlating the IH-RHAC scales with the barriers to alcohol consumption subscale, the attitude correlated with the absence of social support/stigma, the search for help in the past with morality standards, and the intention with the morality standards, absence of social support/stigma, and lack of family support (see Table 9).

TABLE 9 Correlations of Pearson IH-RHAC scales with barrier subscales.

	Morality	No social support and stigma	No family support
Attitude	0.10	0.15*	0.11
Subjective norm	0.06	0.09	0.08
Self-efficacy	0.08	0.11	0.11
HELPA	0.14*	0.06	0.09
Intention	0.21**	0.23**	0.27**

*$p < 0.01$, **$p < 0.05$.
HELPA, help-seeking in the past.

Attitude, subjective norms, and self-efficacy correlate with the four resource subscales. Attitude and self-efficacy have greater correlations with access to services, subjective norms with rejection from parents/friends (see Table 10).

Discussion

The objective of this study was to develop a psychometric scale from TPB that would assess attitudes, subjective norms, self-efficacy, past help-seeking, and help-seeking intentions of young adults with hazardous and harmful alcohol consumption. The specific objectives were to analyze the structure, reliability, and validity of the instrument's scales and to identify whether attitude, subjective norms, self-efficacy, and prior help-seeking would predict help-seeking intentions. According to the results,

TABLE 10 Correlations of Pearson IH-RHAC scales with resource subscales.

	Services	Conse-quences	Parent/Friends rejection	Parent/Partner rejection
Attitude	0.30**	0.23**	0.24**	0.22**
Sn	0.37**	0.35**	0.39**	0.35**
Self-efficacy	0.42**	0.31**	0.41**	0.36**
HELPA	−0.02	−0.07	−0.03	−0.04
Intention	0.14*	0.05	0.13*	0.08

*$p < 0.01$, **$p < 0.05$.
Sn, subjective norm; HELPA, help-seeking in the past.

the IH-RHAC instrument presented favorable psychometric characteristics. The reliability of each subscale was satisfactory.

Theoretical and research implications

Regarding the proposed predictive model, it was found that the attitude predicted help-seeking intentions, which is consistent with other studies that have addressed the search for treatment using TPB in substance dependent people (Kelly et al., 2011, 2016; Vederhus et al., 2015) as well as what was found in university students with mental health problems or harmful alcohol consumption (Codd and Cohen, 2003; Lee and Shin, 2022). In this study, attitude was not the strongest predictor of intention in contrast to others for which it was (Schomerus et al., 2009; Aldalaykeh et al., 2019). Subjective norms did not predict help-seeking intentions, similar to the findings in Kelly et al. (2011) and Bohon et al. (2016). There is evidence that this construct has a weaker relationship with the intention to attend screening (Cooke and French, 2008) or in university students who seek help at mental health services (Aldalaykeh et al., 2019). Attitude, subjective norms, and perceived behavioral control are expected to vary in predicting intentions according to different behaviors and situations (Ajzen, 1991). In university students with hazardous and harmful consumption of alcohol, perceived social pressure was not decisive for help-seeking intention.

Following Bohon et al. (2016), young adults may consider that their role models hold beliefs like theirs about seeking help, which contributes to understanding that subjective norms have not been predictors of intention. These results on perceived social pressure are also similar to those reported by Salazar et al. (2020) who indicated that young adults with a hazardous and harmful consumption of alcohol were surrounded by friends and relatives who drank excessively and had no social support from parents and friends in seeking help, which shows the influence of the descriptive norms that could be incorporated into the model as proposed by Kelly et al. (2011).

Self-efficacy was significantly associated with help-seeking intention. This result supports what was found in different investigations on the intention to start treatment in patients with alcohol abuse (Kelly et al., 2011) or in university students who seek help from mental healthcare services (Bohon et al., 2016; Aldalaykeh et al., 2019; Lee and Shin, 2022). In this regard, Lee and Shin (2022) suggest studying the knowledge that young adults have about the location and use of the different assistance services, since this knowledge impacts perceived behavioral control and therefore increases the intention to receive help.

Past help-seeking was the strongest predictor of help-seeking intention. Ajzen (2002c) points out that past behavior is a good predictor of subsequent behavior when attitudes and intention are ambivalent and do not offer clear guidelines for action, which could be understood when addressing a particularly sensitive issue due to stigma and social discrimination associated with alcohol use problems (Loureiro, 2013). Under these conditions including this measure in the prediction models was valuable.

The help-seeking construct can be difficult to measure. Wei et al.'s (2015) of the evaluation of knowledge, attitudes, and seeking help for mental health issues highlights the importance of validating the measurement instruments. In this sense, this scale has psychometric support, it was designed under an integrating model, it is concise and can be applied individually or collectively, in traditional or electronic format, it was created to evaluate the university population, it can be used by teachers, psychologists, and it can also be used to evaluate mental health literacy programs that promote help-seeking for alcohol-related problems.

This scale differs from others (Cellucci et al., 2006; Vogel et al., 2006; Caldeira et al., 2009; Lowinger, 2012; Salazar et al., 2020) in that it is based on a solid theoretical framework and is recommended for studying the help-seeking variable (White et al., 2018), in addition to adhering to Ajzen's (2002a) by having carried out a pilot study to identify beliefs that supported the design of its items. The results found through the model can help shape effective interventions focused on changing attitudes and increasing self-efficacies that promote the help-seeking of students from support services on or off campus.

Limitations and future lines of research

The limitations of this study were, first, not to evaluate the help-seeking behavior itself, followed by the possible effect of social desirability as it is a self-reporting instrument, and convenience sampling limits results generalization. A future line of research might be to evaluate this instrument's predictive validity. Following Lee and Shin (2022), researching young adults' knowledge of the mental healthcare services available on or off campus to check if it has an impact on perceived behavioral control and therefore on the formation of intention and help-seeking behavior would be important.

Conclusion

IH-RHAC presented adequate psychometric characteristics, evidence of its construct, convergent, discriminant, and concurrent validity was obtained, and adequate reliability indices were attained. Subsequent studies should obtain evidence of the predictive validity of the instrument by evaluating help-seeking behavior. In this paper, the advantages of using the non-parametric PLS-SEM technique to test the prediction of TPB in help-seeking behavior

were observed, a technique that allowed the researchers to acquire evidence of the instrument's construct validity.

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 Academic Committee of the Autonomous University of Tamaulipas. The patients/participants provided their written informed consent to participate in this study.

Author contributions

DR: conceptualization, methodology, investigation, writing—original draft preparation, software, and formal analysis. JM: supervision, software, formal analysis, visualization, and writing—review and editing. JY: supervision and writing—review and editing. All authors contributed to the article and approved the submitted version.

Acknowledgments

The participants are gratefully acknowledged. The authors are grateful to Jesús Antonio Martínez Salazar and Ellison Moorehead for the language proofreading services. The authors extend thanks to Universidad Nacional de Educación a Distancia, Tecnológico Nacional de México Campus Ciudad Victoria, and Universidad Autónoma de Tamaulipas for their cooperation.

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.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1112810/full#supplementary-material

References

Ajzen, I. (1991). The theory of planned behavior. *Organiz. Behav. Hum. Dec. Proc.* 50, 179–211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2002a). *Constructing a TPB questionnaire: conceptual and methodological considerations*. Available online at: http://www.people.umass.edu/aizen/ (accessed March 20, 2022).

Ajzen, I. (2002b). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *J. Appl. Soc. Psychol.* 32, 665–683. doi: 10.1111/j.1559-1816.2002.tb00236.x

Ajzen, I. (2002c). Residual effects of past on later behavior: habituation and reasoned action perspectives. *Personality Soc. Psychol. Rev.* 6, 107–122. doi: 10.1207/S15327957PSPR0602_02

Ajzen, I., and Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Hoboken, NJ: Prentice-Hall.

Aldalaykeh, M., Al-Hammouri, M. M., and Rababah, J. (2019). Predictors of mental health services help-seeking behavior among university students. *Cogent Psychol.* 6:1660520. doi: 10.1080/23311908.2019.1660520

Appelbaum, M., Cooper, H., Kline, R. B., Mayo-Wilson, E., Nezu, A. M., and Rao, S. M. (2018). Journal article reporting standards for quantitative research in psychology: the APA publications and communications board task force report. *Am. Psychol.* 73, 3–25. doi: 10.1037/amp0000191

Armitage, C. J., and Conner, M. (2001). Efficacy of the theory of planned behaviour: a meta-analytic review. *Br. J. Soc. Psychol.* 40, 471–499. doi: 10.1348/014466601164939

Ato, M., López-García, J. J., and Benavente, A. (2013). A classification system for research designs in psychology. *Ann. Psychol.* 29, 1038–1059. doi: 10.6018/analesps.29.3.178511

Babor, F. T., and Higgins-Biddle, J. C. (2001). *Brief intervention for risky and harmful alcohol consumption. A manual for use in primary care*. Geneva: World Health Organization.

Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., and Monteiro, M. G. (2001). *The alcohol use disorders identification test guidelines for use in primary care*. Geneva: World Health Organization.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *Am. Psychol.* 37, 122–147. doi: 10.1037/0003-066X.37.2.122

Belló, M., Puentes-Rosas, E., and Medina-Mora, I. M. E. (2008). The role of gender in the demand for care for problems associated with alcohol consumption in Mexico. *Pan Am. J. Public Health* 23, 231–236. doi: 10.1590/s1020-49892008000400002

Bentler, P. M. (2006). EQS 6: structural equation program manual. Encino, CA: Multivariate Software.

Bhochhibhoya, A., Hayes, L., Branscum, P., and Taylor, L. (2015). The use of the internet for prevention of binge drinking among the college population: a systematic review of evidence. *Alcohol Alcohol.* 50, 526–535. doi: 10.1093/alcalc/agv047

Bobes, B. M. T., Flórez, G., Seijo, P., and Bobes, G. J. (2019). Does ICD-11 improve the epidemiological and nosological purposes of mental, behavioral and developmental disorders? *Adicciones* 31, 183–188. doi: 10.20882/adicciones.1368

Bohon, L. M., Cotter, K. A., Kravitz, R. L., Cello, P. C. Jr., and Garcia, E. (2016). The theory of planned behavior as it predicts potential intention to seek mental health services for depression among college students. *J. Am. Coll. Health* 64, 593–603. doi: 10.1080/07448481.2016.1207646

Buscemi, J., Murphy, J. G., Martens, M. P., McDevitt-Murphy, M. E., Dennhardt, A. A., and Skidmore, J. R. (2010). Help-seeking for alcohol-related problems in college students: correlates and preferred resources. *Psychol. Addict. Behav.* 24, 571–580. doi: 10.1037/a0021122

Caldeira, K. M., Kasperski, S. J., Sharma, E., Vincent, K. B., O'Grady, K. E., Wish, E. D., et al. (2009). College students rarely seek help despite serious substance use problems. *J. Subst. Abuse Treat.* 37, 368–378. doi: 10.1016/j.jsat.2009.04.005

Carmines, E., and Zeller, R. (1979). *Reliability and validity assessment*. Thousand Oaks, CA: SAGE Publications.

Cellucci, T., Krogh, J., and Vik, P. (2006). Help seeking for alcohol problems in a college population. *J. General Psychol.* 133, 421–433. doi: 10.3200/GENP.133.4.421-433

Charles, N. E., Strong, S. J., Burns, L. C., Bullerjahn, M. R., and Serafine, K. M. (2021). Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. *Psychiatry Res.* 296:113706. doi: 10.1016/j.psychres.2021.113706

Codd, R. T., and Cohen, B. N. (2003). Predicting college student intention to seek help for alcohol abuse. *J. Soc. Clin. Psychol.* 22, 168–191. doi: 10.1521/jscp.22.2.168.22877

Cooke, R., and French, D. P. (2008). How well do the theory of reasoned action and theory of planned behaviour predict intentions and attendance at screening programmes? A meta-analysis. *Psychol. Health* 23, 745–765. doi: 10.1080/08870440701544437

Cornally, N., and McCarthy, G. (2011). Help-seeking behaviour: a concept analysis. *Int. J. Nurs. Pract.* 17, 280–288. doi: 10.1111/j.1440-172X.2011.01936.x

Davoren, M. P., Demant, J., Shiely, F., and Perry, I. J. (2016). Alcohol consumption among university students in Ireland and the United Kingdom from 2002 to 2014: a systematic review. *BMC Public Health* 16:113706. doi: 10.1186/s12889-016-2843-1

Finney, J. W., and Moos, R. H. (1995). Entering treatment for alcohol abuse: a stress and coping model. *Addiction* 90, 1223–1240. doi: 10.1046/j.1360-0443.1995.90912237.x

Freyer, J., Coder, B., Bischof, G., Baumeister, S. E., Rumpf, H., John, U., et al. (2007). Intention to utilize formal help in a sample with alcohol problems: a prospective study. *Drug Alcohol Dep.* 87, 210–216. doi: 10.1016/j.drugalcdep.2006.08.018

Gogeascoechea-Trejo, M. D. C., Blázquez-Morales, M. S., Pavón-León, P., and Ortiz León, M. C. (2021). Alcohol consumption in university students as a predictor for the consumption of other drugs. *Health Addict.* 21:569. doi: 10.21134/haaj.v21i1.569

Hagger, M. S., Polet, J., and Lintunen, T. (2018). The reasoned action approach applied to health behavior: role of past behavior and tests of some key moderators using meta-analytic structural equation modeling. *Soc. Sci. Med.* 213, 85–94. doi: 10.1016/j.socscimed.2018.07.038

Hair, J. F., Risher, J. J., Sarstedt, M., and Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev.* 31, 2–24. doi: 10.1108/EBR-11-2018-0203

Henseler, J., Ringle, C., and Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* 43, 115–135. doi: 10.1007/s11747-014-0403-8

Kazak, A. E. (2018). Editorial: journal article reporting standards. *Am. Psychol.* 73:263. doi: 10.1037/amp0000263

Kelly, P. J., Deane, F. P., McCarthy, Z., and Crowe, T. P. (2011). Using the theory of planned behaviour and barriers to treatment to predict intention to enter further treatment following residential drug and alcohol detoxification: a pilot study. *Addict. Res. Theory* 19, 276–282. doi: 10.3109/16066359.2011.564690

Kelly, P. J., Leung, J., Deane, F. P., and Lyons, G. C. (2016). Predicting client attendance at further treatment following drug and alcohol detoxification: theory of planned behaviour and implementation intentions. *Drug Alcohol Rev.* 35, 678–685. doi: 10.1111/dar.12332

Kleinman, B. P., Millery, M., Scimeca, M., and Polissar, N. L. (2002). Predicting long-term treatment utilization among addicts entering detoxification: the contribution of help-seeking models. *J. Drug Issues* 32, 209–230. doi: 10.1177/002204260203200109

Krieger, H., Young, C. M., Anthenien, A. M., and Neighbors, C. (2018). The epidemiology of binge drinking among college-age individuals in the united states. *Alcohol Res. Curr. Rev.* 39, 23–30.

Lee, J. Y., and Shin, Y. J. (2022). Using the theory of planned behavior to predict korean college students' help-seeking intention. *J. Behav. Health Serv. Res.* 49, 76–90. doi: 10.1007/s11414-020-09735-z

Loureiro, L. M. D. J. (2013). Personal and perceived stigma about alcohol abuse and intention to seek help. *Rev. De Enferm. Ref.* 3, 59–66.

Lowinger, R. J. (2012). College students' perceptions of severity and willingness to seek psychological help for drug and alcohol problems. *Coll. Stud. J.* 46, 829–833.

Martínez, A. M., and Fierro, M. E. (2018). Application of the PLS-SEM technique in knowledge management: a practical technical approach. *RIDE Rev. Iberoamericana Para La Invest. Y El Des. Educ.* 8, 130–164. doi: 10.23913/ride.v8i16.336

Medina-Mora, E., Carreño, S., and De la Fuente, J. R. (1998). "Experience with the alcohol use disorders identification test (AUDIT) in Mexico," in *Recent developments in alcoholism*, Vol. 14, ed. M. Galanter (Springer), 383–396. doi: 10.1007/0-306-47148-5_19

Moral, J. M., Bringas, M. C., Ovejero, B. A., Morales, Q. L. A., and Rodríguez, D. F. J. (2017). Social and health emergency in risky alcohol consumption and symptoms of dependence in young people. *Health Addict.* 17, 91–99. doi: 10.21134/haaj.v17i2.307

Mota, R. T., Fuentes-Mejía, C., Belchior, M. D. C., Pinto, G. H., León, F. M., and Cruvinel, E. (2019). Brief interventions for substance abuse in Latin America: a systematic review. *Psychol. Study* 24:44393. doi: 10.4025/psicolestud.v24i0.44393

Rangel, C. L. G., Gamboa, D. E. M., and Murillo, L. A. L. (2017). Prevalence of modifiable behavioral risk factors associated to non-communicable diseases in Latin American college students: a systematic review. *Nutr. Hospit.* 34, 1185–1197. doi: 10.20960/nh.1057

Salazar, G. M. L., Pantoja, V. J. A., Vacio, M. M. A., Ramírez, G. J. A., and Jurado, C. S. (2020). Scales that evaluate barriers and environmental resources to seek help in university students who drink alcohol. *Health Addict.* 20, 52–67. doi: 10.21134/haaj.v20i1.467

Saunders, J. B., Aasland, O. G., Babor, T. F., De la Fuente, J. R., and Grant, M. (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction* 88, 791–804. doi: 10.1111/j.1360-0443.1993.tb02093.x

Schomerus, G., Matschinger, H., and Angermeyer, M. (2009). Attitudes that determine willingness to seek psychiatric help for depression: a representative population survey applying the theory of planned behaviour. *Psychol. Med.* 39, 1855–1865. doi: 10.1017/S0033291709005832

Tomczyk, S., Schomerus, G., Stolzenburg, S., Muehlan, H., and Schmidt, S. (2020). Ready, willing and able? an investigation of the theory of planned behaviour in help-seeking for a community sample with current untreated depressive symptoms. *Prevent. Sci. Offi. J. Soc. Prevent. Res.* 21, 749–760. doi: 10.1007/s11121-020-01099-2

Vederhus, J., Zemore, S. E., Rise, J., Clausen, T., and Høie, M. (2015). Predicting patient post-detoxification engagement in 12-step groups with an extended version of the theory of planned behavior. *Addict. Sci. Clin. Pract.* 10, 1–9. doi: 10.1186/s13722-015-0036-3

Villatoro-Velázquez, J., Reséndiz-Escobar, E., Mujica-Salazar, A., Bretón-Cirett, M., Cañas-Martínez, V., Soto-Hernández, I., et al. (2017). *National survey of drug, alcohol and tobacco use 2016-2017: alcohol report*. Available online at: :https://encuestas.insp.mx/ena/encodat2017/reporte_encodat_alcohol_2016_2017.pdf (accessed May 10, 2022).

Vogel, D. L., Wade, N. G., and Haake, S. (2006). Measuring the self-stigma associated with seeking psychological help. *J. Couns. Psychol.* 53:325. doi: 10.1037/0022-0167.53.3.325

Wei, Y., McGrath, P. J., Hayden, J., and Kutcher, S. (2015). Mental health literacy measures evaluating knowledge, attitudes and help-seeking: a scoping review. *BMC psychiatry* 15:291. doi: 10.1186/s12888-015-0681-9

White, M. M., Clough, B. A., and Casey, L. M. (2018). What do help-seeking measures assess? Building a conceptualization framework for help-seeking intentions through a systematic review of measure content. *Clin. Psychol. Rev.* 59, 61–77. doi: 10.1016/j.cpr.2017.11.001

Zemore, S. E., Ware, O. D., Gilbert, P. A., and Pinedo, M. (2021). Barriers to retention in substance use treatment: validation of a new, theory-based scale. *J. Subst. Abuse Treat.* 131:108422. doi: 10.1016/j.jsat.2021.108422

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 20 July 2023
DOI 10.3389/fpsyg.2023.1171264

OPEN ACCESS

EDITED BY
Alejandro De La Torre-Luque,
Complutense University of Madrid, Spain

REVIEWED BY
Jing Zhang,
Kent State University, United States
Adelya A. Urmanche,
Mount Sinai Beth Israel, United States

*CORRESPONDENCE
Genevieve F. Dash
genevievedash@mail.missouri.edu

RECEIVED 23 February 2023
ACCEPTED 30 June 2023
PUBLISHED 20 July 2023

CITATION
Dash GF, Bryan AD, Yang M, Chung T, Hudson KA and Feldstein Ewing SW (2023) Adolescent: provider connectedness and STI risk reduction following a brief alcohol intervention: findings from a randomized controlled trial.
Front. Psychol. 14:1171264.
doi: 10.3389/fpsyg.2023.1171264

Adolescent: provider connectedness and STI risk reduction following a brief alcohol intervention: findings from a randomized controlled trial

Genevieve F. Dash[1]*, Angela D. Bryan[2], Manshu Yang[3], Tammy Chung[4], Karen A. Hudson[3] and Sarah W. Feldstein Ewing[3]

[1]Department of Psychological Sciences, University of Missouri, Columbia, MO, United States, [2]Department of Psychology and Neuroscience, University of Colorado Boulder, Boulder, CO, United States, [3]Department of Psychology, University of Rhode Island, Kingston, RI, United States, [4]Department of Psychiatry, Institute for Health, Healthcare Policy and Aging Research, Rutgers, The State University of New Jersey, New Brunswick, NJ, United States

Objective: Given the frequent co-occurrence between alcohol use and sexual behavior among adolescents, alcohol interventions may play a role in helping prevent sexually transmitted infections (STIs) in this age group. Psychotherapy "common factors" are one potential active ingredient in intervention efficacy. Thus, the purpose of this study was to evaluate the influence of a critical common factor, adolescent: provider connectedness, on STI risk reduction at 3months post-intervention.

Methods: Community-based youth (*N*=168) were randomized to two 60-min individual sessions of either motivational interviewing (MI) or brief adolescent mindfulness (BAM). Logistic regressions predicted post-intervention positive STI from adolescent: provider connectedness, intervention condition, and their interaction. Path analytic models tested post-intervention hazardous drinking as a mediator of the association between adolescent: provider connectedness and reduction in STI risk at 3-month follow-up.

Results: Stronger adolescent: provider connectedness reduced risk of STI at 3months post-intervention, with no differences by treatment condition. A mediational relationship between adolescent: provider connectedness and STI risk via hazardous drinking was not observed.

Conclusion: Psychotherapeutic common factors, including adolescent: provider connectedness, may be important in mitigating adolescent health risk in behavioral interventions, above and beyond intervention condition and beyond the target behavior of the intervention.

KEYWORDS

adolescents, alcohol use, STI risk, common factors, motivational interviewing, mindfulness

1. Introduction

Adolescents represent one of the highest-risk groups for acquisition of sexually transmitted infections (STIs), accounting for nearly half of newly reported cases annually (Kreisel et al., 2021), and data continue to reflect that the likelihood of HIV infection is elevated among certain groups who have historically been less well represented in research, including youth ages 13–24 (Mendenhall and Singer, 2020). Of critical current public health importance is that present rates of oftentimes preventable STIs are escalating quickly among young people, despite several decades of declining rates of STIs in this age group (Feldstein Ewing and Bryan, 2020). Motivational interviewing (MI) has gained traction as an HIV/STI prevention intervention approach that is well-positioned to access and engage otherwise difficult-to-reach youth through settings such as pediatric/medical, juvenile justice, and school based-health centers (Vallabhan et al., 2017; D'Amico et al., 2018; Feldstein Ewing et al., 2022; Thompson et al., 2020; DiGuiseppi et al., 2021; Gaume et al., 2021; Miller et al., 2021; Sanchez-Puertas et al., 2022). Across settings, brief (often 1–2 session) HIV/STI prevention intervention programs such as MI have gained support for their capacity to reach and engage youth, often by meeting them where they are both physically and socioemotionally. Studies utilizing MI as a prevention program for youth HIV/STI and other health risk behaviors have shown reductions in health risk behaviors as distally as 12 months post-intervention (Murphy et al., 2012; D'Amico et al., 2018; Naar et al., 2020; Miller et al., 2021). While these existing HIV/STI prevention intervention approaches show promise, they still have modest effect sizes (Schmiege et al., 2011; Feldstein Ewing et al., 2016c; Bryan et al., 2018; Bryan and Feldstein Ewing, 2018; Gillman et al., 2018; Feldstein Ewing and Bryan, 2020; Gibson et al., 2020; Bryan et al., 2021; Schmiege et al., 2021). Even among the strongest evidence-based behavioral HIV/STI prevention interventions, including MI (Hettema et al., 2005; Lundahl et al., 2013; Miller and Rollnick, 2013; Henderson et al., 2020), effect sizes for youth (Jensen et al., 2011; Cushing et al., 2014; Steele et al., 2020; Calomarde-Gomez et al., 2021) indicate that there is still substantial room for improvement (Feldstein Ewing et al., 2016a; Silvers et al., 2019). Similarly, meta-analyses of MI reflect that gains are modest and component studies are fraught with statistical and clinical heterogeneity (Morales et al., 2018; Henderson et al., 2020). Together, these data leave concerned providers at a loss for how to better articulate HIV/STI prevention programs to more impactfully catalyze and sustain behavior change with this important and underserved age group (Cushing et al., 2014; Feldstein Ewing et al., 2016a,c; Morales et al., 2018; Silvers et al., 2019; Feldstein Ewing and Bryan, 2020; Steele et al., 2020).

Behavioral interventions for adolescent alcohol use may offer one avenue to more efficaciously target and reduce substance-related HIV/STI risk behavior (Kahler et al., 2018; Schmiege et al., 2021; Starks et al., 2022) by accessing and intervening on hazardous drinking-a central risk factor in the STI health decision making context (Feldstein Ewing et al., 2016c). Adolescence is a period of increased experimentation with alcohol, which frequently corresponds with debut and exploration of sexual behavior in this age group (Feldstein Ewing et al., 2016c). Alcohol use prior to intercourse is not uncommon: of the more than 27% of sexually active high school students in the United States (US), over one-fifth reported alcohol and/or other substance use prior to their most recent intercourse (Szucs et al., 2020). This is concerning, as alcohol use prior to intercourse can escalate risk for HIV/AIDS risk behaviors among adolescents, including acquisition of STIs (e.g., via incorrect condom use, condomless sex, and/or intercourse with multiple partners) (Ritchwood et al., 2015). Ultimately, when youth are intoxicated, they are less able to successfully engage in the requisite planning for enactment of health protective behaviors, which in turn increases the risk for exposure to STIs, and, in addition to other long-term sequelae (e.g., infertility, neurological problems, blindness), heightens risk of HIV infection (Feldstein Ewing et al., 2016c; Bryan et al., 2018; Feldstein Ewing and Bryan, 2020; DiClemente et al., 2021). A recent randomized controlled trial (RCT) found that the inclusion of alcohol content in a single-session, 2-h group-based HIV/AIDS risk intervention for adolescents reduced risk of STI at follow-up compared to an intervention focused only on reducing HIV/AIDS risk behavior (Bryan et al., 2018). Another study by the same team, but with a different sample, observed that MI interventions incorporating alcohol content were more efficacious in reducing HIV/AIDS risk behavior than an educational condition that only contained sexual risk reduction content (Bryan et al., 2021). These findings suggest that MI interventions incorporating alcohol content may be particularly well-positioned to reduce STI risk among youth.

1.1. The role of common therapeutic factors in efficacy of interventions for adolescent health risk behaviors

The therapeutic relationship is the cornerstone of MI, wherein empathic understanding and acceptance are critical to the delivery of the intervention (Moyers, 2014). A large literature has examined how these relational psychotherapeutic "common factors," including adolescent: provider connectedness, may enhance outcomes (e.g., reductions in drinking) across intervention modalities (Wampold, 2015; Magill et al., 2019, 2021). Within the therapeutic context, the connection between patient and provider is assumed to be healing in and of itself (Cuijpers et al., 2019). Given the literature underscoring the particularly impactful role of therapeutic common factors in MI studies with adults more broadly (Miller and Moyers, 2015), it may be the case that adolescent: provider connectedness could also help enhance health risk reduction in the adolescent age group. This is particularly relevant given the developmentally salient shift in adolescents' interpersonal awareness and social landscape that can directly impact health risk behavior (Silvers et al., 2019), changes in relationship dynamics with adults and authority figures (e.g., healthcare providers), and drive for increased autonomy over health-related behaviors and choices. Youth's perceptions of the relationship between patient and provider play an important role in health-related decisions: youth are more likely to engage in mental healthcare if they feel respected, taken seriously, listened to, and not judged by their provider (Radez et al., 2021). Further, there is evidence that the therapeutic relationship is influential in outcomes of adolescent therapy for internalizing, externalizing, and substance-related problems (Shirk and Karver, 2003; Faw et al., 2005; McCambridge et al., 2011; McLeod, 2011; Shirk et al., 2011).

Common factors, including elements of the therapeutic relationship, are often posited to be at least partially responsible for the frequently observed lack of between-condition differences in

efficacy across therapeutic modalities (Messer and Wampold, 2002). Our team's prior clinical HIV/STI prevention intervention studies with youth have found fewer between-condition outcomes than expected, despite carefully and successfully ensuring distinction between modalities *via* use of separate therapists across conditions, separate supervision throughout the course of the study, and validated fidelity metrics that supported our capacity to deliver distinct content and clinical approaches in these interventions (Feldstein Ewing et al., 2013, 2014, 2015, 2016b, 2022; Mackiewicz-Seghete et al., 2022; Dash et al., 2023). As such, our observation of minimal differences between intervention conditions likely does not reflect intervention contamination and/or therapist overlap; rather, we posit that these outcomes reflect the presence and salience of common relational factors such as youth: provider relationship factors, and their impact across all modalities of HIV/STI prevention intervention programming (Miller and Moyers, 2015). Consistent with the broader common factors literature, it may be the case that these interventions are efficacious with adolescents because they provide 2 h of individual attention with a caring and nonjudgmental adult; that is, they foster a positive connection between the adolescent and the provider. This foundation of a warm, supportive, therapeutic environment could, in part, be what helps positively position youth for health-oriented behavior change.

1.2. Present study

The present study represents a secondary analysis of data from an RCT examining brief MI and mindfulness interventions for adolescent alcohol use (ClinicalTrials.gov registry number NCT03367858) The purpose of this study was to evaluate the influence of a common factor, adolescent: provider connectedness, on STI risk reduction at 3 months post-intervention across two therapeutic modalities: MI and brief adolescent mindfulness (BAM). Additionally, given the interconnected findings that (1) common factors within brief interventions for adolescents are associated with reductions in alcohol use, (2) many adolescents consume alcohol prior to engaging in sexual behavior, and (3) incorporating alcohol content into HIV/STI prevention intervention is associated with greater reductions in health risk behavior, we also aimed to test whether reductions in hazardous drinking might mediate the association between adolescent: provider connectedness and STI risk reduction. We hypothesized that adolescent: provider connectedness would significantly reduce odds of positive STI at 3-month follow-up above and beyond intervention condition, and that this negative association between adolescent: provider connectedness and positive STIs at 3-month follow-up would be mediated by post-intervention reductions in hazardous drinking.

2. Materials and methods

2.1. Trial design

The goal of the parent RCT was to begin to pave the way for new translational (integrated brain: behavioral) studies in the field of adolescent addiction (Mackiewicz-Seghete et al., 2022). Building upon prior work, which had largely used single-treatment arm within-subjects designs (Feldstein Ewing et al., 2013, 2016b), adolescents were randomized to one of two empirically supported behavioral treatments for addiction, MI (Jensen et al., 2011) and BAM (Crane et al., 2017). Participants across both conditions discussed factors relevant to problem drinking and received two individual 60-min sessions of one-on-one treatment contact; no treatment as usual (TAU) condition was administered. The MI and BAM interventions were selected due to the preliminary translational (integrated brain: behavioral) literature available for each modality-a topic central to the parent study questions (Mackiewicz-Seghete et al., 2022).

The parent RCT utilized a parallel assignment model, with an allocation ratio of 1:1 (see CONSORT, Figure 1). Participants were blinded to intervention assignment and all interventionists were trained in, supervised in, and delivered only one of the two interventions. All study procedures were conducted with University Institutional Committee on Human Subjects approval and a federal Certificate of Confidentiality. Consent was obtained for participants age 18 years or older and parent consent with adolescent assent was obtained for youth under age 18 years. Youth received up to $150 for completing the intervention. Requests for deidentified data can be made to the senior author.

2.2. Participants

2.2.1. Eligibility criteria

Participants were community-based youth recruited in the northwest United States. Eligibility included age of 14–19, current engagement in hazardous drinking (defined for the parent RCT as one or more heavy drinking episodes during past 2 months), and no more than three past-month non-tobacco or non-cannabis-substance use events. Exclusion criteria also included left-handedness and/or MRI contraindications in line with the translational requirements for the parent study.

2.2.2. Present sample

Sample size for the parent study was determined *via* power analysis at a two-tailed alpha of 0.05 and power of.80. The power analysis assumed 16% attrition over the follow-up period. For this study, the analytic sample included all adolescents who completed the intervention and 3-month follow-up data collection protocol ($N = 168$; 35.71% female; $M_{age} = 18.13$ [SD = 1.12]; see Table 1). Baseline data were collected from participants at the university-based laboratory during attendance for intervention sessions, and follow-up was conducted in person at the university-based laboratory 3 months post-intervention.

2.3. Interventions

Adolescents were randomized to one of two individual-level manualized empirically supported behavioral treatments: MI (Feldstein Ewing et al., 2009) or BAM (Feldstein Ewing and Somohano, 2015). Of note, both MI and BAM are client-centered, primarily open-ended approaches (and thus, in these manuals, are youth-guided and not directive approaches). Participants received one

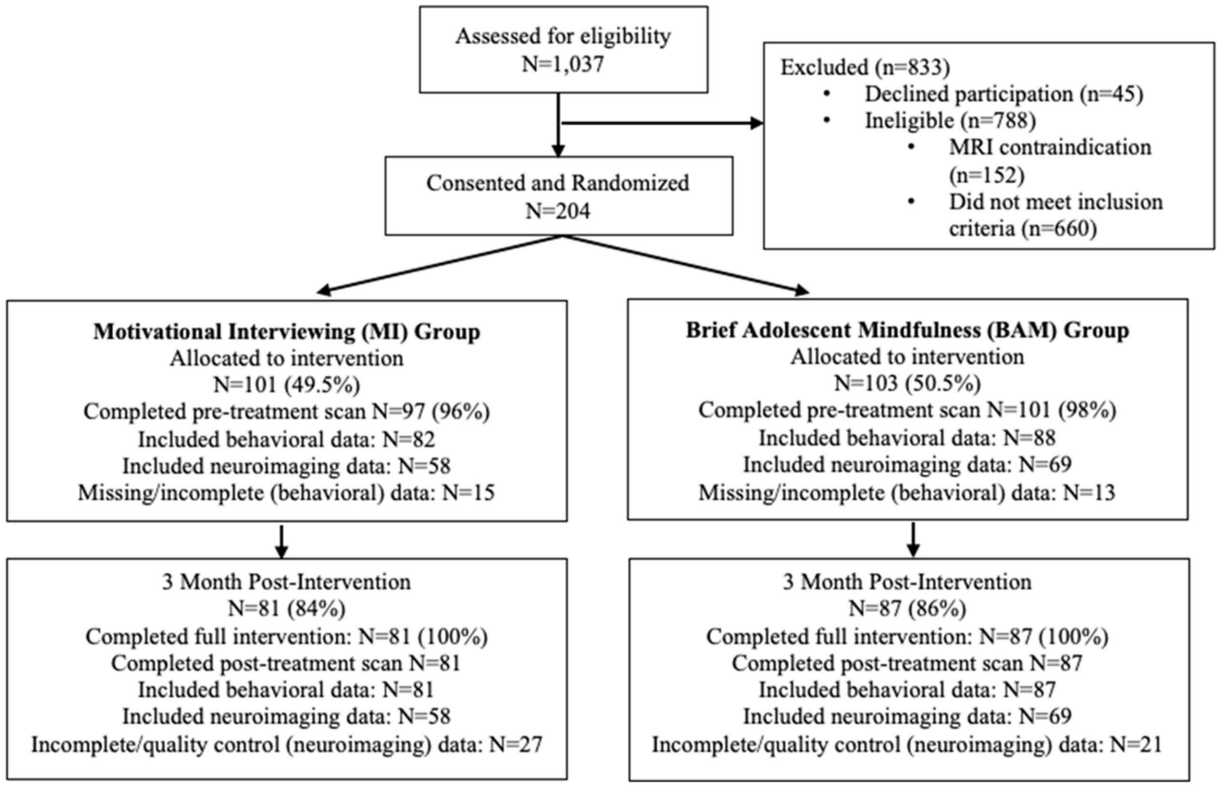


FIGURE 1
Study CONSORT.

TABLE 1 Sample characteristics and descriptive statistics.

	Total (*N*=168)	MI (*N*=81)	BAM (*N*=87)	Difference test
Demographics	N (%) or M (SD)	N (%) or M (SD)	N (%) or M (SD)	
Age	18.13 (1.12)	18.35 (0.95)	17.92 (1.22)	**$t(166) = 2.40, p = 0.02$**
Cisgender female	60 (35.71%)	30 (37.04%)	30 (34.48%)	$\chi^2(3) = 0.45, p = 0.93$
Cisgender male	98 (58.33%)	47 (58.02%)	51 (58.62%)	
Transgender or genderqueer	10 (5.95%)	4 (4.94%)	6 (6.90%)	
Non-Hispanic white	129 (76.79%)	61 (75.31%)	68 (78.16%)	$\chi^2(6) = 5.30, p = 0.51$
African American	8 (4.76%)	1 (1.23%)	7 (8.05%)	
Native Hawaiian or Pacific Islander	6 (3.57%)	2 (2.47%)	4 (4.60%)	
Asian American	28 (16.67%)	13 (16.05%)	15 (17.24%)	
Native American or Alaska Native	6 (3.57%)	2 (2.47%)	4 (4.60%)	
Hispanic	26 (15.48%)	17 (20.99%)	9 (10.34%)	
Other identity	5 (2.98%)	2 (2.47%)	3 (3.45%)	
Adolescent: provider connectedness	5.78 (1.22)	6.11 (1.04)	5.48 (1.30)	**$t(165) = -3.47$ $p = 0.0007$**
Positive STI				
Positive STI history at baseline (lifetime)	11 (6.55%)	5 (7.81%)	6 (9.38%)	$\chi^2(1) = 0.10, p = 0.75$
Positive STI at 3 month follow-up	6 (3.57%)	3 (4.48%)	3 (4.55%)	$\chi^2(1) = 0.53, p = 0.46$
Hazardous drinking	4.45 (5.65)	4.93 (6.08)	4.01 (5.21)	$t(166) = -1.05, p = 0.30$

MI, motivational interviewing; BAM, brief adolescent mindfulness; STI, sexually transmitted infection; M, mean; SD, standard deviation. Bold font denotes statistically significant difference test.

of the two time-matched interventions. Interventions were comprised of two 60-min sessions that were delivered with at least one intervening weekend to give youth the opportunity to practice session content in between meetings. The MI intervention applied MI-congruent approaches (Miller and Rollnick, 2013) to foster adolescent-driven behavior change in the context of alcohol use. The adolescent-tailored mindfulness intervention introduced youth to eastern thought with the goal of demystifying mindful concepts to help unburden and navigate stressors, including in the context of alcohol use. Intervention manuals are available upon request to the senior author. Further details on the interventions, therapist training, and intervention fidelity are available in Mackiewicz-Seghete et al. (2022).

2.4. Outcome measures

Primary outcome measures for the parent RCT are described in Mackiewicz-Seghete et al. (2022). Results indicated that both interventions (MI and mindfulness) performed equivalently in reducing adolescent alcohol use at 3 months post-intervention, with no differences by treatment group. The design of the parent trial did not include collection of any information on harms of the intervention.

2.4.1. Adolescent: provider connectedness

Immediately following the second and final intervention session, youth completed the Inclusion of Other in the Self scale, a pictorial measure of interpersonal closeness implemented in evaluations of behavioral interventions (Aron et al., 1992) that has been validated and used previously in adolescent populations (Lourenco et al., 2015; Braams and Crone, 2017; Meng et al., 2022). The measure includes a sequence of 7 images depicting two circles (one representing the youth and, for the present study, one representing the counselor) that overlap to varying degrees. Youth were instructed to select the image that they felt best represented their connectedness with their counselor. The scale ranged from 1 to 7. The adolescent: provider connectedness variable was mean centered for analysis.

2.4.2. Sexually transmitted infection (STI)

At baseline, participants responded to a validated sexual history measure regarding lifetime history of STIs with the item: "have you ever had a sexually transmitted infection like chlamydia, herpes, or warts?" At the 3-month-follow-up, participants reported if they had been diagnosed with an STI (such as chlamydia, herpes, or warts) during the prior 3 months (i.e., since completing the intervention).

2.4.3. Adolescent hazardous drinking

Adolescent hazardous drinking was measured by the Rutgers Alcohol Problems Index (RAPI; White and Labouvie, 1989). The RAPI is a well-validated 23-item metric of problem drinking (e.g., "Missed out on things because you spend too much money on alcohol"). Response options for each item (never, 1–2 times, 3–5 times, 6–10 times, more than 10 times) were summed to create an index of hazardous drinking. At follow-up, participants reported their post-intervention hazardous drinking over the past 3 months ($\alpha = 0.84$) (i.e., since completing the intervention).

2.5. Statistical methods

Analyses were conducted in SAS Version 9.4 (SAS Institute Inc., 2014) and Mplus version 8 (Muthén, 2017). Preliminary analyses tested baseline equivalence on demographic characteristics, adolescent: provider connectedness, positive STI (lifetime), and hazardous drinking across conditions. Next, a series of logistic regression models predicting post-intervention STI risk reduction were fit using SAS PROC LOGISTIC. First, we tested a model including main effects of adolescent: provider connectedness and intervention, and an adolescent: provider connectedness x intervention interaction ("Model 1"). Next, the adolescent: provider connectedness x intervention interaction was dropped from the model ("Model 2"). Finally, positive STI (lifetime) at baseline was included as a predictor to determine whether the effect of adolescent: provider connectedness persisted above and beyond the effect of lifetime STI history ("Model 3"). We subsequently tested post-intervention hazardous drinking as a mediator of adolescent: provider connectedness and STI risk reduction at 3 months *via* path analysis conducted in Mplus. This model was structured to mirror Model 3, meaning that it included positive STI history (lifetime) at baseline and intervention as well as (1) a direct path from adolescent: provider connectedness to post-intervention STI risk reduction, (2) a direct path from adolescent: provider connectedness to post-intervention hazardous drinking, (3) a direct path from post-intervention hazardous drinking to post-intervention STI risk reduction, and (4) and indirect path from adolescent: provider connectedness to post-intervention STI risk reduction *via* post-intervention hazardous drinking. Modeling was conducted using full information maximum likelihood estimation with bootstrapped standard errors.

3. Results

3.1. Sample characteristics

Data collection was conducted from January 2017 through January 2020. All follow-up data were collected prior to the onset of the COVID-19 pandemic. Of the 1,037 youth screened for eligibility, 204 provided consent/assent and were randomized to condition (101 MI, 103 mindfulness). Of those participants, 168 completed 3-month follow-up data collection protocols (81 MI, 87 mindfulness; see Figure 1) and were included in the present analyses (results from analyses including all participants randomized to condition are available in the Supplemental material); one participant was excluded from analyses due to extreme response patterns. Demographics and descriptive statistics for study variables are presented in Table 1; SGM youth represented 6% of the sample. Baseline age and adolescent: provider connectedness differed across intervention groups, with participants in the MI condition being slightly older (18.35 years vs. 17.92 years) and reporting stronger adolescent: provider connectedness scores (6.11 vs. 5.48). Rates of positive STI did not differ across the MI and mindfulness conditions at baseline (7.81% vs. 9.38%) or 3-month follow-up (4.48% vs. 4.55%).

TABLE 2 Results from logistic regressions predicting positive STI at 3months post-intervention.

	Estimate (95% CI)	OR (95% CI)	χ^2	*p*
Model 1				
Main effect				
Adolescent: provider connectedness	**−0.58 (−1.10, −0.06)**	-	**4.69**	**0.03**
Intervention MI vs. BAM [Adolescent: provider connectedness = 0 (mean)]	−0.17 (−1.04, 0.70)	0.71 (0.13, 4.02)	0.15	0.70
Interaction				
Adolescent: provider connectedness x intervention	−0.13 (−0.65, 0.39)		0.25	0.62
MI		0.49 (0.21, 1.14)		
BAM		0.64 (0.35, 1.19)		
Model 2				
Main effect				
Adolescent: provider connectedness	**−0.54 (−1.04, −0.04)**	**0.58 (0.35, 0.97)**	**4.39**	**0.04**
Intervention	−0.07 (−0.85, 0.70)	0.86 (0.18, 4.09)	0.04	0.85
Model 3				
Main effect				
Adolescent: provider connectedness	−0.58 (−1.21, 0.05)	0.56 (0.30, 1.05)	3.24	0.07
Intervention	−0.53 (−1.61, 0.55)	0.35 (0.04, 3.02)	0.92	0.34
No positive STI history at baseline (lifetime)	**−1.92 (−2.94, −0.90)**	**0.02 (0.00, 0.16)**	**13.72**	**0.0002**

Bold font, significant estimate, $p < 0.05$; MI, motivational interviewing; BAM, brief adolescent mindfulness; STI, sexually transmitted infection; OR, odds ratio; CI, confidence interval.

3.2. Model results

Results of the logistic regression models are presented in Table 2. In the first model ("Model 1"), stronger adolescent: provider connectedness was associated with lower odds of positive STI at 3 months post-intervention. The adolescent: provider connectedness x intervention interaction was nonsignificant, and inspection of the odds ratios for each condition confirmed that the effect of adolescent: provider connectedness on STI risk reduction at 3 months did not differ across intervention condition. As such, we proceeded with dropping the adolescent: provider connectedness x intervention interaction term from the model ("Model 2"), but retained intervention due to differences in adolescent: provider connectedness ratings across condition (see Table 1). The effect of adolescent: provider connectedness remained significant in this model, with higher adolescent: provider connectedness rating decreasing odds of positive STI at 3 months. When lifetime history of STI (baseline) was included in the model ("Model 3), adolescent: provider connectedness was, by a very small margin (0.04 vs. 07), no longer significant; however, magnitude of effect for adolescent: provider connectedness was not diminished, suggesting that this shift may be due increased imprecision of the estimate (as evidenced by the widened confidence interval), potentially resulting from data sparsity, rather than true absence of effect (Gelman and Stern, 2006; Greenland et al., 2016).

Results from the mediation model are depicted in Figure 2. Post-intervention hazardous drinking did not predict STI risk reduction at 3 months ($\beta = -0.10$, SE = 0.29, $p = 0.73$). Direct effects of adolescent: provider connectedness on hazardous drinking neared but did not achieve statistical significance ($\beta = -0.16$, SE = 0.08, $p = 0.06$). The indirect effect adolescent: provider connectedness on STI risk reduction at 3 months via hazardous drinking was also near-zero and nonsignificant ($\beta = 0.02$, SE = 0.05, $p = 0.73$). Again, positive lifetime history of STI (baseline) was the most robust predictor of STI risk reduction at 3 months ($\beta = 0.46$, SE = 0.15, $p = 0.002$), though the direct effect of adolescent: provider connectedness displayed an estimate of moderate magnitude and neared statistical significance ($\beta = -0.35$, SE = 0.19, $p = 0.07$). Together, this pattern of results suggests that the present analysis may have been underpowered to detect the direct effects on adolescent: provider connectedness on post-intervention hazardous drinking and STI risk reduction within this more complex model, despite evidence of these associations in the prior models presented here.

4. Discussion

The present study aimed to explore the degree to which a well-established psychotherapeutic "common factor," adolescent: provider connectedness, may impact adolescents' HIV/AIDS risk behavior in the context of two widely-used brief behavioral interventions, MI and mindfulness. While most studies examining relational factors have done so in adult samples (Flückiger et al., 2018; Cuijpers et al., 2019), results here supported the role of common factors on HIV/AIDS outcomes during behavioral interventions for adolescents. Specifically, we found that adolescent: provider connectedness was significantly and directly associated with short-term (3 month) STI risk reduction among adolescents, an age group that is at elevated risk for STI and HIV/AIDS (Kreisel et al., 2021). In fact, adolescent: provider connectedness predicted STI risk reduction above and beyond the impact of each independent intervention (MI vs. mindfulness). This pattern of results indicates that adolescent: provider connectedness is relevant to health behavior outcomes beyond the sphere of substance use, even within an intervention targeting alcohol consumption. Given the role of positive STIs as a central risk factor for the later acquisition of HIV/AIDS, this finding has high public health relevance. Ultimately, these data suggest that providers who work with youth in caring, compassionate ways even during very brief (2-session) interventions, may be able to significantly impact the reduction of important health risk behavior at a time when STIs are on the rise among adolescents (Feldstein Ewing and Bryan, 2020).

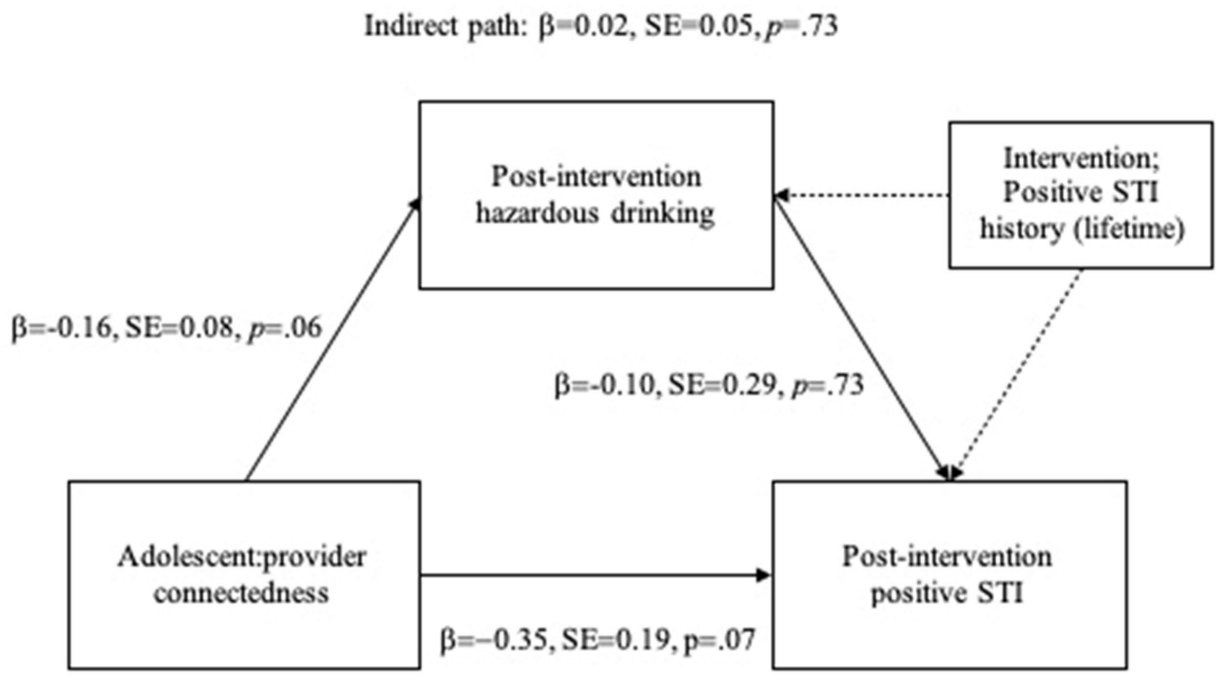


FIGURE 2
Mediation model.

In terms of clinical implications, the data observed in this study align with recent reviews (Feldstein Ewing et al., 2016a; Yeager et al., 2018; Silvers et al., 2019; Feldstein Ewing and Bryan, 2020), which suggest stepping back from existing paradigms to understand the nature and impact of the youth: provider relationship on youth HIV/STI and alcohol use outcomes in this age group. These clinical reviews support that interventions like MI allow providers to rapidly and impactfully connect with youth (Feldstein and Ginsburg, 2007). Qualitative data from our team's prior studies reflect that youth report feeling like these brief prevention intervention programs offer an opportunity to explore their HIV/STI and related syndemic health risk behavior in a non-judgmental atmosphere, facilitating the unique experience of feeling listened to, respected, and empowered to make a behavioral change when they are ready. Similarly, providers conducting brief prevention programs with youth can clearly articulate those with whom they felt more connected, and how that connection seemed to act as an engine for therapeutic rapport and subsequent HIV/STI and related health risk intervention gains. While it is clear to most MI providers that these relational factors represent an essential component of who responds (and who does not) to brief behavioral HIV/STI prevention intervention programs (Miller and Moyers, 2015), this study takes a step further by examining these relationships quantitatively with understudied an underserved age group.

Such empirical data are urgently needed to meaningfully advance provider direct practice in HIV/STI and syndemic prevention intervention programs with youth (Feldstein Ewing et al., 2016a; Silvers et al., 2019; Feldstein Ewing and Bryan, 2020). We propose that we have found comparable outcomes across distinct evidence-based behavioral HIV/STI and syndemic prevention interventions (MI vs. mindfulness) within our RCTs because they all share the common core of providing youth with individualized attention with a caring adult. Important in this equation, these relationships were not localized to only HIV/STI and syndemic prevention interventions utilizing approaches specific to MI or mindfulness; rather, these effects have also been generalized across other intervention modalities examined by our team, including those with highly didactive/tutorial-based and reward-centered frameworks, such that they performed on par with the youth receiving MI at some, if not all, of the study follow-ups (Feldstein Ewing et al., 2013, 2014, 2015, 2016b, 2022; Mackiewicz-Seghete et al., 2022; Dash et al., 2023). In sum, there appears to be something highly impactful in this youth: provider relationship that we must continue to explore in youth clinical research.

This has several implications for risk reduction strategies for adolescents and training for providers who work with this age group. These data suggest that a relationship with a caring adult can reduce youth engagement in HIV/AIDS risk behaviors, even within an intervention focused on other health risk behavior (i.e., alcohol use). While future research is requisite to disaggregate what constitutes meaningful therapeutic rapport, and how we can best facilitate and achieve it with our youth who are of high need and low treatment receipt, this study indicates that opening the door to build an impactful relationship is critical. The potential transportability of such a transtheoretical approach is highly promising in terms of generalizing risk reduction approaches to a wide range of settings and maximizing the reach of efficacious approaches. In terms of training for providers, an important implication may be that explicit training in skills that foster interpersonal connectedness in addition to the "nuts and bolts" of manualized treatments is of critical importance.

4.1. Limitations

While this study had numerous strengths, including a first look at the role of the adolescent: provider connectedness in STI outcomes within an underexamined age group, results of the present study should be interpreted in light of limitations. Because the parent study was not originally developed to examine STI risk reduction, we were not able to include biometric testing for STIs. In addition, given the somewhat limited sample size, analyses may have been underpowered; future studies would benefit from replication of this analysis with a larger sample size fully powered to detect what is often a subtle effect for therapeutic outcomes this age group. Relatedly, it is unclear how results from this sample of adolescents recruited from the northwest US may generalize to other regions and populations. Finally, while it speaks well to our teams' capacity to engender positive therapeutic working relationships with this sample of young people, ratings of adolescent: provider therapeutic connectedness were uniformly high, which may have limited variability to detect statistically significant associations between study variables.

4.2. Conclusion

This study builds on recent calls regarding the importance of explicitly examining the multifactorial nature of HIV risk in order to specifically incorporate and examine co-occurring outcomes that can dynamically exacerbate youth health risk, including the intersection of sexual risk behavior, positive STI, and alcohol use. The importance of examining such syndemic outcomes simultaneously is that they can interactively, negatively influence young people's developmental trajectory, placing youth at greater risk for sustained patterns of health risk and related problems as they transition into adulthood (Castelpietra et al., 2022; Fu et al., 2022; Safiri et al., 2022). Extant meta-analyses of patient: provider relational factors indicate promise (small to medium effects) in broad-based mental health outcomes among older populations (e.g., adults) (Martin et al., 2000; Rouleau et al., 2020; Del Re et al., 2021; Rodriguez et al., 2021; Lauckner et al., 2022) and children/adolescents (Murphy and Hutton, 2018; Roest et al., 2023), but the youth HIV/STI prevention intervention field remains largely absent from empirical studies that examine the role of youth: provider relational factors. The present study is one step toward filling this gap.

Given that behavioral interventions are one of the most widely utilized intervention approaches to reduce HIV/AIDS risk for adolescents (Cushing et al., 2014; Hosek and Pettifor, 2019), these findings represent a relevant signal indicating the importance of further future exploration of the role of common factors across other adolescent HIV/AIDS risk reduction modalities. While these data do not ask or answer questions that enable us to speak to risk reduction strategies that may be most impactful to adolescents at this time, these data do highlight the continued need to deeply query and evaluate what constitutes common factors and how they may be impactful in HIV/STI risk reduction.

Because adolescence is a time of enhanced exploration of health risk behaviors including alcohol use and HIV/AIDS risk behaviors, identifying how to most meaningfully promote therapeutic relationships that will allow practitioners to explore HIV/AIDS health during what is often limited contact with clinical providers and youth is of critical public health importance for high need and underserved young people (Feldstein Ewing and Bryan, 2020). This study suggests that even in brief intervention settings, individual time with a caring adult may be particularly impactful in supporting health-oriented adolescent behavior change across numerous domains of adolescent health, including, but not limited to, HIV/AIDS risk reduction. Future research should continue to build upon these findings to examine how common factors within other types of brief and/or behavioral intervention modalities may continue to impact adolescent health and development. In sum, this study begins to open an essential window into the role of relational factors in youth HIV/STI prevention intervention response-an under-studied area among youth at high risk for HIV. Together, these data bring us one small step closer to developing more impactful HIV/STI prevention interventions, delivered at the right time, in the right way, to high-risk young people.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: the data that support the findings of this study are available from the senior author upon reasonable request. Requests to access these datasets should be directed to SWFE, feldsteinewing@uri.edu.

Ethics statement

This study involved human participants and was reviewed and approved by the Institutional Review Boards at Oregon Health & Science University and the University of Rhode Island. Written informed consent to participate in this study was obtained from participants (age 18 or older) or from the participants' legal guardian with participant assent (under age 18).

Author contributions

SWFE secured funding and collected the data used in the present study. SWFE and GFD contributed to the conceptualization of the study. GFD conducted data analysis. GFD drafted the first version of the manuscript. All authors contributed to editing the manuscript and revising it for important intellectual content. All authors provided approval for publication of the content of the manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding

This work was supported by the National Institute on Alcohol Abuse and Alcoholism [grant numbers 1R01AA023658–01, K24AA026876–0 (to SWFE)] and the National Institute on Drug Abuse [grant number F31DA054701 (to GFD)].

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.

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1171264/full#supplementary-material

References

Aron, A., Aron, E. N., and Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *J. Pers. Soc. Psychol.* 63, 596–612. doi: 10.1037/0022-3514.63.4.596

Braams, B. R., and Crone, E. A. (2017). Peers and parents: a comparison between neural activation when winning for friends and mothers in adolescence. *Soc. Cogn. Affect. Neurosci.* 12, 417–426. doi: 10.1093/scan/nsw136

Bryan, A. D., and Feldstein Ewing, S. W. (2018). Sex and the brain: empirical intersection of Neurocognition and sexual behavior. *Ann. Behav. Med.* 52, 353–355. doi: 10.1093/abm/kax070

Bryan, A. D., Magnan, R. E., Claus, E. W., Hutchison, K. E., Feldstein Ewing, S. W., and Schmiege, S. J. (2021). Randomized controlled trial of an alcohol-related sexual risk reduction intervention with adolescents: the role of neurocognitive activation during risky decision-making. *AIDS Behav.* 25, 265–275. doi: 10.1007/s10461-021-03190-3

Bryan, A. D., Magnan, R. E., Gillman, A. S., Yeater, E. A., Feldstein Ewing, S. W., Kong, A. S., et al. (2018). Effect of including alcohol and Cannabis content in a sexual risk-reduction intervention on the incidence of sexually transmitted infections in adolescents: a cluster randomized clinical trial. *JAMA Pediatr.* 172:e175621. doi: 10.1001/jamapediatrics.2017.5621

Calomarde-Gomez, C., Jimenez-Fernandez, B., Balcells-Olivero, M., Gual, A., and Lopez-Pelayo, H. (2021). Motivational interviewing for Cannabis use disorders: a systematic review and Meta-analysis. *Eur. Addict. Res.* 27, 413–427. doi: 10.1159/000515667

Castelpietra, G., Knudsen, A. K. S., Agardh, E. E., Armocida, B., Beghi, M., Iburg, K. M., et al. (2022). The burden of mental disorders, substance use disorders and self-harm among young people in Europe, 1990-2019: findings from the global burden of disease study 2019. *Lancet Reg. Health Eur.* 16:100341. doi: 10.1016/j.lanepe.2022.100341

Crane, R. S., Brewer, J., Feldman, C., Kabat-Zinn, J., Santorelli, S., Williams, J. M., et al. (2017). What defines mindfulness-based programs? The warp and the weft. *Psychol. Med.* 47, 990–999. doi: 10.1017/S0033291716003317

Cuijpers, P., Reijnders, M., and Huibers, M. J. (2019). The role of common factors in psychotherapy outcomes. *Annu. Rev. Clin. Psychol.* 15, 207–231. doi: 10.1146/annurev-clinpsy-050718-095424

Cushing, C. C., Jensen, C. D., Miller, M. B., and Leffingwell, T. R. (2014). Meta-analysis of motivational interviewing for adolescent health behavior: efficacy beyond substance use. *J. Consult. Clin. Psychol.* 82, 1212–1218. doi: 10.1037/a0036912

D'Amico, E. J., Parast, L., Shadel, W. G., Meredith, L. S., Seelam, R., and Stein, B. D. (2018). Brief motivational interviewing intervention to reduce alcohol and marijuana use for at-risk adolescents in primary care. *J. Consult. Clin. Psychol.* 86, 775–786. doi: 10.1037/ccp0000332

Dash, G. F., Bryan, A. D., Montanaro, E., and Feldstein Ewing, S. W. (2023). Long-term RCT outcomes for adolescent alcohol and Cannabis use within a predominantly Hispanic sample. *J. Res. Adolesc.* Advance online publication. doi: 10.1111/jora.12856

Del Re, A. C., Fluckinger, C., Horvath, A. O., and Wampold, B. E. (2021). Examining therapist effects in the alliance-outcome relationship: a multilevel meta-analysis. *J. Consult. Clin. Psychol.* 89, 371–378. doi: 10.1037/ccp0000637

DiClemente, R. J., Rosenbaum, J. E., Rose, E. S., Sales, J. M., Brown, J. L., Renfro, T. L., et al. (2021). Horizons and group motivational enhancement therapy: HIV prevention for alcohol-using young black women, a randomized experiment. *Am. J. Prev. Med.* 60, 629–638. doi: 10.1016/j.amepre.2020.11.014

DiGuiseppi, G. T., Tucker, J. S., Prindle, J. J., Henwood, B. F., Huey, S. J., Rice, E. R., et al. (2021). Comparing the effectiveness of three substance use interventions for youth with and without homelessness experiences prior to treatment. *J. Consult. Clin. Psychol.* 89, 995–1006. doi: 10.1037/ccp0000704

Faw, L., Hogue, A., Johnson, S., Diamond, G. M., and Liddle, H. A. (2005). The adolescent therapeutic Alliance scale (ATAS): initial psychometrics and prediction of outcome in family-based substance abuse prevention counseling. *Psychother. Res.* 15, 141–154. doi: 10.1080/10503300512331326994

Feldstein Ewing, S. W., and Bryan, A. D. (2020). Have we missed the boat? The current, preventable surge of sexually transmitted infections (STIs) in the United States. *Health Psychol.* 39, 169–171. doi: 10.1037/hea0000834

Feldstein Ewing, S., Bryan, A. D., Dash, G. F., Lovejoy, T. I., Borsari, B., and Schmiege, S. J. (2022). Randomized controlled trial of motivational interviewing for alcohol and cannabis use within a predominantly Hispanic adolescent sample. *Exp. Clin. Psychopharmacol.* 30, 287–299. doi: 10.1037/pha0000445

Feldstein Ewing, S. W., Gaume, J., and Apodaca, T. R. (2016a). Ambivalence: prerequisite for success in motivational interviewing with adolescents? *Addiction* 111, 1900–1907. doi: 10.1111/add.13286

Feldstein Ewing, S. W., Gaume, J., Ernst, D. B., Rivera, L., and Houck, J. M. (2015). Do therapist behaviors differ with Hispanic youth? A brief look at within-session therapist behaviors and youth treatment response. *Psychol. Addict. Behav.* 29, 779–786. doi: 10.1037/adb0000079

Feldstein Ewing, S. W., Houck, J. M., Yezhuvath, U., Shokri-Kojori, E., Truitt, D., and Filbey, F. M. (2016b). The impact of therapists' words on the adolescent brain: in the context of addiction treatment. *Behav. Brain Res.* 297, 359–369. doi: 10.1016/j.bbr.2015.09.041

Feldstein Ewing, S. W., McEachern, A. D., Yezhuvath, U., Bryan, A. D., Hutchison, K. E., and Filbey, F. M. (2013). Integrating brain and behavior: evaluating adolescents' response to a cannabis intervention. *Psychol. Addict. Behav.* 27, 510–525. doi: 10.1037/a0029767

Feldstein Ewing, S. W., Ryman, S. R., Gillman, A., Weiland, B. J., Thayer, R. E., and Bryan, A. D. (2016c). Developmental cognitive neuroscience of adolescent sexual risk and alcohol use. *AIDS Behav.* 20, 97–108. doi: 10.1007/s10461-015-1155-2

Feldstein Ewing, S. W., and Somohano, V. (2015). *Brief adolescent mindfulness (BAM) for adolescent addiction*.

Feldstein Ewing, S.W., Wray, A., Bryan, A.D., and Hutchison, K.E. (2009). Adolescent alcohol and marijuana education intervention manual. Mind research Network.

Feldstein Ewing, S. W., Yezhuvath, U., Houck, J. M., and Filbey, F. M. (2014). Brain-based origins of change language: a beginning. *Addict. Behav.* 39, 1904–1910. doi: 10.1016/j.addbeh.2014.07.035

Feldstein, S. W., and Ginsburg, J. I. D. (2007). "Sex, drugs, and rock 'n' rolling with resistance: motivational interviewing in juvenile justice settings" in *Handbook of forensic mental health with victims and offenders: assessment, treatment, and research*. eds. A. R. Roberts and D. W. Springer (New York: Charles C. Thomas), 247–271.

Flückiger, C., Del Re, A., Wampold, B. E., and Horvath, A. O. (2018). The alliance in adult psychotherapy: a meta-analytic synthesis. *Psychotherapy* 55, 316–340. doi: 10.1037/pst0000172

Fu, L., Sun, Y., Han, M., Wang, B., Xiao, F., Zhou, Y., et al. (2022). Incidence trends of five common sexually transmitted infections excluding HIV from 1990 to 2019 at the global, regional, and National Levels: results from the global burden of disease study 2019. *Front. Med.* 9:851635. doi: 10.3389/fmed.2022.851635

Gaume, J., Grazioli, V. S., Paroz, S., Fortini, C., Bertholet, N., and Daeppen, J.-B. (2021). Developing a brief motivational intervention for young adults admitted with alcohol intoxication in the emergency department - results from an iterative qualitative design. *PLoS One* 16:e0246652. doi: 10.1371/journal.pone.0246652

Gelman, A., and Stern, H. (2006). The difference between "significant" and "not significant" is not itself statistically significant. *Am. Stat.* 60, 328–331. doi: 10.1198/000313006X152649

Gibson, L. P., Gust, C. J., Gillman, A. S., Bryan, A. D., and Feldstein Ewing, S. W. (2020). Mechanisms of action for empirically supported interventions to reduce adolescent sexual risk behavior: a randomized controlled trial. *J. Adol. Health* 67, 53–60. doi: 10.1016/j.jadohealth.2020.01.004

Gillman, A. S., Yeater, E. A., Feldstein Ewing, S. W., Kong, A. S., and Bryan, A. D. (2018). Risky sex in high-risk adolescents: associations with alcohol use, marijuana use, and co-occurring use. *AIDS Behav.* 22, 1352–1362. doi: 10.1007/s10461-017-1900-9

Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., et al. (2016). Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations. *Eur. J. Epidemiol.* 31, 337–350. doi: 10.1007/s10654-016-0149-3

Henderson, J. T., Senger, C. A., Henninger, M., Bean, S. I., Redmond, N., and O'Connor, E. A. (2020). Behavioral counseling interventions to prevent sexually transmitted infections: updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA* 324, 682–699.

Hettema, J., Steele, J., and Miller, W. R. (2005). Motivational interviewing. *Annu. Rev. Clin. Psychol.* 1, 91–111. doi: 10.1146/annurev.clinpsy.1.102803.143833

Hosek, S., and Pettifor, A. (2019). HIV prevention interventions for adolescents. *Curr. HIV/AIDS Rep.* 16, 120–128. doi: 10.1007/s11904-019-00431-y

SAS Institute Inc. (2014). *Base SAS® 9.4 procedures guide: statistical procedures*. Cary: SAS Institute Inc.

Jensen, C. D., Cushing, C. C., Aylward, B. S., Craig, J. T., Sorell, D. M., and Steele, R. G. (2011). Effectiveness of motivational interviewing interventions for adolescent substance use behavior change: a meta-analytic review. *J. Consult. Clin. Psychol.* 79, 433–440. doi: 10.1037/a0023992

Kahler, C. W., Pantalone, D. W., Mastroleo, N. R., Liu, T., Bove, G., Ramratnam, B., et al. (2018). Motivational interviewing with personalized feedback to reduce alcohol use in HIV-infected men who have sex with men: a randomized controlled trial. *J. Consult. Clin. Psychol.* 86, 645–656. doi: 10.1037/ccp0000322

Kreisel, K. M., Spicknall, I. H., Gargano, J. W., Lewis, F. M., Lewis, R. M., Markowitz, L. E., et al. (2021). Sexually transmitted infections among US women and men: prevalence and incidence estimates, 2018. *Sex. Transm. Dis.* 48, 208–214. doi: 10.1097/OLQ.0000000000001355

Lauckner, C., Walthers, J., Stuck, J., Bryant, K., Edelman, E. J., Fiellin, D. A., et al. (2022). The relationship between drinking behavior and conversational processes during a brief alcohol reduction intervention for people with HIV. *AIDS Behav.* 26, 2067–2080. doi: 10.1007/s10461-021-03553-w

Lourenco, F. S., Decker, J. H., Pedersen, G. A., Dellarco, D. V., Casey, B., and Hartley, C. A. (2015). Consider the source: adolescents and adults similarly follow older adult advice more than peer advice. *PloS One* 10:e0128047. doi: 10.1371/journal.pone.0128047

Lundahl, B., Moleni, T., Burke, B. L., Butters, R., Tollefsosn, D., Butler, C., et al. (2013). Motivational interviewing in medical care settings: a systematic review and meta-analysis of randomized controlled trials. *Patient Educ. Couns.* 93, 157–168. doi: 10.1016/j.pec.2013.07.012

Mackiewicz-Seghete, K. L., Filbey, F. M., Hudson, K. A., Hyun, B., and Feldstein Ewing, S. W. (2022). Time for a paradigm shift: the adolescent brain in addiction treatment. *Neuroimage Clin.* 34:102960. doi: 10.1016/j.nicl.2022.102960

Magill, M., Martino, S., and Wampold, B. (2021). The principles and practices of psychoeducation with alcohol or other drug use disorders: a review and brief guide. *J. Subst. Abus. Treat.* 126:108442. doi: 10.1016/j.jsat.2021.108442

Magill, M., Ray, L., Kiluk, B., Hoadley, A., Bernstein, M., Tonigan, J. S., et al. (2019). A meta-analysis of cognitive-behavioral therapy for alcohol or other drug use disorders: treatment efficacy by contrast condition. *J. Consult. Clin. Psychol.* 87, 1093–1105. doi: 10.1037/ccp0000447

Martin, D. J., Garske, J. P., and Davis, M. K. (2000). Relation of the therapeutic alliance with outcome and other variables: a meta-analytic review. *J. Consult. Clin. Psychol.* 68, 438–450. doi: 10.1037/0022-006X.68.3.438

McCambridge, J., Day, M., Thomas, B. A., and Strang, J. (2011). Fidelity to motivational interviewing and subsequent cannabis cessation among adolescents. *Addict. Behav.* 36, 749–754. doi: 10.1016/j.addbeh.2011.03.002

McLeod, B. D. (2011). Relation of the alliance with outcomes in youth psychotherapy: a meta-analysis. *Clin. Psychol. Rev.* 31, 603–616. doi: 10.1016/j.cpr.2011.02.001

Mendenhall, E., and Singer, M. (2020). What constitutes a syndemic? Methods, contexts, and framing from 2019. *Curr. Opin. HIV AIDS* 15, 213–217. doi: 10.1097/COH.0000000000000628

Meng, X., Sedikides, C., and Luo, Y. L. (2022). The development of self–other overlap from childhood to adolescence. *Psych J.* 11, 968–970. doi: 10.1002/pchj.600

Messer, S. B., and Wampold, B. E. (2002). Let's face facts: common factors are more potent than specific therapy ingredients. *Clin. Psychol. Sci. Pract.* 9, 21–25. doi: 10.1093/clipsy.9.1.21

Miller, M. K., Catley, D., Adams, A., Staggs, V. S., Dowd, M. D., Stancil, S. L., et al. (2021). Brief motivational intervention to improve adolescent sexual health service uptake: a pilot randomized controlled trial in the emergency department. *J. Pediatr.* 237, 250–257.e2. doi: 10.1016/j.jpeds.2021.06.007

Miller, W. R., and Moyers, T. B. (2015). The forest and the trees: relational and specific factors in addiction treatment. *Addiction* 110, 401–413. doi: 10.1111/add.12693

Miller, W. R., and Rollnick, S. (2013). *Motivational interviewing: helping people change*. New York, NY: Guilford press.

Morales, A., Espada, J. P., Orgiles, M., Escribano, S., Johnson, B. T., and Lightfoot, M. (2018). Interventions to reduce risk for sexually transmitted infections in adolescents: a meta-analysis of trials, 2008–2016. *PLoS One* 13:e0199421. doi: 10.1371/journal.pone.0199421

Moyers, T. B. (2014). The relationship in motivational interviewing. *Psychotherapy* 51, 358–363. doi: 10.1037/a0036910

Murphy, D. A., Chen, X., Naar-King, S., and Parsons, J. T.Adolescent Trials Network (2012). Alcohol and marijuana use outcomes in the healthy choices motivational interviewing intervention for HIV-positive youth. *AIDS Patient Care STDS.* 26, 95–100. doi: 10.1089/apc.2011.0157

Murphy, R., and Hutton, P. (2018). Practitioner review: therapist variability, patient-reported therapeutic alliance, and clinical outcomes in adolescents undergoing mental health treatment - a systematic review and meta-analysis. *J. Child Psychol. Psychiatry* 59, 5–19. doi: 10.1111/jcpp.12767

Muthén, L. (2017). *Mplus Users Guide (Version 8) Muthén & Muthén*. Los Angeles, CA, USA.

Naar, S., Robles, G., MacDonell, K. K., Dinaj-Koci, V., Simpson, K. N., Lam, P., et al. (2020). Comparative effectiveness of community-based vs clinic-based healthy choices motivational intervention to improve health behaviors among youth living with HIV: a randomized clinical trial. *JAMA Netw. Open* 3:e2014650. doi: 10.1001/jamanetworkopen.2020.14650

Radez, J., Reardon, T., Creswell, C., Lawrence, P. J., Evdoka-Burton, G., and Waite, P. (2021). Why do children and adolescents (not) seek and access professional help for their mental health problems? A systematic review of quantitative and qualitative studies. *Eur. Child Adolesc. Psychiatry* 30, 183–211. doi: 10.1007/s00787-019-01469-4

Ritchwood, T. D., Ford, H., DeCoster, J., Sutton, M., and Lochman, J. E. (2015). Risky sexual behavior and substance use among adolescents: a meta-analysis. *Child Youth Serv. Rev.* 52, 74–88. doi: 10.1016/j.childyouth.2015.03.005

Rodriguez, V. J., Abbamonte, J. M., Alcaide, M. L., Rodriguez Yanes, N. L., Del La Rosa, A., Sued, O., et al. (2021). Motivational interviewing training for HIV care physicians in Argentina: uptake and sustainability of an effective behavior change intervention. *AIDS Behav.* 25, 1675–1687. doi: 10.1007/s10461-020-03083-x

Roest, J. J., Welmers-Van de Poll, M. J., Peer Van der Helm, G. H., Stams, G. J. J. M., and Hoeve, M. (2023). A three-level Meta-analysis on the Alliance-outcome association in child and adolescent psychotherapy. *Res. Child Adolesc. Psychopathol.* 51, 275–293. doi: 10.1007/s10802-022-00986-2

Rouleau, G., Pelletier, J., Cote, J., Gagnon, M. P., Martel-Laferrier, V., Levesque, R., et al. (2020). Codeveloping a virtual patient simulation to Foster Nurses' relational skills consistent with motivational interviewing: a situation of antiretroviral therapy nonadherence. *J. Med. Internet Res.* 22:e18225. doi: 10.2196/18225

Safiri, S., Nejadghaderi, S. A., Karamzad, N., Carson-Chahhoud, K., Bragazzi, N. L., MJM, S., et al. (2022). Global, regional, and national cancer deaths and disability-adjusted life-years (DALYs) attributable to alcohol consumption in 204 countries and territories, 1990–2019. *Cancer* 128, 1840–1852. doi: 10.1002/cncr.34111

Sanchez-Puertas, R., Vaca-Gallegos, S., Lopez-Nunez, C., and Ruisoto, P. (2022). Prevention of alcohol consumption programs for children and youth: a narrative and critical review of recent publications. *Front. Psychol.* 13:821867. doi: 10.3389/fpsyg.2022.821867

Schmiege, S. J., Feldstein Ewing, S. W., Hendershot, C., and Bryan, A. D. (2011). Positive outlook as a moderator of the effectiveness of an HIV/STI intervention with adolescents in detention. *Health Educ. Res.* 26, 432–442. doi: 10.1093/her/cyq060

Schmiege, S. J., Magnan, R. E., Yeater, E. A., Feldstein Ewing, S. W., and Bryan, A. D. (2021). Randomized trial to reduce risky sexual behavior among justice-involved adolescents. *Am. J. Prev. Med.* 60, 47–56. doi: 10.1016/j.amepre.2020.07.009

Shirk, S. R., and Karver, M. (2003). Prediction of treatment outcome from relationship variables in child and adolescent therapy: a meta-analytic review. *J. Consult. Clin. Psychol.* 71, 452–464. doi: 10.1037/0022-006X.71.3.452

Shirk, S. R., Karver, M. S., and Brown, R. (2011). The alliance in child and adolescent psychotherapy. *Psychotherapy* 48, 17–24. doi: 10.1037/a0022181

Silvers, J. A., Squeglia, L. M., Romer Thomsen, K., Hudson, K. A., and Feldstein Ewing, S. W. (2019). Hunting for what works: adolescents in addiction treatment. *Alcohol. Clin. Exp. Res.* 43, 578–592. doi: 10.1111/acer.13984

Starks, T. J., Adebayo, T., Kyre, K. D., Millar, B. M., Stratton, M. J., Gandhi, M., et al. (2022). Pilot randomized controlled trial of motivational interviewing with sexual minority male couples to reduce drug use and sexual risk: the couples health project. *AIDS Behav.* 26, 310–327. doi: 10.1007/s10461-021-03384-9

Steele, D. W., Becker, S. J., Danko, K. J., Balk, E. M., Adam, G. P., Saldanha, I. J., et al. (2020). Brief behavioral interventions for substance use in adolescents: a meta-analysis. *Pediatrics* 146. doi: 10.1542/peds.2020-0351

Szucs, L. E., Lowry, R., Fasula, A. M., Pampati, S., Copen, C. E., Hussaini, K. S., et al. (2020). Condom and contraceptive use among sexually active high school students—youth risk behavior survey, United States, 2019. *MMWR Suppl.* 69, 11–18. doi: 10.15585/mmwr.su6901a2

Thompson, R. G., Aivadyan, C., Stohl, M., Aharonovich, E., and Hasin, D. (2020). Smartphone application plus brief motivational intervention reduces substance use and sexual risk behaviors among homeless young adults: results from a randomized controlled trial. *Psychol. Addict. Behav.* 34, 641–649. doi: 10.1037/adb0000570

Vallabhan, M. K., Kong, A. S., Jimenez, E. Y., Summers, L. C., DeBlieck, C. J., and Feldstein Ewing, S. W. (2017). Training primary care providers in the use of motivational interviewing for youth behavior change. *Res. Theory Nurs. Pract.* 31, 219–232. doi: 10.1891/1541-6577.31.3.219

Wampold, B. E. (2015). How important are the common factors in psychotherapy? An update. *World Psychiatry.* 14, 270–277. doi: 10.1002/wps.20238

White, H. R., and Labouvie, E. W. (1989). Towards the assessment of adolescent problem drinking. *J. Stud. Alcohol* 50, 30–37. doi: 10.15288/jsa.1989.50.30

Yeager, D. S., Dahl, R. E., and Dweck, C. S. (2018). Why interventions to influence adolescent behavior often fail but could succeed. *Perspect. Psychol. Sci.* 13, 101–122. doi: 10.1177/1745691617722620

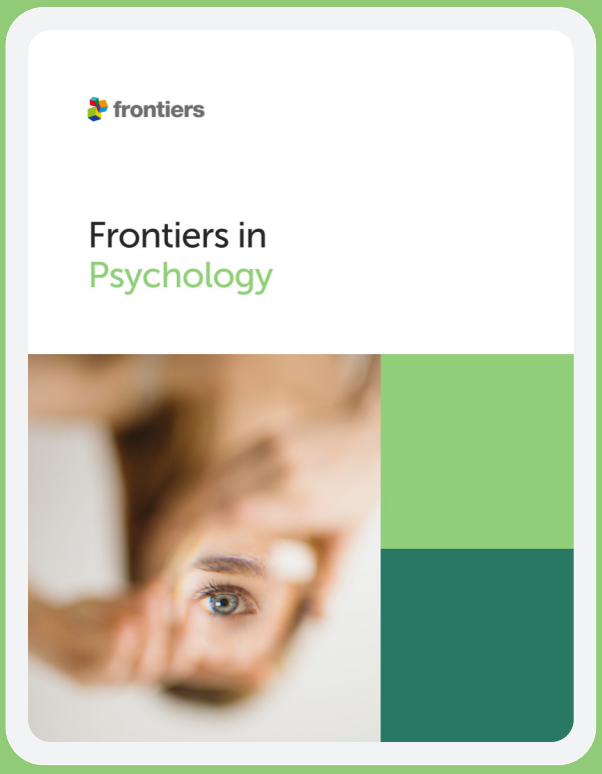
Frontiers in Psychology

Paving the way for a greater understanding of human behavior

The most cited journal in its field, exploring psychological sciences - from clinical research to cognitive science, from imaging studies to human factors, and from animal cognition to social psychology.

Discover the latest Research Topics

See more →



Frontiers

Avenue du Tribunal-Fédéral 34
1005 Lausanne, Switzerland
frontiersin.org

Contact us

+41 (0)21 510 17 00
frontiersin.org/about/contact