frontiers | Research Topics

Mental health promotion and protection, 2nd Edition

Edited by
Naseem Akhtar Qureshi, Samrat Singh Bhandari, Giorgio Di Lorenzo and Harshavardhan Sampath

Published in
Frontiers in Psychiatry
Frontiers in Public Health



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ISSN 1664-8714
ISBN 978-2-8325-3491-5
DOI 10.3389/978-2-8325-3491-5

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Mental health promotion and protection, 2nd Edition

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Citation

Qureshi, N. A., Bhandari, S. S., Di Lorenzo, G., Sampath, H., eds. (2023). *Mental health promotion and protection, 2nd Edition*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-3491-5

Publisher's note: This is a 2nd edition due to an article retraction.

Table of contents

07 Editorial: Mental health promotion and protection
Naseem Akhtar Qureshi, Samrat Singh Bhandari, Giorgio Di Lorenzo and Harshavardhan Sampath

09 Sexuality in Ultra-High Risk for Psychosis and First-Episode Psychosis. A Systematic Review of Literature
Giacomo Ciocca, Tommaso B. Jannini, Michele Ribolsi, Rodolfo Rossi, Cinzia Niolu, Alberto Siracusano, Emmanuele A. Jannini and Giorgio Di Lorenzo

23 Telemental Health Use in the COVID-19 Pandemic: A Scoping Review and Evidence Gap Mapping
Amit Abraham, Anupama Jithesh, Sathyanarayanan Doraiswamy, Nasser Al-Khawaga, Ravinder Mamtani and Sohaila Cheema

39 Stigma Levels Toward Psychiatric Patients Among Medical Students—A Worldwide Online Survey Across 65 Countries
Mateusz Babicki, Monika Małecka, Krzysztof Kowalski, Bogna Bogudzińska and Patryk Piotrowski

48 Prevalence and Associated Factors of Depressive Symptoms Among Patients With Chronic Low Back Pain: A Cross-Sectional Study
Yueming Hu, Zechuan Yang, Yong Li, Yong Xu, Mengge Tian, Nan Jiang and Ningfeng Guo

55 Perceived Academic Stress and Depression: The Mediation Role of Mobile Phone Addiction and Sleep Quality
Xin Zhang, Fei Gao, Zheng Kang, Hongguo Zhou, Jianfeng Zhang, Jingjing Li, Jun Yan, Jiahui Wang, Huan Liu, Qunhong Wu and Baohua Liu

67 Effects of Mindfulness Exercise Guided by a Smartphone App on Negative Emotions and Stress in Non-Clinical Populations: A Systematic Review and Meta-Analysis
Jinlong Wu, Yudan Ma, Yifan Zuo, Kangyong Zheng, Zhenhui Zhou, Yifan Qin and Zhanbing Ren

78 Evaluating a Psychological First Aid Training Intervention (Preparing Me) to Support the Mental Health and Wellbeing of Chinese Healthcare Workers During Healthcare Emergencies: Protocol for a Randomized Controlled Feasibility Trial
Ling Wang, Ian Norman, Tao Xiao, Yamin Li, Xizhao Li and Mary Leamy

94 Heterogeneity of Urban and Rural Areas in Association of Fringe Benefits and Depression: A Cross-Sectional Study
Tianwen Luo, Chaoyang Yan and Xiang Zhang

103 Mediating Effect of Sleep Disorder Between Low Mental Health Literacy and Depressive Symptoms Among Medical Students: The Roles of Gender and Grade
Jie Hu, Jun Wang, Danlin Li, Xuexue Huang, Yanni Xue, Liyuan Jia, Zhixian Zhang, Yuhui Wan, Xianbing Song, Rui Wang, Jun Fang, Yehuan Sun and Shichen Zhang

112 Effort-Reward Imbalance in Emergency Department Physicians: Prevalence and Associated Factors
Mengge Tian, Xuan Zhou, Xiaoxv Yin, Nan Jiang, Yafei Wu, Jiali Zhang, Chuanzhu Lv and Yanhong Gong

119 Applied Mindfulness for Physician Wellbeing: A Prospective Qualitative Study Protocol
Elli Weisbaum and Nicholas Chadi

128 Using Structural Equation Modeling to Examine Pathways Between Environmental Characteristics and Perceived Restorativeness on Public Rooftop Gardens in China
Zhanglei Chen, Kar Kheng Gan, Tiejun Zhou, Qingfeng Du and Mingying Zeng

146 Volunteer Service and Well-Being of Older People in China
Hua-lei Yang, Shuo Zhang, Wen-chao Zhang, Zheng Shen, Jia-hao Wang, Si-meng Cheng, Yi-wen Tao, Si-qing Zhang, Li-xingzi Yang, Yi-dan Yao, Lin Xie, Li-li Tang, Yuan-yang Wu and Zhi-yun Li

156 The Relationship Between Self-Care Behavior and Concerns About Body Image in Patients Undergoing Hemodialysis in Iran
Hamid Sharif Nia, Daniyal Kohestani, Erika Sivarajan Froelicher, Fatima Muhammad Ibrahim, Maryam Mohammad Ibrahim, Fatemeh Bayat Shahparast and Amir Hossein Goudarzian

162 Association Between Wisdom and Psychotic-Like Experiences in the General Population: A Cross-Sectional Study
Zhipeng Wu, Zhengqian Jiang, Zhipeng Wang, Yuqiao Ji, Feiwen Wang, Brendan Ross, Xiaoqi Sun, Zhening Liu and Yicheng Long

171 Effects of Social Participation and Its Diversity, Frequency, and Type on Depression in Middle-Aged and Older Persons: Evidence From China
Jiahui Wang, Jiao Xu, Yizhen Nie, Pochuan Pan, Xin Zhang, Ye Li, Huan Liu, Libo Liang, Lijun Gao, Qunhong Wu, Yanhua Hao and Saleh Shah

184 The Impact of Early Neighborhood Cohesion, and Its Mechanism, on Cognitive Function in Later Life
Tao Zhou, Xiaoyi Zhang, Shuming Fan, Zeming Deng and Can Jiao

194 Workplace Mental Health Interventions in India: A Rapid Systematic Scoping Review
Apurvakumar Pandya, Niharika Khanal and Mudita Upadhyaya

202 Internalized and Perceived Stigma and Depression in Pulmonary Tuberculosis: Do They Explain the Relationship Between Drug Sensitivity Status and Adherence?
Anmol Pradhan, Prakash Koirala, Samrat Singh Bhandari, Sanjiba Dutta, Pau García-Grau, Harshavardhan Sampath and Indralal Sharma

210 Mental Health Status and Its Impact on TB Treatment and Its Outcomes: A Scoping Literature Review
Charles Kwaku Agbeko, Manthar Ali Mallah, Biyu He, Qiao Liu, Huan Song and Jianming Wang

222 The Impact of the COVID-19 Pandemic on the Mental Health of Healthcare Workers in Italy: Analyzing the Role of Individual and Workplace-Level Factors in the Reopening Phase After Lockdown
Maria Francesca Moro, Gemma Calamandrei, Ranieri Poli, Valentina Di Mattei, Alessandra Perra, Peter Konstantin Kurotschka, Alexandra Restrepo, Ferdinando Romano, Giuseppe La Torre, Emanuele Preti, Franco Mascayano, Angelo Picardi, Flavia Chiarotti, Venerando Rapisarda, Antonio Urban, Ruben Alvarado, Ezra Susser and Mauro Giovanni Carta

232 Development of an Online-Coaching Blended Couple-Oriented Intervention for Preventing Depression in Middle Adulthood: An Intervention Mapping Study
Suk-Sun Kim, Minji Gil and Daeun Kim

243 Development and Feasibility of an Online Brief Emotion Regulation Training (BERT) Program for Emerging Adults
Alyssa Jo Gatto, Truitt J. Elliott, Jonathan S. Briganti, Michael J. Stamper, Nathaniel D. Porter, Anne M. Brown, Samantha M. Harden, Lee D. Cooper and Julie C. Dunsmore

258 Associations Among Depression, Hemoglobin A1c Level, and Prognosis in Patients With Coronary Artery Disease: A Prospective Study
Weiya Li, Han Yin, Quanjun Liu, Yilin Chen, Yanting Liang, Haofeng Zhou, Huan Ma and Qingshan Geng

266 Mental Health Prevention and Promotion—A Narrative Review
Vijender Singh, Akash Kumar and Snehil Gupta

283 The impact of distress disclosure and anxiety on the association between social support and quality of life among Chinese women with systemic lupus erythematosus
Rui-Chen Gao, Li Wu, Pei-Li Shi, Ni Sang, Min Hao and Guo-Cui Wu

293 Amelioration and deterioration: Social network typologies and mental health among female domestic workers in China
Binbin Tang, Mahefuzha Mamubieke, Maitixirepu Jilili, Linping Liu and Bowen Yang

305 Association between maternal depression and neonatal outcomes: Evidence from a survey of nationally representative longitudinal studies
Haoran Li, Wei Ning, Ning Zhang, Jingya Zhang, Rongxin He, Ying Mao and Bin Zhu

318 Attitude and influencing factors of patients with schizophrenia toward long-acting injections: A community-based cross-sectional investigation in China
Yiying Sun, Jie Tong, Ying Feng, Haiping Fang, Tao Jiang, Liping Zhao, Qiang Wang and Yi Yang

327 A case-control study on depression, anxiety, and belief in sexual myths in trans women
Betul Uyar, Ilyas Yucel, Emre Uyar, Elif Ateş Budak, Ilker Kelle and Semra Bulbuloglu

336 Risk factors for violent behaviors in patients with schizophrenia: 2-year follow-up study in primary mental health care in China
Zhuo-Hui Huang, Fei Wang, Zi-Lang Chen, Yao-Nan Xiao, Qian-Wen Wang, Shi-Bin Wang, Xiao-Yan He, Christine Migliorini, Carol Harvey and Cai-Lan Hou

frontiers | Frontiers in Psychiatry

TYPE Editorial
PUBLISHED 27 February 2023
DOI 10.3389/fpsyt.2023.1161358

Check for updates

OPEN ACCESS

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

RECEIVED 08 February 2023
ACCEPTED 09 February 2023
PUBLISHED 27 February 2023

CITATION
Qureshi NA, Bhandari SS, Di Lorenzo G and Sampath H (2023) Editorial: Mental health promotion and protection.
Front. Psychiatry 14:1161358.
doi: 10.3389/fpsyt.2023.1161358

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Editorial: Mental health promotion and protection

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KEYWORDS

promotion, protection, mental health, wellbeing, multifactorial

Editorial on the Research Topic
Mental health promotion and protection

> No man is an island, entire of itself;
> Every man is a piece of the continent, a part of the main……!
> —John Donne's (1572–1631) in Devotions upon Emergent Occasions.

Those lines penned by John in 1624 succinctly captured the challenges and opportunities facing not only mental health (MH) professionals but also other health experts worldwide. Like other horrifying pandemics of the past, the COVID-19 was a wake-up call that reminded all health professionals to seriously think of humanity as "a whole greater than the sum of its parts," borrowing from the wisdom and research work of Gestalt psychologists who followed his steps. As clinicians who tirelessly work to ease the suffering of people with mental and physical disorders, we are often plagued by the nagging question at the back of our minds/psyche, "is this all I can do?" given the interconnected and multisectoral web of challenging predisposing, precipitating, and perpetuating factors in terms of biopsychosocial, epigenetic, and spiritual spanning the entire macrocosm often beyond our reach, as also evident in World Health Organization report (1). More specifically, a variety of factors that contribute toward good MH include civil liberties, politics, economics, social rights, and cultural diversity, and quality of life of the individual and the society as a whole. The promotion of mental health needs multidisciplinary approach as to cover all these important factors including education, work, justice, housing, human rights, and welfare and climate change (1, 2). In other words, the identification of barriers to mental health promotion and protection also is of paramount importance which could be addressed at various levels including family, community, society and general population.

However, we are reminded by the lines in the movie Matrix (Reloaded), "Hope. It is the quintessential human delusion, simultaneously the source of (y) our greatest strength, and greatest weakness." Born of this delusional—like hope, this Research Topic on "*Mental health promotion and protection*" was launched by the Frontiers Psychiatry in July 2021. The topic of research was selected by Dr. Qureshi NA and Frontiers' Chief Executive Officer. We are overwhelmed by the positive response to our initiative-positive mental, physical, and social health, and its protection and promotion associated with wellbeing and resilience of people globally-evidenced by high quality, ingenuity and creativity, and breath of research

manuscripts submitted. This Research Topic is highlighted by research on divergently connected areas in the vast terrain-biopsychosociocultural-of MH prevention, promotion and protection.

The research by Tian et al., on the effort-reward imbalance in ER physicians, the review on MH interventions at the workplace by Pandya et al. and the impact of welfare schemes and programs offering fringe benefits to urban and rural employees by Luo et al. span the multiple areas of occupational MH.

The MH of students and young adults is captured by Hu J et al., in their study on MH literacy, sleep and depressive symptoms. A worldwide online survey of 65 countries on stigma of medical students toward psychiatric patients by Babicki et al., shows that more needs and efforts to be done and address this pernicious attitude.

The MH of female domestic workers and their relation to social networks by Tang et al., and the MH of Trans women and its association with sexual myths by Uyar et al., explore issues in marginalized and minority populations.

Technology-driven MH promotion is presented with positive results by Wu J et al., in their study of mindfulness exercise guided by a Smartphone application. Gatto et al., have presented positive results concerning an online brief emotional training program for emerging adults, and Kim et al., have developed an online-coaching blended couple-oriented intervention for adults. At the same time, the negative effects of technology on MH have been explored by Zhang et al., on smartphone addiction, sleep, academic stress, and depression.

Promoting the adherence to treatment in chronic and severe mental disorders, Sun et al., investigated the factors influencing the attitudes of patients living in the community toward long-acting depot antipsychotics, while the risk factors of violent behavior in schizophrenic psychosis is presented by Huang et al., in a 2-year follow-up study. Interestingly, wisdom as a protective factor for psychotic-like experiences in the general population are reported by Wu Z et al. Sexuality in people with ultra-high risk such as late adolescents and early adulthood, genetic vulnerability and attenuated psychotic symptoms and first-episode psychosis is systematically reviewed by Ciocca et al..

In the area of liaison psychiatry, depression, type 2 diabetes mellitus, and coronary atherosclerotic heart disease by Li W et al.; chronic low back pain and depression by Hu Y et al.; body image concerns in hemodialysis by Nia et al.; social support and quality of life in female systemic lupus erythromatosis sufferers by Gao et al.; the impact of maternal depression on neonatal outcomes by Li H et al.; psychological factors affecting treatment adherence in patients with tuberculosis by Pradhan et al.; and finally a review of the impact of MH on outcome in tuberculosis by Agbeko et al., are presented in this issue.

Novel studies including the research by Chen et al., on the restorative effect of rooftop gardens in urban settings needs special mention. Similarly, Zhou et al., have demonstrated that childhood neighborhood cohesion has a significant impact on neurocognitive functions in later life. Also a protocol for assessing the feasibility of psychological or MH first aid training of front-line healthcare workers in the provision of MH care during emergencies is presented by Wang L et al..

The role of community services on positive MH is highlighted by Yang et al., in their study on the impact of volunteering services in older adults and Wang J et al., in their research paper related to social participation in community activities in middle age and elderly residents.

Finally, the impact of the COVID-19 pandemic on the MH of healthcare workers in Italy during the reopening phase after lockdown by Moro et al., and the review of telemental health use during COVID-19 pandemic by Abraham et al., find place in this Research Topic.

To summarize, we are sure this issue does justice to MH Promotion and Protection, as we coordinate our resources, influence policy makers, engage with the community, and strive to make this World a better place for our future generations. We tentatively suggest the next topic of greatest interest: "Traumatic events in infants and adolescents and its psychiatric trajectories in future life."

Author contributions

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

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frontiers in Psychiatry

REVIEW
published: 27 October 2021
doi: 10.3389/fpsyt.2021.750033

Sexuality in Ultra-High Risk for Psychosis and First-Episode Psychosis. A Systematic Review of Literature

Giacomo Ciocca[1], Tommaso B. Jannini[2], Michele Ribolsi[3], Rodolfo Rossi[2], Cinzia Niolu[2], Alberto Siracusano[2], Emmanuele A. Jannini[2] and Giorgio Di Lorenzo[2,4]*

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A considerable body of literature reports that individuals with psychotic disorders often suffer from sexual dysfunctions (SDs), with these representing a major unmet need. Long-term antipsychotic drug treatment may be the main cause for SDs in psychotic patients, through a plethora of different mechanisms, including prolactin dyscrasia, histamine-mediated sedation, and serotonin-induced sexual demotivation. However, a few pieces of evidence treat sexuality in patients at risk or the onset of psychosis. For this purpose, we systematically reviewed literature of the last 10 years in order to investigate sexuality in ultra-high risk (UHR) for psychosis and first-episode psychosis (FEP). We included in our review 34 articles fitting our research criteria on SDs in UHR and FEP. Evidence of SDs in the transition from UHR to FEP emerges through the selected studies. In FEP, sexuality is affected by the severity of the psychotic symptoms and, in some cases, by the iatrogenic effects of psychopharmacological treatment. Further experimental and clinical studies should systematically investigate the role of sexual functioning in the transition from UHR to FEP and, consequently, clarify whether or not SDs could be considered a possible marker for the onset of psychosis in at-risk populations. Moreover, psychiatrists and clinical psychologists should take into consideration the role of sexual life in young people with prodromal mental symptoms or at the onset of psychosis. Focusing on a thorough sexual evaluation might be a major challenge that could break down barriers of mental health promotion among young people with schizophrenia-spectrum disorders and therefore achieve better clinical outcomes.

Keywords: ultra-high risk for psychosis, first-episode psychosis, sexuality, mental health promotion, sexual trauma

OPEN ACCESS

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

Received: *30 July 2021*
Accepted: *30 September 2021*
Published: *27 October 2021*

Citation:
Ciocca G, Jannini TB, Ribolsi M, Rossi R, Niolu C, Siracusano A, Jannini EA and Di Lorenzo G (2021) Sexuality in Ultra-High Risk for Psychosis and First-Episode Psychosis. A Systematic Review of Literature. Front. Psychiatry 12:750033. doi: 10.3389/fpsyt.2021.750033

INTRODUCTION

Psychotic spectrum disorders (PSDs), e.g., schizophrenia. schizoaffective disorder, affective disorders with psychotic manifestations, are devastating conditions generally accompanied by a consistent number of medical comorbidities (1).

It is well-established in literature that individuals with psychiatric disorders, psychosis in particular, can often suffer from sexual dysfunctions (SDs) (2). Indeed, a major cause of impairment

may be the patients' long-term drug treatment, which affects sexuality through a plethora of different mechanisms, including prolactin dyscrasia, histamine-mediated sedation, and serotonin-induced sexual demotivation (3, 4). Sexual function (SF) can be impaired in many domains, ranging from desire, arousal, erection, and ejaculation in males, to orgasm (5, 6). Therefore, it is easy to understand how the prevalence of sexual dysfunctions in psychotic patients is much higher than in the general population (7).

First-episode psychosis (FEP) is defined as the first time a person experiences psychosis or psychotic symptoms. Patients with FEP go through different periods of transition, with phases of well-being alternating with prodromal states characterized by (i) non-psychotic behavioral disorders (such as depression or obsessive-compulsive symptoms); (ii) attenuated psychotic symptoms that do not require treatment; (iii) psychotic symptoms that require initial antipsychotic drug therapy; (iv) a formal diagnosis of the schizophreniform disorder and, subsequently, of schizophrenia (8).

The trajectory to developing first-episode psychosis was systematized in the last years by the concept of ultra-high risk (UHR), a sub-clinical period characterized by one of the following conditions and criteria: the attenuated psychotic symptom (APS) criterion, the brief limited intermittent psychotic symptom (BLIPS) criterion, and the genetic risk and functional decline (GRFD) criterion (9). Clinicians and researchers consider this period and the presence of UHR criteria as a possible phase to prevent a possible imminent frank psychosis (10).

Within the context of these clinical scenarios, it is useful to understand the role of sexuality. Sexuality itself has a large number of meanings, namely symbolizations, perceptions, impulses. Sexuality can easily fit inside a delusional, erotomaniac, or persecutory frame (11). On the other hand, a recent and relevant overview article pointed out the importance of considering sexuality in the psychiatric field and severe mental illnesses (12).

It is well-established in literature how people with psychotic spectrum disorders have serious impairments in the theory of mind (ToM) domain (13). ToM refers to the mental ability, defined as mentalization, to understand other people's behavior, considering it the result of different mental states. Since interpersonal relationships and intimacy play a key role in early psychosexual development, it is easy to imagine how mentalization among these patients might be crucial during these years. A recent review article has indeed underscored how dating might be extremely challenging for people with psychotic disorders, as romantic and intimate relationships are often precluded for such patients (14). From a psychodynamic point of view, a disrupted ToM might result in a compromised capacity to integrate sexual states in one's own developing identity, therefore producing high levels of distress (15). To this end, it is not surprising that early evidence has indeed shown how a poor premorbid sociosexual functioning is associated with a greater severity of negative symptoms as well as current social withdrawal (16).

UHR and FEP are critical moments in the clinical history of psychosis. During these times, sexuality is indeed completely reworked in its symbolic-relational connotations, characterized by remarkable impairments, and delusional contents. In addition, it also remains a major unmet need in the life of psychotic patients. Some interesting studies have indeed found that clinicians often fail to evaluate sexual problems, with this having dramatic repercussions on the partner, on the couple, on the therapy itself, and eventually on the overall quality of life (QOL) (17). In a recent article, the Authors surveyed a group of 750 psychiatrists, investigating their clinical care algorithms; the findings suggested how little importance is generally given to sexual health (18). In particular, only up to 3% of clinicians reported conduct a thorough sexual assessment on people with severe mental illnesses.

Since sexual dysfunction deeply weighs on QOL (19), it is easy to understand how neglecting sexual health might represent a relevant barrier in mental health promotion and a dangerous risk factor among young people with a clinical high risk of developing full-blown schizophrenia. In keeping more closely with this issue, two recent review articles discuss how important it is to better assess intimacy and sexuality among young people with FEP and psychotic disorders in general (14, 20). However, to date, a comprehensive review of sexual dysfunction among patients with a clinical high risk of developing psychosis is still missing.

Considering that sexual health is a perfect crossover between mental and physical health and yet a major unmet need among people with UHR and FEP, the aim of this present article is to enhance awareness on this important topic. For this purpose, we reviewed the most relevant original experimental articles found in literature on the relationship between sexuality and psychosis in UHR and FEP individuals.

METHODS

Search Strategies

For this review, a thorough analysis was conducted of literature focused on Sexual functioning, First Episode Psychosis, and Ultra-High Risk for psychosis.

A computerized search was performed to identify a full relevant experimental article in PubMed, Web of Science, and Scopus on sexual functioning in First-Episode Psychosis and Ultra-High Risk for psychosis, published from January 2010 up to December 2020.

The following search terms were used: "First Episode Psychosis" AND "Sexuality" OR "First Episode Psychosis" AND "Sexual Dysfunction" OR "First Episode Psychosis" AND "Sexual Behavior" OR "Ultra-High Risk for Psychosis" AND "Sexuality" OR "Ultra-High Risk for psychosis" AND "Sexual Dysfunction" OR "Ultra-High Risk for psychosis" AND "Sexual Behavior."

Inclusion criteria were: English published studies with a high/medium level of evidence according to the Canadian Task Force on the Periodic Health Examination (21), i.e., randomized controlled trials (RCTs), case-control, and cross-sectional studies; the articles must include patients diagnosed with either FEP or UHR for psychosis according to the DSM-V (1) or ICD-10/ICD-11 (22).

Exclusion criteria were review articles, books/book chapters, editorials, theses; studies concerning characteristics

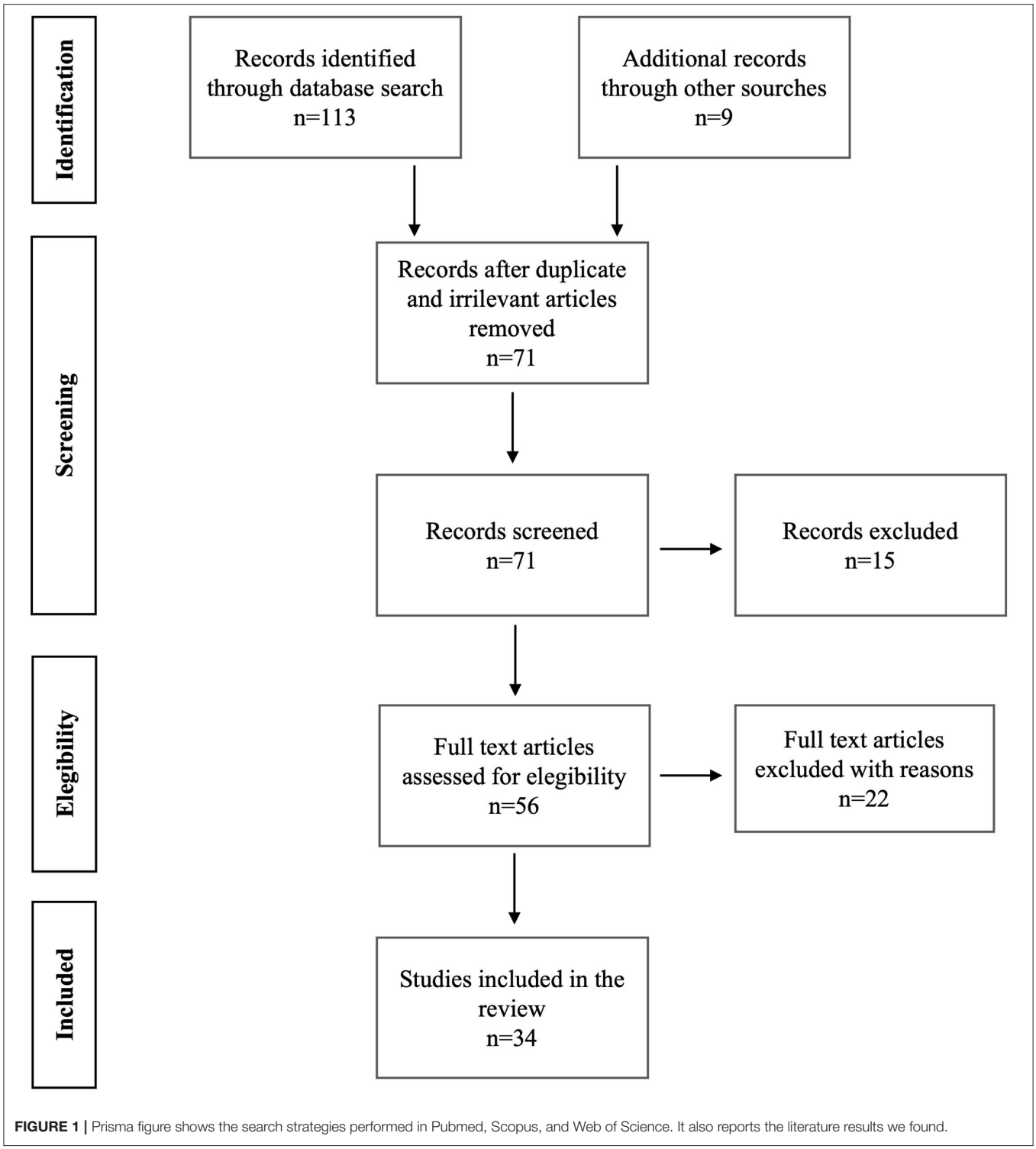


FIGURE 1 | Prisma figure shows the search strategies performed in Pubmed, Scopus, and Web of Science. It also reports the literature results we found.

of personality not connected to sexuality; chemical, biological, and other field studies different from sexology and sexual medicine. **Figure 1** represents the flowchart showing further details on the literature search and the selection of articles included in this literature review.

RESULTS

A total of 113 articles were retrieved on PubMed, Scopus, and Web of Science. Subsequently, 47 articles were selected based on their abstracts. Finally, 34 articles, of which 1 was a RCT, 7 were retrospective studies and 26 were cross-sectional studies,

fully satisfied the criteria for the review (**Figure 1**, **Table 1**). We broke down these literature results between UHR and FEP into the following paragraphs.

Ultra-High Risk for Psychosis and Sexuality

Traditionally, sexual dysfunction in psychotic illnesses has always been linked to adverse side effects of psychopharmacology. However, sexuality can be severely impaired by numerous factors regardless of pharmacotherapy, like premorbid personality, i.e., schizoid or schizotypal, psychopathology itself, as a result of the negative effect of psychosis on personal and sexual relationships, and medical comorbidities that frequently occur in these patients (58). Indeed, a proof of concept of this was provided by a previous study where sexual function in UHR people was compared with healthy control subjects and with first-episode psychosis patients (28). The Authors demonstrated that UHR people that subsequently became full-blown psychotic patients primarily revealed greater sexual impairment compared to UHR individuals who did not develop psychosis. This evidence was not related to the gender or to the side effects of any antipsychotic treatment, as the UHR people were not undergoing any psychopharmacological therapy (28). In light of this study, it is possible to consider sexual dysfunctions as manifestations of UHR criteria-related psychotic symptoms. Moreover, it is also interesting to notice how the sexual content of thinking may be a direct consequence of early-life sexual abuse among young people with clinical high risk for psychosis.

UHR and Sexual Trauma

Although it is well-established how early trauma represents a vulnerability factor toward psychosis (59), previous research has also pointed out how the sexual nature of delusion demonstrates a close relationship with a past episode of sexual trauma or sexual abuse. For instance, being watched in the shower/toilet or undressing were the most frequent sexual delusions to be reported in UHR people (32). Generally, the relationship between sexual trauma and the UHR condition is mostly characterized by perceptual disturbances with sexual contents (35), symptomatologic elements that reveal once again to be predictive for psychosis.

In this regard, most of the experimental articles we reviewed affirmed that sexual abuse, physical abuse, and sexual trauma in childhood represent the main predictors for developing a frank psychosis in adulthood. More than 20% of people with UHR for psychosis had an experience of sexual abuse during childhood (24, 25, 31). Consistent with the literature, this dramatic evidence is mostly related both to the female gender and to higher levels of childhood trauma (33, 35).

Young individuals with at risk mental states who suffered from sexual abuse are also reported to have a higher severity and frequency of psychotic experiences (30, 53).

Moreover, recent evidence reported that UHR patients with a past clinical history of sexual abuse feature both cognitive and neuroanatomical impairments. In particular, patients with a history of physical trauma performed worse in attention, interference inhibition, working memory, and cognitive flexibility. Significant cortical thickness reductions in prefrontal and temporal brain regions were also observed in individuals at UHR for psychosis who reported moderate to high levels of childhood sexual abuse (29, 34). In addition, a study found that the striatal dopamine function, whose system is well-known to be impaired in PSDs, is increased in people with experiences of sexual abuse (27).

Therefore, it is possible to hypothesize that sexual trauma in childhood might represent a *primum movens* in people with UHR, with a devastating impact on the neuroanatomical and neurophysiological development.

First Episode Psychosis and Sexuality

The overall prevalence of sexual impairments in an FEP study population may vary from 13 to 64%, mostly depending on how patients were both selected and assessed (47, 49, 52). The European First Episode Schizophrenia Trial (EUFEST) reported dysfunctions in many domains of sexuality, i.e., orgasm (15%), erectile dysfunction (17%), and decreased libido (30.8%) in patients that were randomly assigned to various antipsychotics. Findings also showed that the main side effects caused by the increase in prolactin resulted in amenorrhea, galactorrhea, and gynecomastia (50).

As these patients are often young, it is important to investigate sexual health during the psychiatric evaluation (39). For instance, people with psychiatric disorders are more prone to engage in risky sexual behaviors, with psychotic patients ranking among the top positions (60). Notably, young people with FEP are more likely to have unprotected sexual intercourse compared to their peers. Previous research highlighted how younger age, absence of peer support, unemployment, and clinical status were associated with an increased probability of condom misuse in these patients (41). Sexual knowledge among such patients is poor, not only from a physical and technical standpoint (i.e., how to perform sexual intercourse or other sexual practices) but also in terms of prevention of sexually transmissible infections (STIs) (61).

Hence, it is easy to understand how people with FEP are at greater risk of contracting STIs, therefore needing significant prevention strategies and risk-reduction measures (42).

FEP and Sexual Trauma

It is not surprising to see that, similarly to UHR patients, consistent evidence of sexual abuse during childhood among people with FEP is also present in literature. A recent systematic review has indeed pointed out how its prevalence spans from 6 to 40%, with women suffering more sexual abuse compared to men (62). Moreover, the impact of childhood trauma tends to be greater on later-stage symptoms. For instance, FEP patients who suffered sexual abuse showed more positive and depressive symptoms as well as more severe delusions and hallucinations compared to their counterparts (37). Consistent with this, sexually abused patients with FEP show poor premorbid functioning, longer DUP, fewer years of education, past history of suicide attempts, and other psychiatric disorders; moreover, they are more likely to be diagnosed with a lifetime substance use disorder (43).

This evidence is backed up by an interesting model, known as the *traumagenic neurodevelopmental model of psychosis* (TN),

TABLE 1 | Studies inserted in the review analysis about the sexuality in ultra-high risk for psychosis and first-episode psychosis.

References	Psychiatric condition	Design of the study	Sample size	Tools and measures		Main findings
				Sexual behavior measures	**Other psychiatric measures**	
Adan Sanchez et al. (23)	UHR	Cross-sectional	103	Items relating to sexual risk behavior	Brief Psychiatric Rating Scale (BPRS)	Young people with mental disorders reported major sexual risk behaviors and also a relevant frequency of sexually transmitted infections (STIs). The contraceptive methods use are few, and also the most of pregnancy is unplanned.
Appiah-Kusi et al. (24)	UHR	Case-control	68	N/A	Childhood Trauma Questionnaire (CTQ); Beck Depression Inventory (BDI); State-Trait Anxiety Inventory (STAI); Cannabis Experience Questionnaire (CEQ); Paranoid Thought Scales (PTS); Psychosis Screening Questionnaire (PSQ)	The 21% of UHR patients assessed had been exposed to sexual abuse. On the whole, this study confirmed the pathogenetic role of childhood trauma in the development of psychosis. Moreover, major negative self-schemas were found in UHR patients compared to healthy controls.
Bechdolf et al. (25)	UHR	Cross-sectional	92		Comprehensive Assessment of At-Risk Mental States (CAARMS); General Trauma Questionnaire (GTQ)	UHR patients with past sexual trauma have a major risk to develop psychosis. About one-quarter of UHR patients had a history of sexual abuse. Sexual trauma in the UHR population is, therefore, a predictive factor for the conversion in FEP and frank psychosis.
Dragt et al. (26)	UHR	Cross-sectional	72	N/A	Basic Data Form (BDF); Client Service Receipt Inventory (CSRI); Premorbid Adjustment Scale (PAS)	Social–sexual aspects together with the social–personal adjustment were the best predictors for developing a first psychotic episode in the assessed UHR group.
Egerton et al. (27)	UHR	Case-control	67	Childhood Experience of Care and Abuse Questionnaire (CECA-Q)	Comprehensive Assessment of At-Risk Mental States (CAARMS); Positive and Negative Syndrome Scale (PANSS); Hamilton Depression and Anxiety Rating Scales; Positron Emission Tomography (PET).	Among childhood adversities, only sexual and physical abuse was found with a higher prevalence in the UHR group compared to the healthy control. Subjects with experiences of physical or sexual abuse in childhood show higher dopamine function in the associative striatum.
Marques et al. (28)	UHR	Case-control	124	Sexual Function Questionnaire (SFQ)	Positive and Negative Syndrome Scale (PANSS); Calgary Depression Scale	UHR people then converted into psychotic patients primarily revealed a great sexual impairment, as sexual dysfunctions, compared to UHR individuals no developed psychosis.
Rapado-Castro et al. (29)	UHR	Cross-sectional	62	N/A	Comprehensive Assessment of At-Risk Mental States (CAARMS); Scale for the Assessment of Negative Symptoms (SANS); Brief Psychiatric Rating Scale (BPRS); Hamilton Rating Scale for Depression (HRSD); Global Assessment of functioning Scale (GAF); Quality of Life Scale (QLS); Adult Intelligence Scale-Revised (WAIS-R); Wechsler Abbreviated Scale of Intelligence (WASI); Intelligence Scale for Children (WISC-III); Childhood Trauma Questionnaire (CTQ); magnetic resonance imaging (MRI)	UHR patients with experiences of sexual abuse show reductions in prefrontal and temporal brain regions, highlighting a particular morphological vulnerability of superior prefrontal and temporal structures to sexual trauma. Sexual abuse, inducing a reduction of cortical thickness in the right middle temporal gyrus, has an indirect effect on the transition to psychosis.
Sahin et al. (30)	UHR	Case-control	193	N/A	Brief Psychiatric Rating Scale (BPRS); Scale for the Assessment of Negative Symptoms (SANS); Scale for the Assessment of Positive Symptoms (SAPS)	In UHR females the scores for the sexual abuse of CTQ were significantly higher than in males and in the overall group. The sexual abuse was related to positive symptoms. Moreover, the UHR group

(Continued)

TABLE 1 | Continued

References	Psychiatric condition	Design of the study	Sample size	Tools and measures		Main findings
				Sexual behavior measures	**Other psychiatric measures**	
					Trauma Questionnaire (CTQ); Calgary Depression Scale for Schizophrenia (CDSS).	showed higher scores at sexual abuse compared to healthy controls. Overall, childhood trauma is a predictive factor related to both patients with UHR and first-episode schizophrenia.
Schmidt et al. (31)	UHR	Cross-sectional	73	N/A	Structured Interview for Psychosis-Risk Syndromes (SIPS); Trauma And Distress Scale (TADS); German Stress-Coping-Questionnaires; German Competence and Control Beliefs Questionnaire (FKK); Beck Depression Inventory (BDI-II); Mini International Neuropsychiatric Interview in its version for adults (MINI)-suicidality scale.	The 21.5% of CHR patients reported sexual abuse and this aspect is inserted in the relationship between traumatic experience and suicidality. Moreover, sexual abuse is correlated with the major use of dysfunctional coping strategies. On the whole, sexual abuse has resulted related to suicidal ideation in CHR patients.
Thompson et al. (32)	UHR	Cross-sectional	93	N/A	Comprehensive Assessment of At-Risk Mental States (CAARMS)	Being watched in the shower/toilet or undressing were more frequent sexual delusions relived in UHR people. These delusion types in UHR are often related to a history of sexual trauma.
Thompson et al. (33)	UHR	Cross-sectional	416 (233)	N/A	Childhood Trauma Questionnaire (CTQ); Comprehensive Assessment of At-Risk Mental States (CAARMS); Brief Psychiatric Rating Scale (BPRS); Global Assessment of Functioning (GAF); Schedule for the Assessment of Negative Symptoms; Hamilton Rating Scale for Depression; Quality of Life Scale.	Females with UHR showed a higher score to CTQ for sexual abuse and physical abuse and in the overall sample the sexual abuse is related to the transition to psychosis. Therefore, past sexual trauma is the main risk factor to develop a frank psychosis in the UHR population, suggesting clinicians to investigate the sexual abuse experiences in people at risk of severe mental disorders.
Üçok et al. (34)	UHR	Cross-sectional	53	N/A	Brief Psychiatric Rating Scale (BPRS); Global Assessment of Functioning (GAF); Scale for the Assessment of Negative Symptoms (SANS); the Scale for the Assessment of Positive Symptoms (SAPS); the Childhood Trauma Questionnaire (CTQ); the Calgary Depression Scale for Schizophrenia (CDSS) and neuropsychological tests.	Patients with a history of physical trauma performed worse in attention, interference inhibition, working memory, and cognitive flexibility tests than individuals without physical trauma. However, no differences between subjects with and without a history of childhood emotional/sexual trauma were found in terms of cognitive performance
Velthorst et al. (35)	UHR	Case-control	127	N/A	Comprehensive Assessment of At-Risk Mental State (CAARMS).	A major association between female gender and sexual abuse was found in UHR patients. Moreover, sexual abuse was related to post-traumatic stress disorder symptoms and perceptual disturbance with sexual contents.
Ajnakina et al. (36)	FEP	Retrospective study	236	Childhood Experience of Care and Abuse Questionnaire (CECA-Q)	Positive and Negative Syndrome Scale (PANSS)	Childhood sexual abuse, physical abuse, and parental separation had a significant association with positive dimensions.
Bendall et al. (37)	FEP	Cross-sectional	28	Childhood Trauma Questionnaire (CTQ)	Positive and Negative Syndrome Scale (PANSS); Impact of Events Scale-Revised (IES-R); National Adult Reading Test (NART)	FEP patients who suffered a sexual abuse presented more positive and depressive symptoms, more severe delusions and hallucinations compared to their counterparts

(Continued)

TABLE 1 | Continued

References	Psychiatric condition	Design of the study	Sample size	Tools and measures		Main findings
				Sexual behavior measures	**Other psychiatric measures**	
Braehler et al. (38)	FEP	Cross-sectional	171	Childhood Trauma Questionnaire (CTQ);	Dissociative Experiences Scale (DES)	Severe childhood trauma is associated with greater dissociative symptoms, with emotional abuse showing the greatest association with dissociation
Brown et al. (39)	FEP	Cross-sectional	115	Broad indicators of sexual risk behavior were either developed or adapted from Visser and Smith (40)	Brief Psychiatric Rating Scale, Expanded Version (BPRS-E)	Increased frequency of unprotected sex in people with FEP suggests that those with psychosis are at increased STI risk and have distinct needs
Brown et al. (41)	FEP	Cross-sectional	112	Patient-reported questionnaire on sexual behavior	Kessler 10 Psychological Distress Scale; Rosenberg Self-Esteem Scale; Multidimensional Scale of Perceived Social Support; Opiate Treatment Index	Increased probability of inconsistent condom use was associated with clinical status, younger age, unemployment, and the absence of peer support for condom use.
Brown et al. (42)	FEP	Cross-sectional	112	Patient-reported questionnaire on sexual behavior;	Kessler 10 Psychological Distress Scale; Rosenberg Self-Esteem Scale; Multidimensional Scale of Perceived Social Support; Opiate Treatment Index;	Inconsistent condom use was predicted by clinical status, unemployment, and the absence of peer support for condom use.
Conus et al. (43)	FEP	Case-control	658	N/A	Early Psychosis File Questionnaire; EPFQ	
Ciocca et al. (44)	FEP	Cross-sectional	77	Udvalg for Kliniske Undersøgelser (UKU);	Positive and Negative Syndrome Scale (PANSS)	Correlation between sexual dysfunctions and psychopathology did not reveal any association in males. On the other hand, in females, general psychopathology and positive symptoms were linked to the alteration in vaginal lubrication.
Ciufolini et al. (45)	FEP	Cross-sectional	302	Childhood Experience of Care and Abuse Questionnaire (CECA-Q); cortisol saliva levels	N/A	Divergent effect of severe childhood abuse on HPA axis activity in patients with FEP and controls, with FEP showing a reduced cortisol awakening response and a less reactive HPA axis.
Del Cacho et al. (46)	FEP	Cross-sectional	118	Changes in Sexual Function Questionnaire (CSFQ); hormone blood levels	Positive and Negative Syndrome Scale (PANSS)	Evidence of better sexual function in healthy controls compared to patients with FEP. No association between both prolactin and testosterone and sexual function.
El Sayed El Taweel et al. (47)	FEP	Cross-sectional	50	Arizona Sexual Experience Scale (ASEX); designed questionnaire	Mini International Neuropsychiatric Interview (MINI); Positive and Negative Syndrome Scale (PANSS); the Montgomery–Asberg Depression Scale (MADRS)	Male patients with FEP reported significantly more sexual dysfunctions compared to controls. A statistically significant correlation was seen between the long duration of untreated psychosis, the severity of negative symptoms, and depressive symptoms with the severity of sexual dysfunction among patients with schizophrenia.
Gaber et al. (48)	FEP	Cross-sectional	80	International Index of Erectile Function (IIEF-5)	N/A	Males with FEP are more likely to develop erectile dysfunction (ED); the duration of untreated psychosis also leads a higher incidence of ED and hyperprolactinemia.
Hui et al. (49)	FEP	Cross-sectional	343	Udvalg for Kliniske Undersøgelser (UKU);	Scale for the Assessment of Positive Symptoms (SAPS); Scale for the Assessment of Negative Symptoms (SANS); Role Functioning Scale (RFS);	Sexual dysfunction was significantly and independently associated with being married, more general side effects, poorer functioning, and higher monthly income

(Continued)

TABLE 1 | Continued

References	Psychiatric condition	Design of the study	Sample size	Tools and measures		Main findings
				Sexual behavior measures	**Other psychiatric measures**	
Malik et al. (50)	FEP	Randomized controlled trial	498	Udvalg for Kliniske Undersugelser (UKU)	Positive and Negative Syndrome Scale (PANSS); St Hans Rating Scale	Only mild differences in sexual dysfunctions were seen among five antipsychotics groups, underscoring the role of the disease itself on the onset of these adverse effects.
Misiak et al. (51)	FEP	Cross-sectional	141	Childhood Experience of Care and Abuse Questionnaire (CECA-Q)	Positive and Negative Syndrome Scale (PANSS); the Montgomery–Asberg Depression Rating Scale (MADRS); the Young Mania Rating Scale (YMRS); the Global Assessment of Functioning (GAF)	FKBP5 gene methylation is significantly lower in FEP compared to controls. In particular, patients with parental apathy and sex abuse had significantly lower levels of FKBP5 methylation.
Ravichandran et al. (52)	Drug-naïve patients with psychosis	Cross-sectional	100	International Index of Erectile Functioning (IIEF)	Positive and Negative Syndrome Scale (PANSS)	Sexual dysfunction may be found in patients with psychotic disorders before starting their pharmacotherapy.
Reininghaus et al. (53)	FEP	Cross-sectional	147	N/A	Experience sampling method (ESM)	Elevated sensitivity to minor stressful events and enhanced threat anticipation are associated with more psychotic experiences.
Theleritis et al. (54)	FEP	Cross-sectional	239	Childhood Experience of Care and Abuse Questionnaire (CECA-Q); Brain-derived Neurotrophic Factor (BDNF) plasmatic levels	N/A	Significant effect of separation, physical, and sexual abuse on Brain-derived Neurotrophic Factor (BDNF), with patients with a history of sexual trauma showing lower plasmatic levels of Brain-derived Neurotrophic Factor (BDNF).
Theleritis et al. (55)	FEP	Cross-sectional	116	Sexual Function Questionnaire (SFQ); weight; BMI; waist; waist-hip ratio; hormone blood levels	Positive and Negative Syndrome Scale (PANSS); Calgary Depression Score (CDS)	Results showed a correlation of higher SFQ and higher BMI, leptin levels, waist-hip ratio, and lower testosterone levels
Tomassi et al. (56)	FEP	Cross-sectional	345	Childhood Experience of Care and Abuse Questionnaire (CECA-Q)	Cannabis Experiences Questionnaire (CEQ)	Sexual abuse was associated with a diagnosis of affective psychosis and higher rates of cannabis and heroin abuse; physical abuse was associated with lifetime use of heroin.
van Bruggen et al. (57)	FEP	Cross-sectional	40	Questionnaire for Sexual Dysfunction (QSD); hormone blood levels	Positive and Negative Syndrome Scale (PANSS)	Patients reported a significantly higher frequency of problems with ejaculation and problems with insensibility of genitals compared to controls. However, no relation between medication, hormonal levels, frequency of sexual activity, overall satisfaction with sexuality, and any of all sexual dysfunctions was found.

which links childhood sexual maltreatments in people with FEP to functional and structural brain alterations during young adulthood (63). TN posits how hypothalamic-pituitary-adrenal axis (HPA) alterations, structural cerebral changes, such as frontal lobe and hippocampus abnormalities, dopamine system impairments, and psychiatric comorbidities are consistently more frequent in FEP patients who suffered from sexual trauma. For instance, sexual abuse exerts a divergent effect on HPA axis activity in patients with FEP and controls, with FEP showing a reduced cortisol awakening response and a less reactive HPA axis (45). Sexually maltreated people with FEP also reported higher levels of dissociative symptoms compared to controls (38). To this end, childhood sexual abuse, physical abuse, and parental separation are reported to be significantly associated

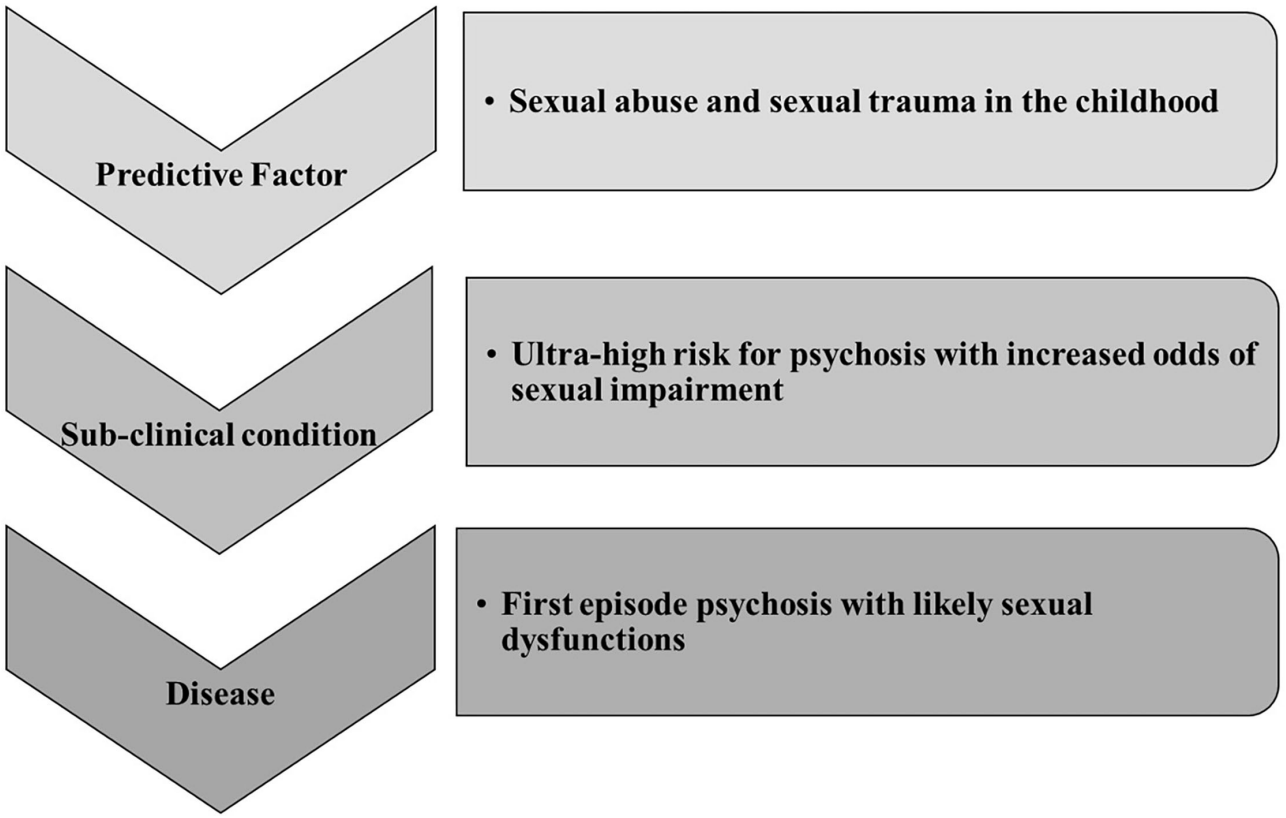


FIGURE 2 | Our literature review is summarized in this figure showing the sexological trajectory of psychosis. It is based on literature finding mainly focused on sexual abuses experience. Sexual trauma can be considered a central etiological factor for UHR, FEP, and then psychosis. However, major clinical and research attention should be posed to sexual impairment during the UHR phase.

with higher positive and negative symptoms (30, 36), more intense psychotic experiences (53), more frequent diagnosis of affective psychosis and higher rates of cannabis and heroin abuse (56) among young patients with FEP. Interestingly, recent evidence reported how sexual trauma may also impact at a molecular and genetic level, with sexually abused FEP young individuals showing a lower methylation of the FKBP5 gene (51) and lower *brain-derived neurotrophic factor* (BDNF) plasmatic levels (54).

lower brain-derived neurotrophic factor (BDNF) levelsŤ]

These findings underline and confirm what is extensively reported in literature; i.e., that early trauma deeply impacts on the development and severity of psychosis (64) (**Figure 2**).

FEP and Gender

If in recent years psychopathology has focused more on what is generically defined as gender medicine, in the case of sexological evaluation in patients with FEP a *genderized* approach takes on clinical and theoretical relevance (65). For example, literature suggests that men show more negative and obsessive-compulsive symptoms, are more prone to drug abuse and develop symptoms earlier than women (66). To date, however, only a few studies offered a dichotomous perspective on gender differences of sexual dysfunctions in FEP (44, 46, 55, 65–67). Apart from the prevalence, which is slightly the same in both sexes, a conflicting result is found in two studies. In the first study, the authors described how vaginal lubrification and orgasm are significatively correlated with either general or positive PANSS scores, without finding any similar homolog association among male subjects (44). On the other hand, the second study reported that sexual functioning was negatively correlated with disorganized and positive symptoms in males and with higher scores in negative symptoms among females (46). Finally, a study on SF and metabolic structure among men found a correlation between higher Sexual Function Questionnaire scores (i.e., worse sexual outcome) and BMI, leptin levels, and waist-hip ratio (55). This highlights how obesity could play a mediating role between psychopathology and sexual dysfunction, with hormonal alterations in testosterone levels in young male patients with psychosis. A recent study evaluated 40 male subjects and found that men with FEP have a higher probability of developing erectile dysfunction (ED), with a DUP increasing the risk of both ED and hyperprolactinemia (48). Women, on the other hand, have more resources and social support during the pre-crisis phase, with levels of social functioning playing a protective role, although they show more depressive, anxious, and affective symptoms (67). Although these findings are scarce and poorly consistent with each other, they highlight

the importance of considering a gender-based perspective in sexual function among patients with FEP in order to obtain a better therapeutic outcome.

Psychopharmacotherapy and Pathophysiology in FEP

Unlike UHR, people with FEP have generally had their first encounter with a specialist. As they are most commonly under psychopharmacological therapy, sexual dysfunctions are certainly enhanced by adverse side effects of antipsychotics (28). Rates of sexual dysfunction recurrence are indeed higher in FEP people under psychopharmacotherapies. To this end, a recent study conducted on a very large sample, within the EUFEST protocol, investigated these aspects during the first year of drug treatment, with particular attention to hormonal alterations and sexual dysfunctions (50). The authors indicated that other than age and general PANSS score, prolactin levels in the blood also predicted erectile dysfunctions in males.

Consistent with this, another study on 243 patients diagnosed with FEP and treated with antipsychotics found a prevalence in sexual impairment of 46% (2). The authors also reported that risperidone weighed on sexuality in a dose-dependent manner, causing more severe sexual dysfunctions compared to other active principles. Moreover, at the univariate logistic regression, risperidone showed a 7-fold increased risk of developing SDs.

However, a growing body of evidence stresses the importance of the disease pathophysiology as a major cause of sexual impairment in drug-naïve patients with FEP. Multiple studies point out how impaired sexuality may be either predicted by or correlated to heavier psychotic symptomatology and longer DUP, without showing any association with hormones blood levels, like prolactin, or testosterone (46, 47, 50, 52), although hyperprolactinemia may be a clinical feature of drug-naïve people with FEP (68). Moreover, these results are consistent with and endorsed by evidence from FEP individuals treated either with olanzapine or risperidone (57). Although patients in the drug groups reported a higher prevalence of sexual dysfunctions (without any difference between olanzapine and risperidone) compared to controls, no relationship between medication, hormones, frequency of sexual activity, and overall sexual satisfaction was found.

DISCUSSION AND CONCLUSIONS

When a physical, psychic, social, or relational problem arises, sexuality is almost always involved in its dysfunctional declination. Over time, a large body of literature has focused on the role of sexual dysfunction as a prodromal symptom of a possible psychotic onset (28). This omnipresent feature of sexuality during either a chronic or transient state of illness takes on considerable importance in young people. This is indeed testified by the families of FEP patients, whose major concerns for their offspring, along with substance abuse and self-esteem, is also sexuality and intimacy (69).

Similarly to major depression, in UHR individuals and people with FEP sexual dysfunctions may be considered as a prodrome or a consequence of either psychopathology or psychopharmacology.

Most of the early evidence indeed underscores a powerful intrinsic influence of psychosis itself on sexual functioning. Possible explanations for this might be found in the neurobiological mechanisms underpinning both sexual dysfunctions and schizophrenia. In a recent review article of five studies about the impact of psychosis on sexual functioning, Varga-Cáceres et al. hypothesized the role of a striatal dopaminergic dysregulation as a major cause of dysfunction in sexual life among unmedicated psychotic patients (20). Although the striatal dopaminergic pathway is key in reward-predicting cues, and therefore in sexual motivation (70), other possible explanations must be taken into account to better define the intricate relationship between these two conditions. In addition to dopamine and striatum, psychosis, and sexual disorders share in fact impairments both at other neurotransmitters and at different brain networks level. From a neurotransmitter perspective, we would like to focus on glutamate, oxytocin, and endocannabinoids. Firstly, it is well-established in literature that schizophrenia is characterized by high levels of glutamate in the prefrontal cortex (71). Interestingly, a recent article highlighted how glutamate afferents from the prefrontal cortex modulate the activation of the *nucleus accumbens*, a key hub for pleasure and reward, in female rodents during sexual intercourse (72). Keeping this in mind, we infer that impaired levels of glutamate in psychosis might be responsible for altered sexual functioning. Secondly, extensive data suggests that impairments in social life occurring in psychosis may also be explained by a dysfunctional oxytocinergic system, a key modulator of emotional, sexual, and social processes (73, 74). Disorders in ejaculation and consequently in orgasm may indeed be linked to a compromised dopamine and oxytocin pathways between the hypothalamus and the limbic structures (75). Thirdly, the endocannabinoid system (ECS) is considered a major modulator of the hedonic effects of natural rewards, such as sexual activity, with endogenous cannabinoids showing a significant relationship with sexual arousal (76, 77). As ECS has shown to be impaired in individuals with psychotic disorders, including those at the early stages of the illness without antipsychotic treatment (78), we might also hypothesize that altered levels of endocannabinoids might be another important etiology of sexual dysfunctions in psychosis.

From a brain network-based perspective, an altered mesocortical pathway may also be responsible for an impaired sexual drive in psychosis. The dorsolateral prefrontal cortex, an area involved in goal-directed behaviors and motivational significance to sexual stimuli (79), is mainly modulated by dopamine from the ventral tegmentum. As its functional alterations are largely reported in psychosis, it would explain why psychosis itself, featuring flattened affect, anhedonia, reduced social drive, and loss of motivation, may account for impaired sexual desire (80).

Finally, there have been several attempts to define psychosis as a disconnection syndrome. In the light of this, we might postulate that dysfunctions in the three major resting-state networks, i.e. default mode, salience, and central executive

networks, which account for most of the behavioral, cognitive, and social deficits of psychosis, might also be an explanation for sexual deficits among people with psychotic disorders (81). In other words, as this model seems to explain the neural bases of intimacy and empathy, it might also be interpreted as a neurophysiological biotype for the comorbidity between psychosis and sexual dysfunctions.

On the other hand, extensive literature has grown on the fact that antipsychotics may impact sexual functioning, mostly because they affect the tuberoinfundibular pathway, therefore resulting in high levels of prolactinemia (82). For this reason, it is of vital importance to actively implement new therapeutical strategies to lower the incidence of these adverse effects. For instance, in addition to the well-known aripiprazole, whose switching (83) or augmentation (84) are now established among therapeutic options, new drugs are proving to decrease their impact on sexual functioning. In particular, both brexpiprazole (85) and the recently introduced SEP-363856 (86) have shown significantly low levels of prolactinemia in patients with schizophrenia.

After our screening of literature, several issues could be considered as lacking in the assessment and prevention of a possible mental disease. For example, a well-known phenomenon of compulsive masturbation related to psychiatric distress was not studied in light of the UHR or FEP condition (87), although it should be considered as one of the markers for the potential development of severe mental illness.

At the same time, hypersexuality and compulsive use of pornography could be indicators of psychosocial distress in more fragile personalities. Therefore, clinicians and researchers should take into consideration a possible relationship between these dysfunctional aspects of sexual behavior and a predisposition toward psychopathology, above all in young adults and adolescents (88, 89). Another understudied aspect, but likely central for psychologically-vulnerable males, is penile dysmorphia, a specific sexual symptom comparable to body dysmorphic disorder. If this symptom is often treated in the urological and andrological fields, with potential surgical approaches, a psychiatric assessment would be highly recommended when penile size becomes an obsession (90).

Hence, the behavioral spectrum related to the predictive role of sexual behavior toward psychopathology or dysfunctional condition is large and variegated. Literature mainly investigated sexual functioning and sexual history related to a traumatic experience in association with FEP and UHR, although other behavioral phenomena could be correlated to the exacerbation of psychopathology in youths. In this regard, clinical protocols should take into consideration more adequate assessment praxis along with the standardized psychometric procedure. To date, many psychometric tools are available to assess sexual behavior in all its facets, from sexual functioning to dysregulated and compulsive sexual behavior. These questionnaires should be integrated into psychodiagnostics in order to detect and possibly prevent a potential predictive association between sexual problems and possible mental disease.

Nevertheless, sexuality has to be considered as one of the major unmet needs and, likewise, sexual impairments as an important barrier to mental health promotion for young people with schizophrenia-spectrum diseases (91). Young people with UHR or FEP might be indeed facing what could be defined as a "*syndemics.*" Although this term is most specifically used within contexts of infectious diseases, syndemics refers to a biosocial model in which two or more medical conditions co-occur and interact leading to worse negative health outcomes (92). This model may also be applied to sexuality among young people with a clinical high risk of psychosis. Disease-related sexual dysfunctions, higher rates of sexual risky behavior, STIs, and sexual self-stigma, together with the well-known array of psychotic symptoms may, in fact, synergistically enhance feelings of worthlessness and increase social isolation (93). It is therefore easy to understand how this may dramatically affect an already delicate doctor-patient relationship, especially in a population of young individuals. Having such an unmet need might take away useful pathways of communication between the patient and the psychiatrist/clinical psychologist, therefore leading to worse clinical outcomes and higher rates of therapy drop-outs.

Thus, focusing on a thorough sexual evaluation might be a major challenge that could break down barriers of mental health promotion among young people with schizophrenia-spectrum diseases.

In conclusion, the clinician's defensive denial of a patient's sexuality can significantly affect the treatment, therefore hindering the achievement of a general well-being to which every therapeutic practice should aspire. With this in mind, psychiatry and clinical psychology should considerably include sexual assessment, as well as sexological expertise, in their research and clinical praxis.

Although this review benefits of a broad focus, our study suffers from a number of major limitations. Firstly, the vast majority of the studies were cross-sectional, with only one RCT. This means that no follow-up data was present; thus caution must be taken when generalizing these findings. Secondly, the high heterogeneity of studies did not allow to use a metanalytic approach, which would have been desirable in order to draw more consistent conclusions on this topic. Thirdly, none of the mentioned studies used a structural equation modeling approach, that would allow to gain information on the possible modulating or moderating effects of certain variables (i.e., gender, type of psychosis, *etc.*) on other variables (such as desire, arousal, orgasm, or overall sexual behavior). For this reason, with this article we aim to encourage future studies that will shed a brighter light on psychosis and sexual functioning.

AUTHOR CONTRIBUTIONS

GC: manuscript drafting and conceptualization. TBJ: investigation and manuscript drafting. MR and RR: literature review. CN, AS, and EAJ: data curation and literature review. GDL: supervision and project administration. All authors contributed to the article and approved the submitted version.

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SYSTEMATIC REVIEW
published: 08 November 2021
doi: 10.3389/fpsyt.2021.748069

Telemental Health Use in the COVID-19 Pandemic: A Scoping Review and Evidence Gap Mapping

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Background: The COVID-19 pandemic has highlighted telemedicine use for mental illness (telemental health).

Objective: In the scoping review, we describe the scope and domains of telemental health during the COVID-19 pandemic from the published literature and discuss associated challenges.

Methods: PubMed, EMBASE, and the World Health Organization's Global COVID-19 Database were searched up to August 23, 2020 with no restrictions on study design, language, or geographical, following an *a priori* protocol (https://osf.io/4dxms/). Data were synthesized using descriptive statistics from the peer-reviewed literature and the National Quality Forum's (NQF) framework for telemental health. Sentiment analysis was also used to gauge patient and healthcare provider opinion toward telemental health.

Results: After screening, we identified 196 articles, predominantly from high-income countries (36.22%). Most articles were classified as commentaries (51.53%) and discussed telemental health from a management standpoint (86.22%). Conditions commonly treated with telemental health were depression, anxiety, and eating disorders. Where data were available, most articles described telemental health in a home-based setting (use of telemental health at home by patients). Overall sentiment was neutral-to-positive for the individual domains of the NQF framework.

Conclusions: Our findings suggest that there was a marked growth in the uptake of telemental health during the pandemic and that telemental health is effective, safe, and will remain in use for the foreseeable future. However, more needs to be done to better understand these findings. Greater investment into human and financial resources, and research should be made by governments, global funding agencies, academia, and other stakeholders, especially in low- and middle- income countries. Uniform guidelines for licensing and credentialing, payment and insurance, and standards of care need to be developed to ensure safe and optimal telemental health delivery. Telemental health education should be incorporated into health professions curricula globally. With rapidly advancing technology and increasing acceptance of interactive online platforms amongst patients and healthcare providers, telemental health can provide sustainable mental healthcare across patient populations.

Systematic Review Registration: https://osf.io/4dxms/.

Keywords: COVID-19, coronavirus disease, telemedicine, mental health, psychiatry

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Edited by:
Samrat Singh Bhandari, Sikkim Manipal University, India

Reviewed by:
Sonu Menachem Maimonides Bhaskar, Liverpool Hospital & South West Sydney Local Health District (SWSLHD), Australia
Arunkumar Annamalai, University of Madras, India

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

Received: *27 July 2021*
Accepted: *15 October 2021*
Published: *08 November 2021*

Citation:
Abraham A, Jithesh A, Doraiswamy S, Al-Khawaga N, Mamtani R and Cheema S (2021) Telemental Health Use in the COVID-19 Pandemic: A Scoping Review and Evidence Gap Mapping. Front. Psychiatry 12:748069. doi: 10.3389/fpsyt.2021.748069

INTRODUCTION

Mental illness is a significant global public health issue; it is estimated to account for 13% of disability-adjusted life-years and 32.4% of years lived with disability (1). The ongoing COVID-19 pandemic has exacerbated the mental illness of vulnerable communities and individuals. Those with mental illnesses are highly vulnerable to suffer exacerbations during times of stress, such as the COVID-19 pandemic, due to their reliance on their social support network and their propensity to loneliness and isolation (2). Multiple reports indicate a rise in the prevalence of depression, anxiety, and substance use across the demographic spectrum since the onset of the COVID-19 pandemic (3–7).

During the pandemic, there was an increase in the uptake of telehealth. This digital tool, which was used sparingly prior to the pandemic, has helped enhance access to healthcare services and has proven to be safe and effective for evaluation and management (8, 9). It further leverages the expertise of highly specialized professionals across the globe (9). The myriad methods of telehealth delivery emphasize its potential to connect with marginalized populations, such as refugees or those living in remote areas (9).

Several terminologies in the published literature are currently interchangeably used to characterize telehealth related to mental health. In this review, we use the term "telemental health" [a term previously used in the literature and the National Institute of Mental Health (10–13)] in order to comprehensively describe the complete scope of Internet and Communication Technologies (ICT) based range of diagnostic and preventive mental health services. Scholarly literature has ascertained the need to guide clinical and public health decision-making by conducting scoping reviews to identify evidence, clarify concepts and characteristics, and determine research gaps (14, 15). This differentiates it from a systematic review, which is used to answer specific and well-defined research questions. As our purpose was to characterize the nature and context of the evidence in the published literature on telemental health, we decided to conduct a scoping review. The objective for this scoping review and evidence synthesis is to delineate and map the scope and domains of telemental health during the COVID-19 pandemic from the published literature and discuss associated challenges.

METHODS

Overview

The scoping review was conducted in accordance with the Joanna Briggs Institute (JBI) Reviewer Manual (16, 17), the framework suggested by Arksey and O'Malley (15), and the evidence and gap map was based on the Campbell Collaboration Guidance (18). The protocol was registered on the Open Science Framework (registration ID: https://osf.io/4dxms) (19).The scoping review is reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (**Supplementary Material 1**) (20) and the PRISMA for Abstracts Checklist (**Supplementary Material 2**) (21).

Abbreviations: ICT, Internet and communication technologies; JBI, Joanna briggs institute reviewer manual; NQF, national quality forum; PRISMA-ScR, Preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews; WHO, World health organization.

Eligibility Criteria

The eligibility criteria were established *a priori* as described in the protocol and are summarized here. All article types published within the COVID-19 pandemic context were included–viewpoints, observational articles, qualitative data, and systematic reviews. We considered all articles that described the use of any form of ICT, such as telephone calls, text messaging, video conferencing, smartphone applications, websites, blogs, store-and-forward, etc., for the purpose of prevention, screening, diagnosis, treatment, counseling, rehabilitation, and any other form of mental healthcare during COVID-19 as telemental health outcomes, as determined by the WHO definition of telemedicine (22, 23). We included any type of population without restriction (e.g., adults, children & adolescents, people with and without chronic disease, people with and without pre-existing mental illness, people who were diagnosed with COVID-19 etc.), provided that some ICT modality was used to provide for their mental health needs. No language or geographical restrictions were implemented.

We excluded any article that was not relevant to mental health or that focused exclusively on telehealth use in medical education or explored the use of telemental health prior to the onset of the COVID-19 pandemic.

Search Strategy

Two reviewers (AA and SD) systematically searched Medline (via PubMed), Embase, and the World Health Organization's (WHO) Global COVID-19 Research Database, with an end-date of August 23, 2020. The end-date coincided with the increasing recognition of the mental health consequences of the pandemic and the emergence of literature to that effect (24, 25). For Medline and Embase, both controlled vocabulary and keyword searches (a combination of keywords related to COVID-19, mental health, and telehealth) were used. The WHO Global COVID-19 Research Database allows a keyword search only. Details are provided in **Supplementary Material 3**. We also systematically checked the bibliographies of relevant included articles for additional references. Further, we created a database of articles from related scoping reviews that we previously conducted (23, 26) and, from these, were able to identify several articles that were not picked up in our initial search strategy. The search strategy was verified by a senior librarian from Weill Cornell Medicine-Qatar.

Study Selection

AA removed all identified duplicates using Rayyan (27), the systematic review software, following which two reviewers (AA and AJ) screened the identified articles in a two-stage screening process (title/abstract screening and full-text screening). Discrepancies at both stages were reconciled through discussion with the team. The reasons for exclusion at each step were recorded.

Data Extraction

A standardized charting sheet was developed by AA, AJ, and SD to extract relevant information, which was modified after piloting on a small sample of articles. Once the form was finalized, AA and AJ each extracted 50% of the identified articles and then checked the remaining 50% of each other's extraction. Discrepancies were resolved between AA and AJ while keeping the review team informed. If any retrieved article was in a language unknown to the authors, the article was translated into English using Google Translate.

Data Synthesis

Data was extracted into Microsoft Excel and synthesized using descriptive statistics. Following the recommendations of the Campbell Collaboration (18), we synthesized the evidence and used gap mapping to assess the strength of the evidence included in our scoping review. We classified mental illnesses using the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria (28) to understand the breadth of use of telemental health. If an article described multiple DSM-5 disorders, these were tallied separately, hence the sum totals reported below may not add up to 100%.

We used the telehealth framework developed in 2017 by the National Quality Forum (NQF) (29) to measure telehealth use for delivering healthcare. The framework uses specific domains to categorize the outcomes of telehealth including: (i) Access to Care, (ii) Financial Impact, (iii) Patient Experience, (iv) Healthcare Provider Experience, and (v) Effectiveness. In addition, using the sentiment analysis framework (30, 31), we evaluated the aforementioned domains as "celebratory" (if telehealth viewed positively by the included article authors), "contingent" (if included article authors were undecided between the pros and cons of telehealth), and "concern" (if included article authors considered the negatives to outweigh the positives of telehealth), as used in previously published literature (26, 32, 33). AA performed the sentiment analysis, with SD randomly checking 50% of the analysis to ensure integrity of the data.

RESULTS

Our primary search strategy identified 1,826 articles, from which 481 duplicates were removed. Of the remaining 1,345 articles, 1,072 were excluded during title and abstract screening and 92 during full text screening. The supplementary search strategy yielded 15 articles, so a total of 196 articles were finally included in our scoping review. This is illustrated in the PRISMA flowchart (**Figure 1**). The list of included articles is reported in **Supplementary Material 4**.

The 196 articles included in the scoping review were predominantly commentaries, viewpoints, and opinions (101, 51.53%), followed by primary studies (48; 24.45%) and reviews, recommendations, and guidelines (47; 23.98%). The articles were published across 114 journals, the majority of which were specialized in mental health, psychiatry, or related fields. The remaining journals were either general medicine journals or focused on fields, such as e-health, adolescent medicine, or occupational health. While the journal that published the highest number of the included articles followed a subscription-based model, most articles were published in hybrid or open-access journals. Most of the identified articles were published in English (194/196; 98.98%), followed by two each in French and German (2/196; 1.02%) and one each in Polish, Portuguese, and Russian (1/196; 0.51%).

The identified articles described the context of 26 countries; however, most (95/196; 48.47%) articles did not specify the country of focus. Of the articles that specified a country, most mentioned the US (31/196; 15.82%), followed by Italy and the UK, each with six articles (6/196; 3.06%). Using the WHO's regions, most articles focused on the Americas (38/196; 19.39%) and Europe (32/196; 16.32%), followed by the Western Pacific (12/196; 6.12%), South East Asia (5/196; 2.55%), and the Eastern Mediterranean (3/196; 1.53%). Most articles focused on the World Bank's high-income (71/196; 36.22%) and upper-middle income (15/196; 7.65%) countries. Only four articles focused on lower-middle income countries (4/196; 2.04%) and none on low-income countries. Detailed tables are provided in **Supplementary Material 5**.

The articles identified in our review were mostly written with a specific purpose of telemental health (189/196; 96.43%), while the remaining articles were general articles describing ethics of telemental health, digital privacy rights, etc. (7/196; 3.57%). Of those with a specific purpose, most of the articles described management (169/189; 89.42%); eleven articles reported both management and prevention (focused on the prevention of mental illness) (11/189; 5.82%); six articles described the preventative context only (6/189; 3.18%); two articles described both management and rehabilitative services (restoration of optimal level functioning in those with a mental illness) (2/189; 1.06%); and one article focused solely on rehabilitative services (1/189; 0.53%). The setting in which telehealth was administered was described as home- and hospital-based (55/196; 28.06%), home-based only (25/196; 12.76%), hospital-based only (14/196; 7.14%), home and school-based (2/196; 1.02%), or school-based only (1/196; 0.51%). The setting was unspecified in the remaining 99 articles (99/196; 50.51%).

There were 17 categories of healthcare providers involved in the use of telemental health in the identified articles, the most common of which were psychologists and psychiatrists (**Supplementary Material 6**). The specific telemental health techniques administered (such as cognitive behavioral therapy, prolonged exposure therapy, etc.) are listed in **Supplementary Material 7**. The telehealth modality described in the articles included telephone hotlines and telephone visits, videoconferencing software, text messaging, smartphone-based applications, online chats and emails, websites, social media, and blogs.

We classified the articles using the domains of the NQF's framework (29), the results of which are depicted in **Table 1**. The "Access to Care" domain in the articles primarily discussed the provision of quality service to marginalized populations, technological barriers, and privacy and confidentiality issues. The "Financial Impacts" domain focused on out-of-pocket savings for individuals and families and insurance policy decisions. The "Patient Experience" domain predominantly focused on

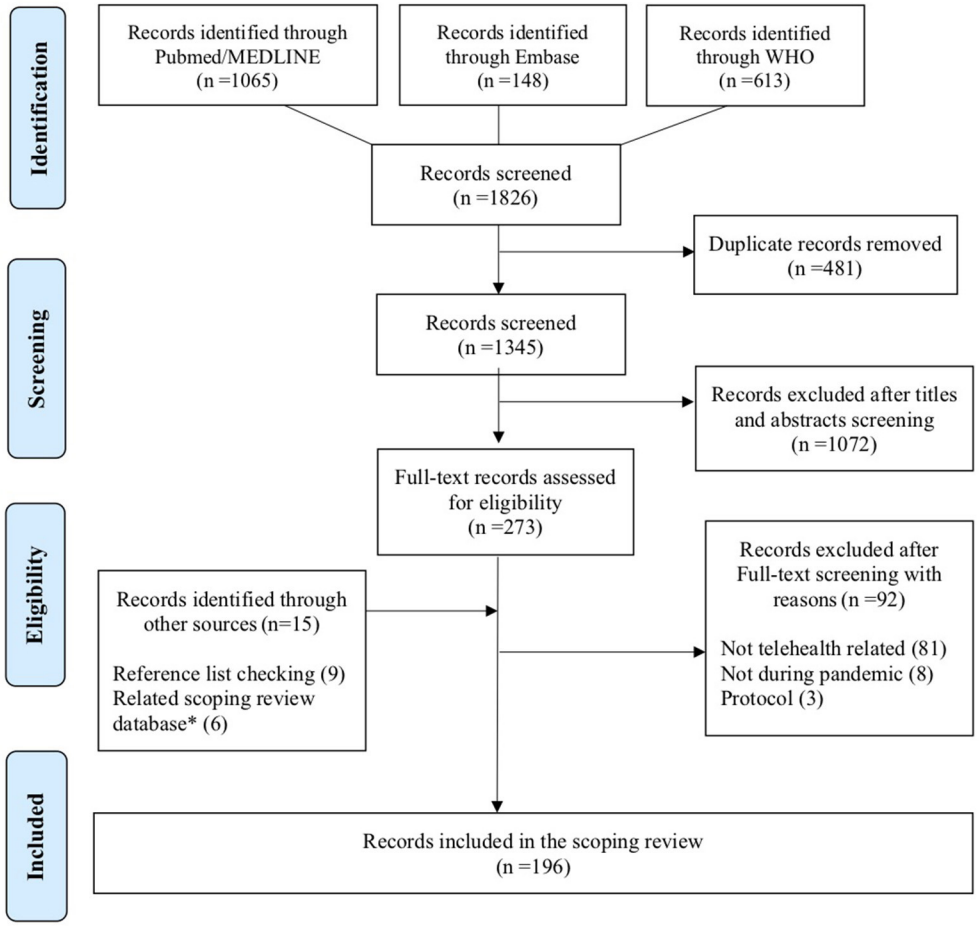


FIGURE 1 | PRISMA 2009 flowchart of the systematic review's inclusion. *Database on telemedicine from previous scoping reviews.

acceptability/satisfaction and the patients' home setting as both a barrier and facilitator. The principal aspects discussed under the "Healthcare Provider Experience" domain were acceptability/satisfaction, building a therapeutic alliance, and privacy and safety. With regards to the "Effectiveness" domain, the therapeutic alliance and the difference in measured outcomes were most frequently discussed. We used the sentiment analysis framework (30, 31) to describe the authors' outlook within the domains of the NQF framework, as shown in **Figure 2**. A majority of the included articles were "celebratory" (telehealth viewed positively by the article authors), or "contingent" (article authors were undecided between the pros and cons of telehealth), in describing the utilization of telemental health in each of the five domains. Articles classified as "concern" (article authors considered the negatives to outweigh the positives of telehealth) raised issues of privacy and confidentiality, digital equity, and technological challenges.

Just over half of all articles described a specific mental health diagnosis (109/196; 55.61%), as described by the DSM-5. More specifically, the most frequently cited DSM-5 disorders were trauma and stressor-related disorders (14/196; 7.14%), anxiety disorders (13/196; 6.63%), and depressive disorders (12/196; 6.12%). The most frequent disorder subtypes, when specified, were depression (12/196; 6.12%), anxiety (10/196; 5.10%), and eating disorders (9/196; 4.59%). A total of 52 articles examined mental health disorders in specific scenarios that could not be classified using the DSM-5 criteria (such as mental health in pediatric, oncology, geriatric, and refugee-care settings), and these were grouped together under "Specialized psychiatry" (52/196; 26.53%). **Table 2** illustrates the DSM-5 disorders and subtypes identified in the articles.

To inform the context of telemental health, we harmonized the evidence into a visual map by comparing the scope of service (management, preventative, rehabilitative, general) to each domain within the NQF's telemental health framework, and the design of the study (**Figure 3**). The map demonstrates that most articles examined management using telemental health and a few articles examined prevention or rehabilitation. Furthermore, commentaries were the most common study design included in our scoping review, nearly double of the other designs. Most articles described the Access to Care and Effectiveness domains, with relatively few focusing on the Financial Impact.

TABLE 1 | Telemental health usage classified by the NQF's framework domains describing the objectives of included publications.

Domains	Telemental health use	
Access to care	Service people in remote locations	(34–63)
	Travel (time; efficiency; difficulty; infectious disease exposure risk)	(36, 39, 48, 50, 51, 54, 57, 58, 64–78)
	Barriers related to stigma	(35, 52, 65, 79–83)
	Transition to outpatient care	(68, 69, 76, 78, 84–87)
	Marginalized populations and healthcare disparities	(37, 41, 45, 47, 50, 53, 57, 62, 65, 70–73, 85, 88–115)
	Technology as a facilitator and barrier	(34, 37, 51, 57, 58, 60, 61, 65, 66, 72, 84, 89, 90, 92, 93, 99, 102, 104, 107, 111, 113, 116–129)
	Digital privacy and confidentiality	(43, 46, 51, 57, 60, 61, 65, 71, 74, 82, 88–90, 93, 102, 106, 108, 109, 111, 113, 117, 125, 130–136)
	Creating reserve capacity to handle increase in usage	(77)
	Licensing and regulatory issues	(39, 43, 58, 65, 89, 93, 98, 109, 113, 119, 124, 137–140)
Financial Impact	Out-of-pocket expenditure for patients and families	(34, 52, 68, 70, 74, 88, 113, 123, 134, 137, 141–144)
	Funding and costs for health service providers, hospitals, and other healthcare facilities	(71, 76, 88, 92, 95, 111, 123, 132, 144–149)
	Community cost benefits	(51, 53, 57, 83, 126, 139)
	Insurance policy on telemental health	(34, 41, 44, 47, 65, 74, 100, 102, 106, 115, 118, 130, 137, 139, 150)
Patient experience	Acceptability	(41, 52, 57, 58, 60, 69–73, 75, 76, 83, 85, 86, 92, 93, 104, 109, 110, 112, 120, 125, 127, 128, 130, 134, 145, 146, 150–159)
	Convenience	(70, 71, 86, 92, 120, 149, 156, 160, 161)
	Communication and rapport with healthcare provider	(50, 52, 91, 126, 133, 162, 163)
	Home setting as facilitator and barrier	(70, 71, 84, 89, 95, 106, 149, 163–167)
	Reduced waiting times	(42, 168)
	Safety	(72, 155, 163, 165, 167, 169)
	Privacy	(71, 92, 128, 165, 170)
Healthcare provider experience	Acceptability	(34, 47, 55, 57, 58, 60, 83, 85, 86, 92, 93, 100, 109, 119, 121, 123, 127, 128, 130, 135, 136, 138, 143, 146, 149, 152, 156, 158, 160, 163, 165, 171, 172)
	Logistics and convenience	(35, 48, 50, 52, 65, 67, 70, 71, 73, 84, 85, 95, 128, 135, 149, 168, 173)
	Communication and rapport with patients	(44, 60, 69, 70, 73, 84, 92, 93, 108, 113, 119–121, 130, 135, 138, 154, 156, 166–168, 174–177)
	Psychiatric examination and testing	(50, 60, 69–71, 111, 112, 120, 134, 156, 165, 168, 171, 174, 176, 178–180)
	Privacy and safety concerns	(34, 52, 60, 65–67, 69, 70, 92, 93, 119, 122, 126, 129, 149, 156, 163, 173, 176, 178, 181)
	Videoconferencing/"Zoom" fatigue	(52, 60, 65, 67, 161, 166, 177)
	Home setting as a facilitator and barrier	(149)
	Recorded sessions as learning for trainees	(84)
Effectiveness	Feasibility	(35, 36, 66, 68, 69, 133, 182)
	Patient engagement	(34, 58, 80, 91, 95, 122, 155, 160, 183)
	Differential outcomes (either empirical evidence or symptomatic relief)	(38, 49, 50, 53, 55, 58, 65, 68–70, 83, 85, 90, 92, 93, 100–103, 112, 114, 122, 125, 127, 130, 141, 145, 146, 151, 156, 157, 167, 170, 175, 180, 183–194)
	Therapeutic alliance and social support systems	(34, 52, 58, 59, 65, 66, 70, 71, 73, 79, 84, 89, 90, 92–95, 108–112, 116, 120–122, 127, 133, 140, 142, 143, 154, 159–161, 166, 167, 169, 176, 195–197)
	Psychiatric examination and testing	(41, 46, 50, 57, 67, 103, 107, 108, 121, 122, 127, 135, 169, 194)
	No-show rate, loss to follow-up, and medication & treatment adherence	(34, 38, 51, 70, 90, 99, 101, 134, 142, 144, 156)
	Harmful self-perception and safety	(42, 65, 122, 143, 157, 176, 198)
	Administrative workflow	(138, 141)
	Cultural considerations	(66, 71, 142)

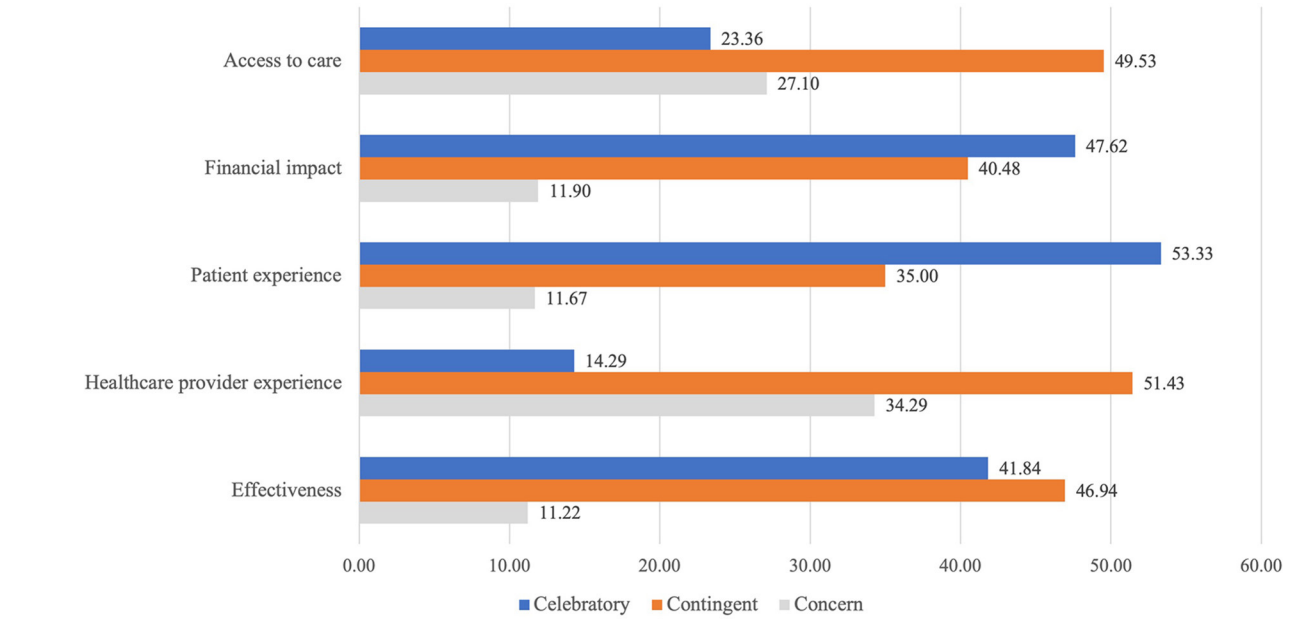


FIGURE 2 | Sentiment analysis of author outlook on NQF domains.

Table 3 summarizes the recommendations, where they were made, for enhancing telemental health from the included articles by NQF domain (36/196; 18.37%). Most articles called for standardizing licensing and regulatory policies, ensuring appropriate privacy and confidentiality measures, adequate preparation of patients and healthcare providers for the telemental health experience, having a back-up plan for technological glitches, and ensuring the presence of safety measures in case of a psychiatric emergency.

DISCUSSION

In this scoping review and evidence synthesis, we collated the extent and use of telemental health during the COVID-19 pandemic and lessons learned that could be beneficial for the future. Most articles in the scoping review described the management aspects of telemental health provision, with only a few describing preventative or rehabilitative aspects. Thus, there is much scope for improvement in order to use telemental health for prevention and early diagnosis of mental illnesses. This can be facilitated by building resilience through social network and connections, augmenting social services and surveillance systems, and enhancing surge capacity and redundancy in the mental healthcare system (5). Approximately half of the articles in our review described general telemental health care rather than focusing on a specific mental health disorder. This finding illustrates the generalizability of telemental health and its application to all aspects of the telemental health continuum, from prevention to management to rehabilitation.

Our findings demonstrate that most of the identified articles described telemental health in the context of high-income countries, which is reflected in the scholarly literature (23, 26). Current data suggest that telemental health can be effectively used in these countries (23, 26). However, there is a scarcity of evidence supporting its use in low-resource settings (202–204). This highlights the importance of data collection from lower middle-income as well as low-income countries.

While telemental health is increasingly becoming more mainstream in high-income countries, the identified articles note that challenges regarding regulations, credentialing and licensing, and standards of care must be overcome. A careful cost-benefit analysis must be conducted for each practice, due to vagaries that are region-specific. Further work must be undertaken to enhance access to and affordability of technology (123). Identified data, while limited in low and middle-income countries, suggests that telemental health is beneficial in these settings. The effectiveness of telemental health may vary in more culturally diverse settings, and the cost of implementation in low- and middle-income countries is unclear. Issues surrounding privacy and confidentiality must be addressed in settings with less-than-robust healthcare systems and high levels of stigma toward mental health problems (202). A total of four identified articles discussed the ethical implications of telemental health (88, 89, 173, 178). The same ethical obligations of patient beneficence; fidelity and responsibility; distributive justice; integrity; privacy; and autonomy apply to telemental health (178, 205). However,

TABLE 2 | Telemental health usage classified by DSM-5 criteria (conditions and subtypes).

Mental disorders	Sub-types	Number of studies[a]
Anxiety disorders		**13**
	Anxiety	10
	Generalized anxiety disorder	1
	Social anxiety disorder	1
	Unspecified	1
Bipolar and related disorders		**5**
	Bipolar disease	5
Depressive disorders		**12**
	Major depressive disorder	12
Disruptive, impulse control, and conduct disorders		**1**
	Unspecified	1
Feeding and eating disorders		**10**
	Anorexia nervosa	1
	Bulimia nervosa	1
	Binge eating disorder	1
	Unspecified	9
Neurocognitive disorders		**5**
	Major and mild neurocognitive disorders [traumatic brain injury]	1
	Unspecified	4
Neurodevelopmental disorders		**6**
	Attention-Deficit/ hyperactivity disorder	1
	Autism spectrum disorder	4
	Intellectual disability	1
	Unspecified	1
Obsessive-Compulsive and related disorders		**2**
	Obsessive compulsive disorders	2
Schizophrenia spectrum and other psychotic disorders		**7**
	Schizoaffective disorder	1
	Schizophrenia	4
	Unspecified	2
Sleep wake disorders		**1**
	Insomnia disorder	1
Somatic symptom and related disorders		**1**
	Unspecified	1
Specialized psychiatry		**52**
	Dermatology	1
	Ethics	1
	Immigrant, refugee, and asylum seekers	2
	Geriatrics	10
	Oncology	3
	Pediatrics	13
	Preventive medicine	2
	Psychological stress	10
	Rural mental health	1
	Serious mental illness	1
	Social isolation	3
	Suicide	1
	Unspecified	4
Substance-Related and addictive disorders		**8**
	Alcohol-Related disorders	1
	Cannabis-Related disorders	1
	Opioid-Related disorders	3
	Unspecified	4
Trauma and stressor-related disorder		**14**
	Persistent complex bereavement disorder	1
	Post-traumatic stress disorder	7
	Unspecified	6
General psychiatric care		**88**

(Continued)

TABLE 2 | Continued

[a] *Several articles described multiple DSM-5 disorders, which were tallied separately. Hence the reported totals do not necessarily add up to 100%.*

telemental health also has unique challenges that must be considered, such as handling patient encounters occurring via third-party videoconferencing software (178, 206). Frameworks have been described in the published literature to ensure that the standards of care are adhered to, and patient autonomy and privacy are maintained (207, 208).

An important consideration in the application of telemental health is the setting in which it is used, as different NQF domains may be of varying importance in different circumstances, as highlighted in the identified articles. For instance, the privacy and security of individuals using telemental health is especially important in a school-based setting or for those being treated for substance use. The identified articles illustrated the use of telemental health across settings such as homes, hospitals, and schools. However, the majority described the use of telemental health for the provision of home-based care. This can provide the healthcare provider with insight into social and environmental conditions at home (204, 209). The healthcare provider is

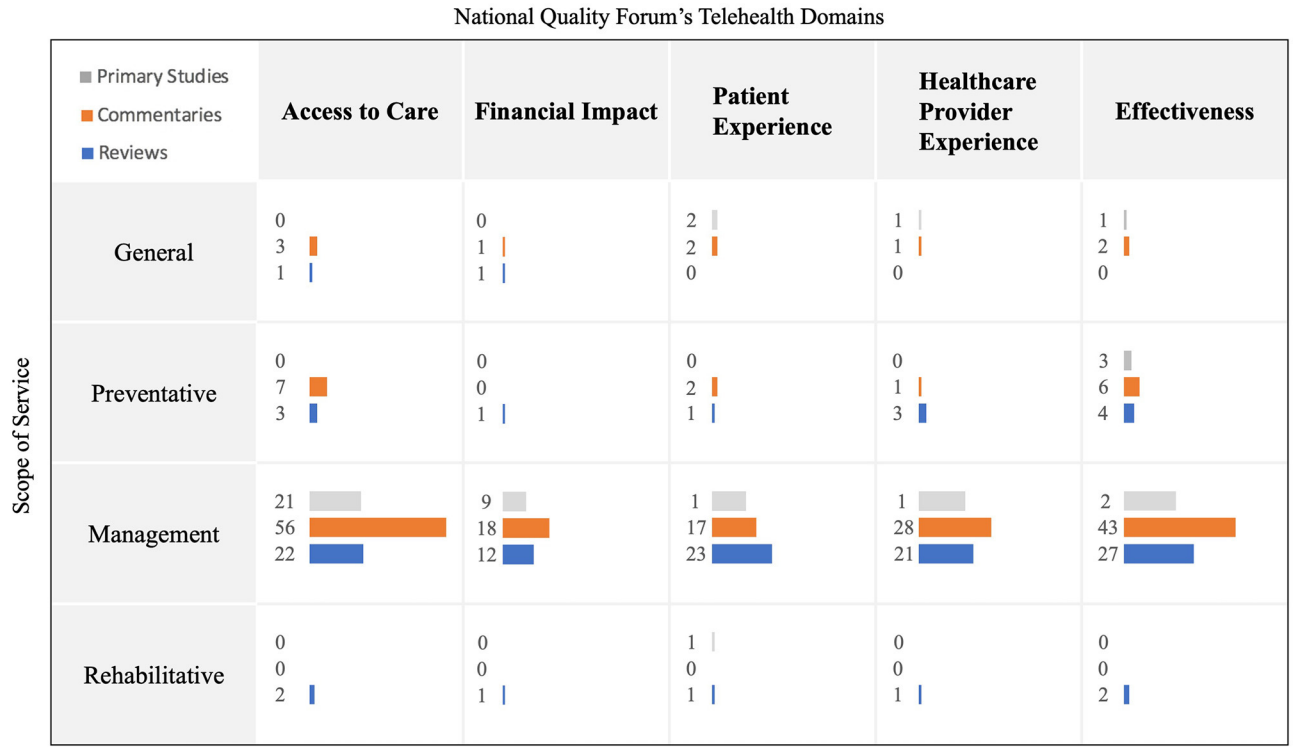


FIGURE 3 | Visual map for scope of service, NQF framework and article type. Preventative: Screening/Triage/Lifestyle/Social connectedness; Management: Treatment/Follow-up Rehabilitative: restoration of optimal level functioning in those with a mental illness; General: No definitive focus; Gray bars: Primary studies; Orange bars: Commentaries, viewpoints, editorials, perspectives; Blue bars: Literature and Scoping reviews; The length of the bars and the numbers correspond to the total number of identified articles.

thus better able to assess some of the social determinants of health, information on which has been otherwise been lacking in the current modern medical system (210). Several articles also emphasized the importance of schools as an additional avenue to ensure that children have access to healthcare. Over a quarter of the identified articles discussed telemental health use in specialized situations, such as pediatrics and adolescent care, geriatrics, oncology, and refugee-care, strengthening the argument that telemental health needs to be tailored to specific scenarios in order to deliver optimal care (160).

The articles included in our review substantiate the claim that telemental health is useful in reducing barriers to mental healthcare access for traditionally marginalized communities, such as those living in remote locations, migrants, refugees, and asylum seekers. Because of the near-ubiquity of smartphones and other internet-enabled devices, telemental health can cater to the needs of such populations (211). However, challenges associated with telemental health exist in these communities that must be addressed. For instance, there is a higher likelihood of digital inequity among the vulnerable populations, with lack of affordability or access to broadband services, patients' unfamiliarity, or the inability to use ICT. In addition, a lack of privacy and higher levels of stigma may also exist as compared to other populations (212–214).

When we categorized the concerns raised in the included articles by DSM-5 criteria (28), we found depression, anxiety, and eating disorders to be the most common concerns. This is not unexpected, given concern over the severity and transmissibility of COVID-19, limited hospital capacity during the initial wave of the pandemic, misinformation and rumors about the pandemic, and the public health measures that were implemented (movement restrictions, limiting in-person interactions, quarantine, isolation, etc.) to reduce the risk of transmission (214, 215).

The NQF framework (29) for tele-mental health allows us to structure our findings. In doing so, we identified that the NQF domains that were addressed in most detail were Access to Care and Effectiveness. Most articles identified telemental health as a boon toward these domains by alleviating the stigma, and time and privacy barriers facing patients and healthcare providers. However, several articles noted challenges in using telemental health services, including the inability of certain at-risk communities to comprehend and use the technology, perceived inefficacy, and technological challenges. Overall sentiment analysis demonstrates a celebratory sentiment toward the Patient Experience and Financial Impact domains, and contingent sentiment toward the other domains. Despite a robust evidence base and the global pivot to telemental health use during the COVID-19 pandemic, there remains work to be

TABLE 3 | Recommendations to enhance telemental health, classified by the NQF framework domains.

Domains	Recommendations regarding telemental health use	
Access to care	Health service providers and policy makers must both recognize and advocate to reduce health disparities	(35, 103, 126, 154)
	Ensure adequate privacy and confidentiality protections	(50, 57, 70, 72, 79, 92, 94, 95, 159, 175, 180)
	Prepare a device inventory (e.g., tablets) to share with marginalized populations	(180)
	Standardize policies on licensing and regulatory issues	(50, 53, 74, 85, 121, 126, 159, 175, 199)
Financial impact	Ensure patients are aware of billing and insurance policies up front	(72, 74)
	Ensure insurance providers expand coverage for telemental health	(53)
	Malpractice insurance for telemental health services	(175)
Patient experience	Prepare for the telemental health experience	(53, 85, 121, 126, 133, 167, 180)
	Telemental health sessions should last for reasonable lengths of time, with a periodic break, if needed	(176)
	Empower patients to participate and be an equal partner in their own care	(176)
	Have one-on-one sessions prior to group sessions, schedule the group sessions at convenient times for all using differing modalities to maximize participation	(57, 91)
Healthcare provider experience	Ensure staff receive appropriate training and practice	(42, 53, 74, 83, 93, 100, 126, 200)
	Adopt empathetic and personalized communications style and properly consent patients	(50, 57, 70, 72, 121, 140, 160)
	Provide multiple telemental health modalities and have back-ups in case of technological issues	(42, 50, 70, 72, 74, 92, 100, 195)
	Address provider and patient concerns and encourage sharing of success and challenges for quality assessment purposes	(57, 83, 159)
	Develop safety and contingency plans in conjunction with patients	(42, 72, 92, 93, 180)
Effectiveness	Enhance therapeutic alliance and dissemination of information	(94, 127, 134)
	Provide integrated care using dedicated teams	(100, 134, 201)
	Adapt appropriate cultural means of communications	(38, 49, 50, 53, 55, 58, 65, 68–70, 72, 83, 85, 90, 92, 93, 100–103, 112, 114, 122, 125–127, 130, 141, 145, 146, 151, 154, 156, 157, 167, 170, 175, 180, 183–194)
	Develop tools to enhance acceptability and safety	(134, 161)

done to ensure that it is affordable, effective, and accessible to all communities worldwide.

Another finding is that telemental health facilitates and enhances the delivery of integrated and quality care when multiple specialist healthcare providers may be needed or when the providers are remotely located (210). Specific competencies have been developed to ensure that healthcare providers are proficient in the delivery of interdisciplinary telemental health care (216, 217). Telemental health also permits family members to be involved in providing support to patients if they are in different geographic locations (210).

Several findings of this scoping review resonate with the findings in literature that has been published recently–telemental health reduced no-show rates (209), had equivalent outcomes to in-person sessions (218) and yielded satisfaction among both patients and healthcare providers (209). Challenges cited included concerns about confidentiality and privacy issues, and disparities in digital equity (218, 219). Other issues that have more recently been highlighted include screen fatigue (150, 220, 221), and a loss in sense of community for patients, due to fewer in-person interactions with fellow patients and healthcare providers (34).

Telemental health use is likely to continue to expand in the future. It confers myriad advantages, such as enhanced access to marginalized communities with limited mental health resources, mitigating individual stigma and creating reserve health system capacity. Telemental health can serve to reduce health disparities and lower the impact of future crises. The findings can help inform policymakers and healthcare institutions on making decisions about the future applications of telemental health.

Our scoping review has some limitations. We did not formally assess the quality of the included articles, the majority of which were commentaries. However, all articles were peer-reviewed, which reassures concerns about quality. Since a majority of the articles described the high-income context, the generalizability of the findings of this scoping review will likely be limited to high-income countries only. Further research in the low- and middle-income countries is warranted, and investment, perhaps with funding from high-income countries/global funding agencies, can help with the implementation of telemental health in countries where it is currently lacking.

Issues that remain unexplored in the published literature include the need for higher quality evidence, such as randomized controlled trials to ensure best clinical outcomes; best measures

to address the digital divide; distinction in usage between the various telemental health modalities (videoconferencing vs. audio-only healthcare vs. text messaging systems), and best practices for training healthcare providers to transition to telemental health. We did not investigate the use of artificial intelligence, an important research topic as it is becoming a part of telemental services, as this was beyond the scope of the study. Policy makers and researchers must prioritize optimizing telemental health services to cater to at-risk populations and address the aforementioned concerns and challenges.

CONCLUSION

Our findings suggest that telemental health could prove to be useful and effective during and beyond the COVID-19 pandemic. However, we must continue to explore opportunities to improve and enhance the delivery of telemental health for optimum health benefit to communities worldwide. The development of high-speed internet infrastructure globally will facilitate the uptake of telemental health. Given the dearth of comprehensive data on the outcomes of telemental health in low resource settings, as well as rural and remote communities, a greater investment into resources and additional research are needed. Guidelines and policies for licensing, geographical coverage, payment, insurance, and standard of care need to be put in place. Further, telemental health education should be incorporated into medical and health professions curricula worldwide to allow for better acceptance and familiarity among healthcare providers. Telemental health has the potential to be beneficial, especially for marginalized communities. Healthcare providers should embrace and offer evidence-based telemental health services to populations most in need in order to promote optimum health.

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.

AUTHOR CONTRIBUTIONS

AA, SD, SC, and RM collectively contributed to the conception and design of the study. NA-K reviewed the literature. AA and SD designed the search strategy, while screening and data extraction were conducted by AA and AJ in consultation with SD, SC, and RM. Analysis and manuscript drafting was carried out by AA with support from SD, AJ, NA-K, SC, and RM. All authors participated in the interpretation of the results, reviewed, edited, and approved the final version of the manuscript.

ACKNOWLEDGMENTS

All authors would like to thank Sinéad M. O'Rourke, Content Development Specialist, Distributed eLibrary, Weill Cornell Medicine-Qatar for English language editing services; Sa'ad Laws, Education & Research Librarian, Distributed eLibrary, Weill Cornell Medicine-Qatar, for validating the search strategy; and Hidenori Miyagawa, Visual Design Specialist Distributed eLibrary, Weill Cornell Medicine-Qatar for advising and helping format the images and tables.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.748069/full#supplementary-material

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frontiers in Psychiatry

ORIGINAL RESEARCH
published: 13 December 2021
doi: 10.3389/fpsyt.2021.798909

Stigma Levels Toward Psychiatric Patients Among Medical Students—A Worldwide Online Survey Across 65 Countries

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OPEN ACCESS

Edited by:
Giorgio Di Lorenzo, University of Rome Tor Vergata, Italy

Reviewed by:
S. M. Yasir Arafat, Enam Medical College, Bangladesh
Sami Richa, Saint Joseph University, Lebanon

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

Received: *20 October 2021*
Accepted: *24 November 2021*
Published: *13 December 2021*

Citation:
Babicki M, Małecka M, Kowalski K, Bogudzińska B and Piotrowski P (2021) Stigma Levels Toward Psychiatric Patients Among Medical Students—A Worldwide Online Survey Across 65 Countries. Front. Psychiatry 12:798909. doi: 10.3389/fpsyt.2021.798909

Background: According to epidemiological data, over 450 million people worldwide suffer from mental disorders, presenting one of the major challenges of modern medicine. In their everyday lives, patients, in addition to fighting the disease itself, often struggle with stigmatization. This phenomenon negatively affects both the diagnostic and therapeutic processes, as well as the patients' everyday functioning. This study aimed to assess stigma attitudes toward psychiatry and psychiatric patients among undergraduate medical students.

Methods: This study used a Computer-Assisted Web Interview (CAWI), which included the standardized items from the Mental Illness: Clinicians' Attitudes (MICA-2) scale to evaluate stigma. The study was disseminated via the internet to students from medical universities from 65 countries worldwide. Participation was voluntary and anonymous. The study involved 1,216 students from these 65 countries. Most of the sample were women, and most were medical faculty students and students living in cities with more than 500,000 residents. Taking into consideration Gross Domestic Product (GDP) per capita and Human Development Index (HDI) variables, it can be seen that there was a prevalence of medical students from highly developed countries.

Results: For the whole sample, the mean MICA-2 score was 40.5 points. Women and medical and nursing students showed more positive attitudes toward psychiatric patients. Students from countries with the highest economic development levels also achieved statistically lower MICA-2 scores. Lower score means a more positive attitude.

Conclusion: Stigma toward both psychiatry and psychiatric patients is common among undergraduate medical students. Female students and respondents with a history of mental disorders in countries with high HDI and GDP per capita indices show more favorable attitudes than other medical students. There is a need to further our

understanding of the problem of stigmatization, both among the general population and among medical personnel, and to implement and maintain appropriate measures to reduce stigma toward psychiatry.

Keywords: medical students, mental disorder, stigma attitude, human developing index (HDI) resource curse, mental health

INTRODUCTION

According to epidemiological data, over 450 million people worldwide experience mental disorders, making these disorders one of the greatest challenges of contemporary medicine (1, 2). Furthermore, the most recent research is not optimistic and suggests that the number of psychiatric patients, especially those over 65, will continue to expand (3). According to recent projections, 6.5 million individuals will need psychological or psychiatric assistance in Poland in the coming years (1). Epidemiological studies on the European population estimate that around 27% of the continent's occupants will need psychiatric consultation throughout their lifetime (1). This will contribute to a substantial burden on the currently inefficient psychiatric care system (4).

Apart from the problems mentioned above, there are also factors conditioned by environmental and social aspects. In their everyday lives, patients, aside from dealing with their diseases, additionally fight stigmatization (5). Because stigmatization is a complex process, it is not feasible to specify its causes. However, the possible variables that might influence its prevalence are a lack of proper understanding about the nature of mental diseases and an increased proneness to succumb to stereotypes about psychiatric patients (6).

Another aspect behind stigmatization may be discomfort and fear during contact with patients and poor knowledge of how to behave appropriately in their presence (7).

In the last decade, much interest has been devoted to treating the enacted and perceived stigma toward individuals with mental illness as an indispensable component of the diagnostic and therapeutic process (8, 9). Typically, individuals struggling with psychiatric conditions are considered to be worse and less intelligent, and are perceived differently to others (10). According to general opinion, people with mental disorders are more disapproved of than those with physical health problems. They are presumed to be responsible for their condition and are often falsely accused of committing fierce criminal offenses (11).

A crucial aspect of discrimination in the economic domain shows up in an increased reluctance to employ people who are making use of psychiatric care services, which may decrease these individuals' socioeconomic status and, what is even worse, postpone the initiation of suitable therapy or perhaps even cause treatment of diseases for patients who respond well to treatment to be ceased (9). All this results in overt discrimination and contributes to the limitation of the patient's ability to meet suitable social roles, which are inevitably connected to the efficiency of mental health well-being rehabilitation.

It is also worth mentioning the self-stigma process that influences some psychiatric patients, especially those who share common views concerning their discrimination. Self-stigma causes a reduction in self-confidence, reduced self-esteem, social isolation, and is usually used as a psychosocial mechanism to protect independent functioning (6, 11). Previous reports clearly show an association between self-stigma and the severity of clinical signs and symptoms, along with limited participation during treatment (10).

Stigmatization is common both among the general population and among medical care employees (12). It has been revealed that medical students who will be future healthcare professionals likewise may contribute to the spread of stigmatizing stereotypes about patients dealing with mental illness. Among the stigmatizing stereotypes are beliefs about patients' aggression and unpredictability, which strengthens the social exclusion of these patients. Furthermore, medical students tend to evaluate the job of psychiatrist as stressful, overwhelming and emotionally exhausting (10, 12).

Nonetheless, this approach toward the mentally ill may change to some extent as education at medical school progresses. While it was confirmed that the penultimate year students present stigmatizing attitudes toward patients who have schizophrenia and also depression (12, 13), for that very reason, numerous research studies suggest that introducing holistic education and learning in medical universities and increasing straight doctor-patient contact may decrease manifestations of stigma attitudes amongst clinical personnel (13, 14).

Regardless of the increasing demand for mental health professionals, low recruitment for this specialization has been observed worldwide (15). According to the World Health Organization (WHO), there ought to be one psychiatrist for every 10,000 citizens in each country. The USA, most European countries, Australia, Japan, and New Zealand already satisfy this condition. Nevertheless, there are nations in Africa and Asia where this percentage is just 0.2 per 10,000 citizens, and there are countries with no psychiatric services at all (16).

It has been shown that medical students consider psychiatry to be the least respected expertise in terms of further professional development (4, 16). Therefore, there is an urgent need to implement techniques aimed at getting medical students interested in psychiatry, specifically to meet the needs of the healthcare system (3, 4).

It has been shown that the stigmatization process exerts a significant impact on the functioning of psychiatric patients, and that most of the variables affecting its occurrence arise from inadequate social awareness induced by a lack of psychoeducation in the society. It is, therefore, crucial to analyse the entire phenomenon comprehensively and to draw conclusions that will enable the implementation of appropriate measures to fight labeling, discrimination and depreciation

driven by stereotypes, as well as to dealing with mentally ill individuals in a different way than the rest of society (6).

This study aimed to assess the extent of stigmatization beliefs in medical university students toward psychiatry research and psychiatric patients. Secondary goals were to examine how the socio-demographics of the student sample affected stigmatization, and how completing a training course in psychiatry could change these stigmatizing attitudes. Based on previous reports indicating the significant prevalence of the phenomenon of stigmatization both in the general population and among medical students, especially among men, the following research hypotheses were formulated (10, 16): (1) Stigmatization is a common attitude amongst medical students. (2) Female students show more favorable attitudes toward psychiatric patients than do male students. (3) Students from countries with a high Human Development Index (HDI) and high Gross Domestic Product (GDP) per capita reveal a greater extent of stigmatizing attitudes.

MATERIALS AND METHODS

Study Participants and Settings

A Computer-Assisted Web Interview (CAWI) survey was addressed to medical students regardless of their faculty (medicine, dentistry, nursing, obstetrics, medical emergency) and the place and stage of their education. A survey designed by the authors included sociodemographic information of participants including age, sex, country of origin, information on medical schools, study course, year of education and whether or not they had completed a course in psychiatry. The individual and/or student's family history of mental disease was additionally analyzed.

The research was performed according to the guidelines of the Declaration of Helsinki and approved by the Bioethics Committee of the Wroclaw Medical University, Poland (Approval No: KB-178/ 2021).

Computer-Assisted Web Interview (CAWI)

The CAWI study was based upon a questionnaire designed for this study and disseminated through the internet using social media. Participation in the research study was voluntary and anonymous, and the participants were not paid to finish the questionnaire. Before participating in the survey, respondents were presented with the most essential aspects of the study, including the methodology, purpose of the study, and approximate duration of the survey. After becoming knowledgeable about the study, respondents gave their informed consent to participate. In addition, all participants were informed of their ability to resign from the study at any phase without providing any reason.

Mental Illness: Clinicians' Attitudes (MICA-2)

The following part of the study involves the standardized MICA-2 psychometric measure of stigma attitudes to assess the attitudes of students at medical schools toward both psychiatry as a field of study and patients with mental health disorders. The MICA-2 is based on a 6-point Likert scale. Questions 3, 9, 10, 11, 12, and 16 are scored as follows: "I Strongly Agree" = 1 point; "I Agree" = 2 points; "I Rather Agree" = 3 points; "I Rather Disagree" = 4 points; "I Disagree" = 5 points; "I Strongly Disagree" = 6 points. The remaining items are scored oppositely. The overall scores acquired by the participants ranged from 16 to 96 and indicated increasing degrees of stigmatization related to attitudes and beliefs expressed by the respondent. The MICA-2 scale shows high internal consistency and also reliability (17–19).

Human Development Index (HDI) and Gross Domestic Product (GDP)

In order to examine the effects of socio-demographics, participants were split according to HDI and GDP groups based on data from the World Bank and the United Nations Development Program (20, 21). Groups were identified with very high, high, medium and low HDI indices, and were categorized by high, upper-middle, lower-middle, and low GDP income per capita.

Statistical Analysis

Statistical analysis was performed using the STATISTICA 13.0 software (StatSoft, Hamburg, Germany). The variables were

TABLE 1 | Characteristics of the study group.

	Number (*n*)	Percentage (%)
Sex		
Female	904	74.3
Male	312	26.7
Course of study		
Medicine	860	70.7
Dentistry	78	6.4
Nursing	146	12
Obstetrics	79	6.5
Medical emergency	53	4.4
GDP income		
High	1,021	84
Upper-middle	86	7.1
Lower-middle	99	8.1
Low	9	0.8
HDI index		
Very high	1,076	88.5
High	62	5.1
Medium	56	4.6
Low	22	1.8
Psychiatry course		
Yes	556	45.7
No	660	54.3
Mental health problems		
Yes	450	37
Yes, in a close relative	388	31.9
No	378	31.1

GDP, Gross Domestic Product; HDI, Human Development Index.

TABLE 2 | Characteristics of the study group considering the HDI index.

Variable		High	Upper-middle	Lower-middle	Low	*p*
Sex	Female	837 (77.9%)	38 (61.3%)	25 (44.6%)	3 (13.6%)	**<0.001**
	Male	238 (22.1%)	24 (38.7%)	31 (55.4%)	19 (86.4%)	
Major of medical studies	Medicine	760 (70.7%)	48 (77.4%)	35 (62.5%)	16 (72.7%)	**<0.001**
	Dentistry	69 (6.3%)	7 (11.3%)	0	2 (9.1%)	
	Nursing	120 (11.2%)	7 (11.3%)	19 (33.9%)	0	
	Obstetrics	78 (7.3%)	0	0	1 (4.6%)	
	Medical emergency	48 (4.5%)	0	2 (3.6%)	3 (13.6%)	
Psychiatry course	Yes	499 (46.4%)	31 (50%)	19 (33.9%)	6 (27.3%)	0.071
	No	576 (53.6%)	31 (50%)	37 (66.1%)	16 (72.7%)	
Mental health problems	Yes	434 (40.4%)	11 (17.7%)	2 (3.6%)	3 (13.6%)	**<0.001**
	Yes, in a close relative	346 (32.2%)	16 (25.8%)	17 (30.4%)	8 (36.4%)	
	No	295 (27.4%)	35 (56.5%)	37 (66.1%)	11 (50%)	

HDI, Human Development Index. Significant effects (<0.05) are marked in bold.

TABLE 3 | Characteristics of the study group considering GDP per capita.

Variable		High	Upper-middle	Lower-middle	Low	*p*
Sex	Female	805 (78.8%)	54 (62.8%)	42 (42.4%)	2 (22.2%)	**<0.001**
	Male	216 (21.2%)	32 (37.2%)	57 (57.6%)	7 (77.8%)	
Major of medical studies	Medicine	709 (69.4%)	74 (86.1%)	71 (71.8%)	5 (55.6%)	**<0.001**
	Dentistry	66 (69.5%)	8 (9.3%)	3 (3%)	1 (11.1%)	
	Nursing	120 (11.8%)	4 (4.7%)	22 (22.2%)	0	
	Obstetrics	78 (7.6%)	0	0	1 (11.1%)	
	Medical emergency	48 (4.7%)	0	3 (3%)	2 (22.2%)	
Psychiatry course	Yes	475 (46.5%)	39 (45.4%)	37 (37.4%)	4 (44.4%)	0.377
	No	546 (53.5%)	47 (54.7%)	62 (62.6%)	5 (55.6%)	
Mental health problems	Yes	423 (41.4%)	17 (19.8%)	7 (7.1%)	3 (33.3%)	**<0.001**
	Yes, in a close relative	335 (32.8%)	17 (19.8%)	31 (31.3%)	4 (44.5%)	
	No	263 (25.8%)	52 (60.4%)	61 (61.6%)	2 (22.2%)	

GDP, Gross Domestic Product. Significant effects (<0.05) are marked in bold.

quantitative, qualitative, and dichotomous. Basic descriptive statistics were used to analyse quantitative variables. In order to examine the normality of the distribution, the Kolmogorov-Smirnov, Lilliefors, and Shapiro-Wilk tests were used with a statistical significance of 0.05. When the distribution was non-normal, the Mann-Whitney *U*, or Kruskal-Wallis tests were used. The analysis of covariance (ANCOVA) was utilized to examine the influence of confounders while assessing the group differences across nations broken down by GDP per capita and HDI, such as age, gender, medicine discipline, course completion in psychiatry, and also history of mental disorders. At each phase of the study, results were considered statistically significant at 0.05.

RESULTS

Characteristics of the Study Group

The study included 1,216 respondents from 65 countries, of which 860 (70.1%) were medical students and 904 (74.3%) were female. The percentage of students who had not yet finished a training course in psychiatry was 54.3%. For GDP and HDI values, the most numerous groups were represented by countries with high-GDP per capita, 1,021 (84%), and high HDI scores, 1,076 (88.5%). The average age of respondents was 23.44 years (min. 18, max. 55; $SD = 4.56$). A detailed characteristic of the study group is presented in **Table 1**, and the division of the respondents by HDI and GDP parameters is presented in **Tables 2**, **3**.

Assessment of Students' Attitudes Toward the Psychiatry Domain and Psychiatric Patients

In this study, the mean MICA-2 score obtained by participants was 40.5 ± 9.1 points. Female students obtained significantly lower stigmatization results than male students (39.1 ± 8.2 vs. 44.4 ± 10.2; $p < 0.001$). The lowest extent of stigmatization attitudes was shown by students of the nursing faculties (38.8 ± 7.3), while the highest was by medical emergency students (43.3 ± 10.1).

TABLE 4 | Results according to specific variables.

Variable	General score	
	$\bar{x}$	SD
General (n = 1,216)	40.5	±9.1
Sex		
Female (n = 904)	39.1	±8.2
Male (n = 312)	44.4	±10.2
P	**<0.001**	
Major of medical studies		
Medical (n = 860)	39.8	±8.8
Dentistry (n = 78)	42.1	±8.2
Nursing (n = 146)	43.3	±10.5
Obstetrics (n = 79)	38.8	±7.3
Medical emergency (n = 53)	43.3	±10.1
P	**<0.001**	
GDP income		
High (n = 1,021)	39.3	±8.1
Upper-middle (n = 86)	41.3	±9.5
Lower-middle (n = 99)	50.3	±10.1
Low (n = 9)	55.5	±4.6
P	**<0.001**	
HDI index		
Very high (n = 1,076)	39.3	±8.2
High (n = 62)	45.3	±11.0
Medium (n = 56)	50.9	±9.9
Low (n = 22)	54.6	±7.0
P	**<0.001**	
Psychiatry course		
Yes (n = 556)	40.1	±9.0
No (n = 660)	40.8	±9.1
P	0.515	
Mental health problems		
Yes (n = 450)	38.4	±8.5
Yes, in a close relative (n = 388)	40.2	±8.6
No (n = 378)	43.2	±9.5
P	**<0.001**	

GDP, Gross Domestic Product; HDI, Human Development Index.

A statistically significant relationship was observed between the total MICA-2 score and the HDI and GDP per capita scores, where the mean MICA-2 score decreased with increasing HDI ($r = -0.348$; $p < 0.001$) and GDP ($r = -0.363$; $p < 0.001$). Both individuals with a history of mental health problems (38.4 ± 8.5) and those who had relatives suffering from mental health problems (40.2 ± 8.6) showed significantly lower MICA-2 scores than students without such experiences (43.2 ± 9, 5).

There were no group differences regarding having completed a psychiatry course (40.1 ± 9.0 vs. 40.8 ± 9.1; $p = 0.515$). Additionally, regardless of GDP per capita, respondents' previous studies included completed psychiatry classes at similar rates ($p = 0.337$). Detailed results of the analyzed variables are presented in **Table 4**.

TABLE 5 | Analysis of covariance (ANCOVA) of potential confounding variables.

Variable	HDI index		GDP income	
	F	*p*	F	*p*
Sex	0.76	0.512	1.06	0.361
Age	2.00	**0.001**	1.91	**0.008**
Year of studies	1.92	**0.015**	1.28	0.204
Major of medical studies	1.61	0.127	1.64	0.107
Psychiatry course	3.07	**0.011**	5.58	**0.001**
Experience with psychiatric conditions either own or a close relative's	2.29	**0.033**	2.93	**0.006**

GDP, Gross Domestic Product; HDI, Human Development Index. Significant effects (<0.05) are marked in bold.

There was no significant correlation between the participants' ages and mean MICA-2 scores ($r = -0.025$; $p = 0.390$). Degree of stigma attitude was also analyzed by the MICA-2 single items. Detailed comparisons for single items by GDP per capita and HDI parameters are presented in **Supplementary Tables 1**, **2**, which are provided in the supplementary material for this research.

The results of this study confirm the research hypotheses we have put forward, pointing to the significant dissemination of the phenomenon of stigmatization among students of medical faculties. Moreover, women and inhabitants of cities with higher HDI and GDP/capita show more favorable attitudes.

ANCOVA Covariance Analysis

The ANCOVA showed group differences in the overall MICA-2 score for age factors, completion of a psychiatry training course and history of a mental disorder, when dividing groups in terms of HDI and GDP per capita parameters. Detailed results of the effects of the confounding factors are presented in **Table 5**.

DISCUSSION

The present study focused on the evaluation of stigma toward the psychiatry domain and patients with psychiatric disorders, as presented by medical university students from 65 countries, taking into account the factors of gender, discipline, whether or not they had finished a training course in psychiatry and individual and/or students' family mental problems. The study also analyzed stigma attitudes internationally by grouping respondents according to the GDP-based income per capita and HDI indices of their home countries (21).

The mean MICA-2 score obtained by the students was 40.05. To the best of the authors' knowledge, this is the first study to include such a diverse population of medical students from medical schools around the world in the context of measuring degree of stigmatization of psychiatry and psychiatric patients using the MICA-2 questionnaire for assessment. So far, available studies have mainly included data on student attitudes from a single academic center or country (12, 16, 17, 22–24).

Amongst the respondents, students from nursing faculties demonstrated the lowest extent of stigmatization, while the

highest level of stigma attitudes was observed in medical emergency students. The higher range of hours might be a possible factor in explaining this outcome, as there is a disproportion during these programs in hours spent in direct relation with patients staying in mental health facilities (i.e., prospective nurses usually have more in-person contact with patients, while students of dentistry and medical emergency have rarer contact with patients). The less frequent stigma attitudes might also be attributable to the fact that the overwhelming number of nursing students in the sample (97.6%) were female, and females presented more positive attitudes toward mental illness generally (25, 26). By contrast, medical emergency students are generally males and often have contact only with psychiatric patients with a specific profile. For example, paramedics often deal with patients with psychomotor agitation during emergency medical services, and these patients may also display limitation or abolition of judgment. Moreover, paramedics in some countries are permitted to making use of direct coercion with patients. This might provide medical emergency students with an insufficient and false view of mental illness and contribute to strengthening incorrect stereotypes and increasing their attitudes of stigmatization toward patients (27).

The present results are consistent with earlier reports, in which males revealed a substantially higher degree of stigmatization attitudes than females (12, 15, 16, 28). This might be connected to the fact that males more often perceive mental illness to be a weakness of a personality than women, who tend to associate the presence of mental illness with traumatic events experienced previously in life (29).

The social role theory may offer another explanation for the gender difference. This theory states that females present reduced attitudes of stigmatization toward the psychiatry discipline and mental illness due to their more advanced socialization process in terms of empathy compared to men (30, 31). In addition, other reports have proved that more empathetic attitudes can diminish the influence of negative beliefs about mental illness and encourage healthcare professionals to present more socialized behaviors toward patients, triggering their more positive reactions (26).

An interesting finding is that there was a substantial disproportion between the number of males and females joining the study. Despite the lack of data on the population of female medical students worldwide, one of the most comprehensive reports on this issue seems to be the publication by the Association of American Medical Colleges (AAMC) in 2019, which shows that the number of females going to medical schools in the US is continuously rising. It also shows that the percentage of women is more than 50%, compared to Great Britain and Australia (32–34). For the Polish population of medical students, the percentage of females is as high as 73% (35). There is a noticeable correlation between the HDI index of a given country and the size of the female population attending medical school there. Countries with a high HDI index, such as Norway, are characterized by a substantial bulk of women students (60.6% in Norway) (36), while in countries with a reduced HDI this percentage is lower; for example, in India this percentage is 49% (37). These data are in line with our outcomes, which indicate that reduced HDI countries have less females in medical schools than do nations with a high HDI.

Surprising results in this study were that neither the stage of medical education nor the previous completion of a psychiatry course influenced the final results of the survey. This prompts unfavorable reflection on the quality of psychoeducation in medical universities globally, contrary to the existing literature on the subject that claims that education is intended to make positive adjustments in attitudes toward psychiatry in medical students (38, 39). It therefore appears justified to consider an arrangement by medical universities for appropriate education or counseling to boost the image of psychiatry (or any other specialty) and familiarize students with a possible future career in psychiatry. These measures might change students' attitudes and viewpoints toward various specialties and also would permit a less-biased selection of a specialized career path. Other study reported that students who proclaim to favor the field of expertise in psychiatry have a lower MICA-2 score than students favoring various other specializations of medicine (40).

Interestingly, an innovative Chinese program for mental health care professionals shows results in enhancing knowledge of mental health problems and decreasing negative attitudes toward individuals experiencing mental illness; this program has additionally proved that changes induced by the course can be sustained over time. This program committed a lot more hours to working with patients, health education and rehabilitation training engaging students and patients and long-lasting observation of the patient, as opposed to the traditional training course in psychiatry that focuses primarily on the clinical aspects of illness (41). Therefore, implementing work and community education components in the core psychiatry curriculum may reduce the stigma of mental illness among medical students. In addition, this type of training offers the chance to recognize patients' needs better and monitor the therapy process from a more comprehensive perspective.

Another study on educating American medical students also provides examples of successful education and awareness-raising work to lower stigmatization amongst medical practitioners. This education model was developed to boost communication between physicians, patients with mental diseases and patients' family members on psychiatric topics such as medical diagnosis, treatment process, and stigma. The program additionally consisted of public presentations by family members and representatives of the American National Alliance on Mental Illness (NAMI) organization on topics of communication and ways of minimizing stigma. Furthermore, NAMI speakers emphasized the value of the biological foundations underlying mental illness as a medical paradigm in the search for disease causes and effective treatment instead of stigmatizing or blaming the patients or identifying family dynamics as the etiological basis of mental disease (42).

Other successful approaches to lowering the stigmatizing attitudes of medical students involved seeing documentaries concerning individuals with mental diseases and attending workshops in which people with mental illnesses actively participated (43–45).

The present study found a decrease in stigma attitudes measured by the MICA-2 survey when the GDP per capita and the HDI indices relevant to the respondent's country increased. We believe that this inverse relationship is driven by better access to education in nations with higher HDI values. It is worth mentioning that education parameters are one of the components of the HDI index, defined as a derivative of the average number of education years received by residents aged 25 and older and the expected years of education for children beginning the education process (21).

There are several reports on the beneficial results of diversifying the psychiatry courses in medical schools and using educational training to reduce stigma. For instance, an Australian study on medical students found a decline in the MICA-2 score from 48.2 to 43.5 points after students attended an eight-week course in psychiatry enriched with visits to drug addiction rehab centers and geriatric facilities (3).

One more reason for reduced stigma attitudes in countries with higher GDP and HDI indices is an increased expense on healthcare and psychoeducation. Different social campaigns on anti-discrimination psychoeducation are increasingly showing up in the general public space in industrialized nations, primarily focussed on depression (46, 47). For example, the "Open the Doors" initiative of the World Psychiatric Association aimed at reducing the stigmatization of mental disorders experienced by individuals had a measurable impact on the application of anti-discrimination programs in youth communities; the effectiveness of the "Open the Doors" program was recognizable in several countries (48). On the other hand, in 2013, a study by Friedrich et al. showed that anti-discrimination training among British medical students had only a short-term impact on MICA-2 outcomes as confirmed by the follow-up after six months (49).

In this present study, both respondents who had histories of mental health issues and those who had relatives suffering from mental health problems showed substantially lower MICA-2 scores than those who did not. These outcomes are consistent with previous studies indicating that specific experience of mental disorders lowers the stigmatization of mental health problems (12, 16, 17, 22–24).

The authors recognize the limitations of this study. The first limitation is that the data collection was based on social media and online circulation of surveys on the internet. Nonetheless, due to the present circumstance of the pandemic, online surveys are a safe and also conveniently accessible research method that permits obtaining a large number of recipients. They also allow accessibility across the world population of medical university students. On the other hand, it is not feasible to confirm the accuracy of the data, including personal information, the real number of recipients that received information about the study, and the number of started but unfinished surveys. Another limitation was the fact that that the Mental Illness: Clinicians' Attitudes (MICA-2) scale didn't go through the process of cross-cultural validation.

This study was also time limited, which did not allow determination of whether the opportunity to interact with mentally ill individuals during the study contributed to stigmatizing views among students or whether these views existed prior to the study. We are likewise unable to determine to what extent stigma attitudes and beliefs might have altered during a training course in psychiatry. However, it is believed that medical students' attitudes toward mentally ill individuals often decrease over time (39, 50, 51). Following the same cohort throughout their period of study and assessing their views each year would be useful in developing appropriate teaching resources targeted at each age group according to their needs and demands. Further considerable limitations of the present study involve the representativeness of the investigated group, notably the predominance of females in the sample, the large proportion of students from countries with high HDI and GDP per capita indices and the digital exclusion of prospective respondents from lower wealthy countries; all of these factors might have affected the final results of the analysis.

The last couple of years have brought massive changes in the mental health care system, including the closures of old psychiatric centers, the expansion of the community care sector and the number of non-pharmacological treatments. A variety of activities have also been undertaken to de-stigmatize the field of psychiatry and psychiatric patients. As a result, progress has been made in understanding the dimensions of mental disorder stigma and the recognition of processes through which public stereotypes convert into discriminatory behaviors. Nevertheless, the activities aimed at increasing public awareness of the role of psychiatry are still not enough and, indeed, in some countries, entirely missing.

The research on student groups and young medical professionals is of great significance in the context of changes in the perception of psychiatry in society as their attitudes and interactions with patients and their family members contribute to lowering discrimination and prejudices and weakening the self-stigmatization of patients. Nevertheless, it appears that some damaging stereotypes still remain among medical students.

These observations are particularly essential in the context of recent research on the global crisis of mental health resulting from the COVID-19 pandemic. It has been revealed that the COVID-19 pandemic has substantially affected social functioning from its beginning. This has resulted in an increase in anxiety and depression symptoms in Poland compared to the pre-pandemic period (52–56).

Undoubtedly, the psychiatry curriculum at universities should focus on understanding the problems faced by patients and the mental health care system. It is possible that prior to the very first clinical contact with psychiatric patients, students need to be familiarized with principles of good practice for contact and care of patients, with particular attention paid to the specifics of mental disorders and related symptoms presented by patients.

CONCLUSIONS

The results of this study indicate the widespread occurrence of stigmatization of both psychiatry and psychiatric patients by medical students in several countries. Women students and individuals who have themselves experienced mental illnesses

show more favorable attitudes, as do the inhabitants of countries with high HDI and GDP per capita values. There is a need to further deepen the research into stigmatization, both among the general population and medical personnel, and implement and maintain appropriate measures to reduce stigma toward mental illness and psychiatry.

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 Bioethics Committee of the Wroclaw Medical University, Poland (approval no: KB-178/2021). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

KK, BB, and PP: conceptualization. MB: data curation. MB and KK: formal analysis. MB, MM, BB, and PP: investigation. MB, MM, KK, BB, and PP: methodology and writing—review and editing. MB and PP: supervision. MM: validation. BB and PP: visualization. MB, MM, KK, and BB: writing—original draft. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.798909/full#supplementary-material

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frontiers in Psychiatry

ORIGINAL RESEARCH
published: 13 January 2022
doi: 10.3389/fpsyt.2021.820782

Prevalence and Associated Factors of Depressive Symptoms Among Patients With Chronic Low Back Pain: A Cross-Sectional Study

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OPEN ACCESS

Edited by:
Samrat Singh Bhandari,
Sikkim Manipal University, India

Reviewed by:
Saumen Gupta,
Sikkim Manipal University, India
Uddip Talukdar,
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *23 November 2021*
Accepted: *20 December 2021*
Published: *13 January 2022*

Citation:
Hu Y, Yang Z, Li Y, Xu Y, Tian M, Jiang N and Guo N (2022) Prevalence and Associated Factors of Depressive Symptoms Among Patients With Chronic Low Back Pain: A Cross-Sectional Study. Front. Psychiatry 12:820782. doi: 10.3389/fpsyt.2021.820782

Background: Few studies have focused on depressive symptoms among patients with chronic low back pain in China. The aim of this cross-sectional study was to assess the prevalence and associated factors of depressive symptoms in patients with chronic low back pain.

Methods: From May to August 2021, 1,172 patients with chronic low back pain were recruited in China. Depressive symptoms were assessed through the Patient Health Questionnaire. Associations of demographic characteristics, clinical characters and social-psychological factors with depressive symptoms were investigated among patients with chronic low back pain.

Results: The prevalence of depressive symptoms was 25.00%. Logistic regression analysis found that duration of pain in 1-5 years (1-3 years: OR = 2.91, 95%CI: 1.65-5.14, 3-5 years: OR = 3.09, 95%CI: 1.55-6.15) and more severe pain (OR = 1.13, 95%CI: 1.10-1.17) were associated with higher risks of depressive symptoms. Better family function (good family function: OR = 0.25, 95%CI: 0.15-0.41, moderate family dysfunction: OR = 0.47, 95%CI: 0.29-0.77) and higher pain self-efficacy (OR = 0.94, 95%CI: 0.93-0.95) were associated with lower risks of depressive symptoms.

Conclusion: Patients with chronic low back pain have a high prevalence of depressive symptoms in China. Duration of pain, pain severity, family function and pain self-efficacy were predictors of depressive symptoms among chronic low back pain patients in China. Early identification of the associated factors may be helpful for the timely management of depressive symptoms.

Keywords: depressive symptoms, chronic low back pain, prevalence, risk factors, patients

INTRODUCTION

Low back pain is a worldwide public health issue (1). And of which, chronic low back pain (CLBP), as a chronic health problem, has attracted much attention due to its features of persistent suffering, high disability rate and heavy medical burden (2). Studies have shown that the prevalence of CLBP has been increasing in recent years, with some countries reaching over 20%, such as Brazil (25%) and Norway (23.6%) (2–4). CLBP not only causes long-term suffering for patients, impairs their physical function and even results in disability, but also increases personal and social medical costs (5–7). Moreover, with the prolongation of pain and the progress of the disease, the risk of psychological problems in patients with CLBP also increased significantly (6).

Depressive symptoms are the most common mental health problem in patients with CLBP (8). And the prevalence of depressive symptoms in patients with CLBP is higher than that of the general population. A previous large-scale study using South Korea national representative population data showed that the prevalence of depressive symptoms in patients with CLBP was as high as 20.3%, which is much higher than 4.5% of the general population (9). A longitudinal study in Spain also showed that patients with chronic pain (such as CLBP) were 1.4 times more likely to have depressive symptoms than patients without chronic pain (8). CLBP patients with depressive symptoms will not only increase the risk of disability and decrease the quality of life, but also lead to an increase in medical costs (10–12). A previous study revealed that CLBP patients with severe depressive symptoms have a higher disability index, and depressive symptoms are the most powerful explanation for their increased disability index (11). A systematic review also found that the direct medical costs of CLBP patients with psychiatric disorders have increased significantly (12).Therefore, it is necessary to explore the prevalence of depressive symptoms and related factors in CLBP patients, thereby developing effective intervention strategies.

China has a large group of patients with CLBP due to its large population base. According to the literature, 67.3 million people in China suffered from CLBP in 2016, causing a heavy burden of disease (13). The results of the Global Burden of Disease study also showed that CLBP was the leading cause of years lived with disability in China, and it is of great significance for patients and society to have a good management of CLBP (14). However, there has been little research on the prevalence and associated factors of depressive symptoms in CLBP patients in China. Therefore, this study aimed to investigate the prevalence of depressive symptoms in CLBP patients attending hospitals and explore its related factors to provide relevant evidence for promoting the mental health of CLBP patients.

Abbreviations: CLBP, chronic low back pain; PHQ-9, Patient health Questionnaire; BPI-PS, Brief Pain Inventory subscale on pain severity; APGAR, Adaptation, Partnership, Growth, Affection, Resolve; PSEQ, Pain Self-efficacy Questionnaire; OR, odds ratio; CI, confidence interval.

MATERIALS AND METHODS

Ethics Statement

The study was approved by the Ethics Committee of Ningbo No.2 Hospital, Zhejiang, China. All participants were voluntary and provided written informed consent before being involved in the study. All data of participants were kept anonymous and confidential.

Participants and Sampling

This study adopted the convenience sampling method to select a general hospital in Ningbo, Zhejiang province and Wuhan, Hubei province in China, respectively, as the study sites. Patients with CLBP admitted to Tongji Hospital in Wuhan and the Ningbo No.2 Hospital in Ningbo during May to August 2021 were invited to participate in this survey. The inclusion criteria included: (1) aged $\geq$ 18 years, (2) duration of low back pain $\geq$ 3 months, (3) a native Chinese speaker, (4) volunteer to participate in this survey. Participants were excluded if they: (1) had a trauma or surgery on the low back within the past year, (2) had a pregnancy within the past year, (3) diagnosed severe psychiatric diseases.

We calculated the minimum sample size by a single population proportion formula: $n = z^2_{\alpha/2}p(1-p)/d^2$, where n is the sample size, p is the proportion of depressive symptoms among CLBP patients, z is the normal deviation, and d is the margin of error. In order to control type I error, we took α as 0.05; therefore, z was equal to 1.96. Based on previous research on the depressive symptoms among CLBP patients, p was assumed to be 20.3% (9). Besides, we took d as 0.15p. The calculated minimum sample size was 670. In this study, allowing a non-response rate of 20% and the final sample size was 838.

Measures

The Patient health questionnaire (PHQ-9) was used to assess depressive symptoms, which consisted of 9 items (15). Each item is evaluated by the frequency of the symptom over the last 2 weeks: "Not at all" scored 0, "Several days" scored 1, "More than half the days" scored 2, and "Nearly every day" scored 3. The total score ranges from 0 to 27, with a cut-off point of 10 differentiating depressive symptom and no depressive symptom. The PHQ-9 has been validated in Chinese patients with good reliability and validity in previous studies (16, 17). In this study, Cronbach's alpha coefficient of this scale was 0.94.

To control for the influence of potential confounding factors on depressive symptoms, we collected information on demographic characteristics, clinical characters (pain severity and duration of pain), family functioning, and pain self-efficacy. The demographic characteristics included sex, age, work status, marital status, educational level, monthly personal income, and medical insurance.

The four-item Chinese version Brief Pain Inventory subscale on pain severity (BPI-PS) was used to assess pain intensity (18). The scale has been widely used in patients with low back pain (19). The four items of BPI-PS included pain severity at "its worst" over the past 24 h, "its least" over the past 24 h, "on average" over the past 24 h, and "right now". Patients were asked

TABLE 1 | Demographic and clinical characteristics of patients with chronic low back pain according to presence of depressive symptoms.

	All patients	No depressive symptoms	Depressive symptoms	*P*-value
Age	50.5 (38-62)	50 (36-61)	52 (43-64)	0.0002*
Sex				0.0685
Male	586 (50.00%)	453 (51.54%)	133 (45.39%)	
Female	586 (50.00%)	426 (48.46%)	160 (54.61%)	
Marital status				0.0947
Unmarried/divorce/widowed	210 (17.92%)	148 (16.84%)	62 (21.16%)	
Married	962 (82.08%)	731 (83.16%)	231 (78.84%)	
Educational level				<0.0001**
Primary school or below	268 (22.87%)	194 (22.07%)	74 (25.26%)	
Secondary school	348 (29.69%)	233 (26.51%)	115 (39.25%)	
Senior high school	177 (15.10%)	135 (15.36%)	42 (14.33%)	
Junior college	172 (14.68%)	146 (16.61%)	26 (8.87%)	
University or above	207 (17.66%)	171 (19.45%)	36 (12.29%)	
Work status				0.1865
Unemployed	377 (32.17%)	272 (30.94%)	105 (35.84%)	
Manual worker	343 (29.27%)	256 (29.12%)	87 (29.69%)	
Non-manual worker	452 (38.57%)	351 (39.93%)	101 (34.47%)	
Monthly personal income				<0.0001**
<¥5,000	682 (58.19%)	474 (53.92%)	208 (70.99%)	
≥¥5,000	490 (41.81%)	405 (46.08%)	85 (29.01%)	
Medical insurance				<0.0001**
Yes	1,045 (89.16%)	811 (92.26%)	234 (79.86%)	
No	127 (10.84%)	68 (7.74%)	59 (20.14%)	
Duration of pain				<0.0001**
<6 months	414 (35.32%)	280 (31.85%)	134 (45.73%)	
6 months to 1 years	288 (24.57%)	245 (27.87%)	43 (14.68%)	
1 to 3 years	263 (22.44%)	207 (23.55%)	56 (19.11%)	
3 to 5 years	105 (8.96%)	71 (8.08%)	34 (11.60%)	
>5 years	102 (8.70%)	76 (8.65%)	26 (8.87%)	
Pain severity	12 (9-19)	11 (8-16)	22 (14-25)	<0.0001**
Family function				<0.0001**
Good family function	643 (54.86%)	537 (61.09%)	106 (36.18%)	
Moderate family dysfunction	377 (32.17%)	273 (31.06%)	104 (35.49%)	
Severe family dysfunction	152 (12.97%)	69 (7.85%)	83 (28.33%)	
Pain self-efficacy	41 (27-51.5)	47 (36-53)	21 (5-38)	<0.0001**

**P-value < 0.05, **P-value < 0.001.*

to rate the extent to pain from 0 (no pain) to 10 (pain as bad as you can imagine) at above four moments. The total score of BPI-PS ranges from 0 to 40, with higher scores indicating more severe pain. In this study, the BPI-PS had a good internal consistency (Cronbach's alpha = 0.92).

The Chinese version of the Family Adaptation, Partnership, Growth, Affection, Resolve (APGAR) index was used to evaluate participants' satisfaction with current family function, which consisted of five items, namely, adaptability, partnership, growth, affection, and resolve (20, 21). Each item was scored 0, 1, and 2 according to its response "Hardly Ever," "Some of the time," and "Almost Always." The total score ranges from 0 to 10 and has been divided into three levels: 0-3 indicates severe family dysfunction, 4-6 indicates moderate family dysfunction, and 7-10 indicates good family function (22, 23). Previous studies have proven to excellent validity and reliability of the scale in Chinese families (22, 23). In this study, Cronbach's alpha coefficient of this scale was 0.88.

Pain self-efficacy was measured through the Chinese version of the Pain Self-efficacy Questionnaire (PSEQ), which has shown excellent validity and reliability in patients with CLBP (24, 25). PSEQ is a psychometric scale, which reflects an individual's confidence in completing daily tasks despite experiencing pain. The scale consists of 10 items rated on a seven-point Likert scale from 0 (lowest confidence) to 6 (highest confidence). Hence, the total score for PSEQ ranges from 0 to 60, where high scores reflect

higher pain self-efficacy. In this study, the scale demonstrated good internal consistency (Cronbach's alpha = 0.98).

Statistical Analysis

The normality of continuous variables was test by the Shapiro-Wilk method. Due to the distribution of all continuous variables did not satisfy the normality ($P < 0.05$), continuous variables were showed by medians and quartiles. Categorical variables were showed by frequencies and percentages. We used Wilcoxon rank-sum test for continuous variables, and Pearson's chi-squared test for categorical variables to compare the demographic characteristics, pain-related variables, and family function between patients with or without depressive symptoms. The binary logistic regression was conducted to assess the association between outcomes and different explanatory variables. We also used stepped modeling approach to compare the fit of three sets of variables. Model 1 only contained individual characteristics; Model 2 contained both individual and pain-related factors; Model 3 was a full model which also included family function. Parameters including −2log likelihood, Akaike's information criterion (AIC) and Schwarz criterion (SC) were used to compare these multilevel models. The −2log likelihood, AIC and SC of Model 1, Model 2, and Model 3 became smaller, indicating that the fit of the models improved (**Supplementary Table S1**). The Hosmer-Lemeshow goodness-of-fit test was used to examine model fitness, and its *P*-value was >0.05 ($P = 0.9257$). The strength of association was interpreted using odds ratio (OR) and 95% confidence interval (CI). All *P*-values were two-tailed and significance level was set at 0.05. The statistical analysis was conducted using SAS 9.4 software.

RESULTS

A total of 1,238 patients with CLBP who met the inclusion criteria were included in this study, and 66 patients who did not complete the questionnaire were excluded. Ultimately, 1,172 patients were included in the analysis. The characteristics of participants and their association with depressive symptoms are presented in **Table 1**. The median age of the participants was 50.5 years, and the percentage of male was 50.00%. Most participants were married (82.08%), secondary school (29.69%), non-manual worker (38.57%), low-income group (58.19%), with medical insurance (89.16%), with good family function (54.86%), with the duration of pain < 6 months (35.32%). The median score of the participants with respect to pain severity and pain self-efficacy was 12 and 41, respectively.

In this study, the prevalence of depressive symptoms in participants was 25.00% ($n = 292$). The univariable analysis showed that age, educational level, monthly personal income, medical insurance, duration of pain, family function, the score of pain severity and pain self-efficacy were significantly different between patients with and without depressive symptom (**Table 1**).

Logistic regression analysis showed that duration of pain, pain severity, family function, pain self-efficacy was significantly associated with depressive symptoms. The results found that patients with pain duration of 1-3 years (OR = 2.91, 95% CI: 1.65-5.14) and 3-5 years (OR = 3.09, 95% CI: 1.55-6.15) were more likely to suffer from depressive symptoms than those with a duration of <6 months. Patients with CLBP who had higher scores of pain severity were at higher risk of developing depressive symptoms (OR = 1.13, 95% CI: 1.10-1.17), while higher score of pain self-efficacy was associated with a decreased likelihood of depressive symptoms (OR = 0.94, 95% CI: 0.93-0.95). Compared to those with severe family dysfunction, those with good family function (OR = 0.25, 95% CI: 0.15-0.41) and moderate family dysfunction (OR = 0.47, 95 % CI: 0.29-0.77) were less likely to have depressive symptoms (**Table 2**).

TABLE 2 | Binary Logistic analysis of depressive symptoms related factors in patients with chronic low back pain.

	OR (95%*CI*)	*P*-value
Age	1.01 (0.99-1.03)	0.3800
Sex (Ref = "male")		
Female	0.99 (0.69-1.43)	0.9633
Marital status (Ref = "Unmarried/divorce/widowed")		
Married	0.77 (0.48-1.25)	0.2916
Educational level (Ref = "Primary school or below")		
Secondary school	1.25 (0.74-2.12)	0.4006
Senior high school	0.91 (0.46-1.79)	0.7900
Junior college	0.80 (0.34-1.87)	0.6016
University or above	1.16 (0.47-2.88)	0.7424
Work status (Ref = "Unemployed")		
Manual worker	1.34 (0.82-2.21)	0.2429
Non-manual worker	1.24 (0.69-2.24)	0.4669
Monthly personal income (Ref = "< ¥5,000")		
≥¥5,000	0.67 (0.42-1.07)	0.0969
Medical insurance (Ref = "Yes")		
No	1.46 (0.84-2.56)	0.1810
Duration of pain (Ref = "< 6 months")		
6 months to 1 years	1.10 (0.62-1.96)	0.7465
1-3 years	2.91 (1.65-5.14)	0.0002*
3-5 years	3.09 (1.55-6.15)	0.0013*
>5 years	1.33 (0.67-2.63)	0.4152
Pain severity	1.13 (1.10-1.17)	<0.0001**
Family function (Ref = "severe family dysfunction")		
Good family function	0.25 (0.15-0.41)	<0.0001**
Moderate family dysfunction	0.47 (0.29-0.77)	0.0028*
Pain self-efficacy	0.94 (0.93-0.95)	<0.0001**

*P-value < 0.05, **P-value < 0.001, Hosmer and Lemeshow goodness of fit test (P-value = 0.9257).

DISCUSSION

The results of this study showed that the prevalence of depressive symptoms in patients with CLBP in China was 25.00%, significantly higher than that in Chinese community-dwelling population (12.30%) (26). This finding was consistent with previous studies (9, 27). The high prevalence of depressive symptoms may be related to the pain of the disease and its

negative effects on life (28). Compared with international studies of depressive symptoms in CLBP patients using the PHQ-9 to assess depressive symptoms, our result was higher than those in Korea (20.3%) (9) and Japan (16.47%) (28), which also suggested that health authorities should pay more attention to the problem of severe depressive symptoms in patients with CLBP in China.

Notably, there is no significant association between medical insurance and depressive symptoms in CLBP patients in this study. This result is contrary to studies in some countries in Southeast Asia (29, 30). This may be because China started to establish a basic medical insurance system covering all people in 2009. Statistics showed that the basic medical insurance coverage rate in China has been as high as 95% by 2020 (31). This is consistent with nearly 90% of the participants in this study with medical insurance.

Pain-related factors were significant related to depressive symptoms in CLBP patients. Our study found that CLBP patients who had pain duration of 1-5 years were at higher risk of developing depressive symptoms, which was similar to previous studies (32, 33). The reason may be that long-term low back pain has a negative impact on the patients' family, social and work activities, which can lead to more prone to depressive symptoms (33). However, in this study, the risk of depressive symptoms did not increase in CLBP patients with a duration of pain more than 5 years. One possible explanation is that as the duration of disease increases, patients may regard pain as more normative and adopt aggressive coping strategies, mitigating the negative effects of disease to physical and psychological health (34). Pain intensity was a risk factor for depressive symptoms in CLBP patients. The results of two previous studies in Japanese CLBP patients showed that more severe pain was associated with worse mental health conditions (28, 35). This suggests that while strengthening pain management of patients with CLBP, it is also important to focus on the psychological status of patients with pain duration of 1-5 years and higher pain severity, thereby timely identifying their psychological problems and providing psychological guidance services.

This study also found that family function was a significant protective factor for depressive symptoms (36–38). When CLBP patients are in a state of family dysfunction, they are more likely to cope with their illness negatively due to conflicting family roles, poor communication, and hampered problem solving, which makes them vulnerable to depressive symptoms (39). In contrast, when family function is good, CLBP patients will get more support from their family members and better cope with the disease and its related adverse emotions (39). In addition, CLBP patients with higher pain self-efficacy had a lower risk of depressive symptoms. Pain self-efficacy refers to the confidence or belief in one's ability to achieve behavioral goals in the context of pain (24). Patients with high levels of pain self-efficacy may make it easier for them to acknowledge the objective reality of the existence of CLBP, to actively manage and cope with the various adverse stresses associated with CLBP, with a correspondingly significantly lower risk of pain-related distress and psychological disorders (40). Therefore, the risk of depressive symptoms in patients with CLBP can be reduced by improving family function and pain self-efficacy.

To our best knowledge, this study is the first to investigate the prevalence of depressive symptoms in Chinese patients with CLBP and to explore the influencing factors in terms of demographic characteristics, clinical characters, individual psychological factors and social factors, which provides evidence for the prevention and treatment of depressive symptoms in patients with CLBP. However, there are some limitations of this study. First, this was a cross-sectional study, and it was difficult to clarify the causal relationship between depressive symptoms and related factors. Second, the convenience sample was adopted in this study, which limited representativeness and generalizability of the results. Third, this study was conducted in two provinces of China, and thus, the generalizability of our results to patients with CLBP in other regions of China may be limited. Further large-scale studies are needed on a national scale.

CONCLUSION

The prevalence of depressive symptoms is high among Chinese patients with CLBP. In the clinic, CLBP patients with pain duration of 1-5 years should be paid more attention. Moreover, pain should be actively managed to reduce pain intensity in CLBP patients. In addition to the treatment of somatic pathological changes, the psychological well-being of CLBP patients should also be promoted by enhancing patients' family function and pain self-efficacy.

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 study was approved by the Ethics Committee of Ningbo No.2 Hospital, Zhejiang, China. Participation was voluntary and all participants provided written informed consent before being involved in the study. All data of participants were kept anonymous and confidential.

AUTHOR CONTRIBUTIONS

YH, ZY, and NG were responsible for the conception, design, and writing of the manuscript. YL and YX were responsible for the acquisition of data and literature research. MT and NJ were responsible for the analysis and interpretation of data. All authors read and approved the final manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.820782/full#supplementary-material

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frontiers in Public Health

ORIGINAL RESEARCH
published: 25 January 2022
doi: 10.3389/fpubh.2022.760387

Perceived Academic Stress and Depression: The Mediation Role of Mobile Phone Addiction and Sleep Quality

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OPEN ACCESS

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Sikkim Manipal University, India

Reviewed by:
Daniel Kwasi Ahorsu,
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: *18 August 2021*
Accepted: *07 January 2022*
Published: *25 January 2022*

Citation:
Zhang X, Gao F, Kang Z, Zhou H, Zhang J, Li J, Yan J, Wang J, Liu H, Wu Q and Liu B (2022) Perceived Academic Stress and Depression: The Mediation Role of Mobile Phone Addiction and Sleep Quality. Front. Public Health 10:760387. doi: 10.3389/fpubh.2022.760387

Background: Although academic stress is a well-known risk factor for students' depression, little is known about the possible psychological mechanisms underlying this association. In this study, we investigated the prevalence of depression and sleep disturbance among Chinese students, examined the relationship between perceived academic stress and depression, considered if mobile phone addiction and sleep quality is a mediator of this relationship, and tested if mobile phone addiction and sleep quality together play a serial mediating role in the influence of perceived academic stress on depression.

Method: A cross-sectional survey was conducted among students from September to December 2018 in Heilongjiang Province, China. The final analysis included 5,109 students. Mobile phone addiction, sleep quality, and depressive symptoms were assessed using the Mobile Phone Addiction Index, Pittsburgh Sleep Quality Index, and Center for Epidemiologic Studies-Depression scales, respectively. The serial mediation model was used to analyse the relationship between perceived academic stress, mobile phone addiction, sleep quality, and depression.

Results: Among all participants, the prevalence of depressive symptoms and sleep disturbance was 28.69 and 27.95%, respectively. High school students showed the highest scores of perceived academic stress (2.68 ± 1.06), and the highest prevalence of depressive symptoms (33.14%) and sleep disturbance (36.47%). The serial mediation model indicated that perceived academic stress was a significant predictor of depression (B = 0.10, SE = 0.02, 95% CI = 0.06 – 0.13). Additionally, mobile phone addiction (B = 0.08, 95% boot CI = 0.06–0.11) and sleep quality (B = 0.27, 95% boot CI = 0.22–0.33) played a mediating role between perceived academic stress and depression. Mobile phone addiction and sleep quality together played a serial mediating role in the influence of perceived academic stress on depression (B = 0.11, 95% boot CI = 0.08–0.14). Furthermore, the indirect effect (i.e., the mediating effect of mobile phone addiction and sleep quality) was significant and accounted for 64.01% of the total effect.

Conclusions: Our research results underscore the need for stakeholders—including family members, educators, and policy makers—to take preventative intervention measures to address depression among Chinese students, especially high school students.

Keywords: perceived academic stress, mobile phone addiction (MPA), sleep quality, depression, depressive symptoms, Chinese students

HIGHLIGHTS

- Perceived academic stress significantly predicts depression.
- Sleep quality mediates perceived academic stress and depression.
- Mobile phone addiction mediates perceived academic stress and depression.
- Mobile phone addiction and sleep quality together play a serially mediating role in the influence of PAS on depression.

INTRODUCTION

Depression (major depressive disorder) is a widespread chronic medical illness that can influence mood, thoughts, and physical health (1), and is a severe problem faced by students worldwide. A meta-analysis that included 183 studies from 43 countries shows that the overall pooled crude prevalence of depression was 27.2% among medical students (2). Previous studies demonstrated that the prevalence of depression was 51.3, 38.3, 28.4, and 30.6% among Indian students (3), Japanese adolescents (4), Chinese university students (5), and Cameroon medical students (6), respectively. It is important to evaluate the prevalence of depressive symptoms and explore the effect mechanism of depressive symptoms to protect students from the harmful effects of depression. Studies related to students' depressive symptoms often focus on a particular group of students, such as medical (2), college (7), and university students (8), and scant research exists about depressive symptoms among students at different levels of education. Many risk factors have been associated with depression, including being female (9, 10), life stressors (9, 10), physical and mental factors, social media addiction (11), and parental factors, including parental psychopathology and parenting attachment (12). Stress has been shown to be one of the most important risk factors of depression, and numerous studies have demonstrated that stress plays an important role in the emergence of depression (13–15). For example, Torres-Berrío et al. supposed that depression is caused by a combination of genetic predisposition and life events (16). Stress often leads to adverse consequences—such as depression and anxiety (17–19), mobile phone addiction (MPA) (20, 21), poor sleep quality (PSQ) (22, 23), changes in legal drug consumption (24), cardiovascular disease (25), and worsens the outcomes of many medical illnesses (26), potentially even leading to suicide (27, 28). Additionally, various physical and mental factors influence the prevalence of depressive symptoms, such as PSQ (29), bodily pain (30), and poor cognitive and physical functioning (31). Scholars have noted that there is a remarkable association between alterations in sleep patterns and depression (32). Furthermore, in the internet age, studies show that individuals who experience depressive symptoms often suffer from social media addictions, such as Facebook (33, 34), mobile phone (35), and internet addictions (8). For instance, Ivanova found that MPA was positively related to both depression and loneliness in Ukrainian students (36).

In China, the school environment and parental practices contribute to the extraordinarily high expectations of students' academic performance (37). Chinese students experience high levels of academic stress throughout their academic careers, including numerous, intense examinations—such as end-of-term tests and the standardized senior high school and university entrance examinations—and a heavy homework burden (37). Scholars have demonstrated that Chinese students experience sleep deprivation owing to this culture of academic achievement. A study of 9,392 Chinese students in primary education through university levels showed that 35.6% of participants slept <7 h a day (38). In addition to the threat of academic stress and sleep deprivation, MPA is a risk factor affecting Chinese students' physical and mental health. Mobile phones have become an integral part of students' quotidian lives—Meng's survey from December 2016 to January 2017 found that 100% of the college students had mobile phones (39)—and the prevalence of problematic mobile phone use has been found to be 28.2% among Chinese college students (40). Our study explored the correlations between perceived academic stress (PAS), MPA, sleep quality, and depression among Chinese students in middle school through college levels. Based on previous literature, our study proposed research hypotheses, and tested hypothesis by using survey data on Chinese students. To our knowledge, this was the first study to investigate relations between these variables among Chinese students by using the serial mediation model.

LITERATURE REVIEW AND RESEARCH HYPOTHESES

Academic Stress

Academic concerns are the most important sources of chronic and sporadic stress for young people in both Western and Asian countries (41). Academic stress is defined as a student's psychological state resulting from continuous social and self-imposed pressure in a school environment that depletes the student's psychological reserves (42, 43). Students experience

Abbreviations: PAS, Perceived Academic Stress; MPA, Mobile Phone Addiction; MPAI, Mobile Phone Addiction Index; CES-D, Center for Epidemiologic Studies-Depression; PSQ, Poor Sleep Quality; PSQI, Pittsburgh Sleep Quality Index; SEM, Structural Equation Model.

academic stress throughout their secondary school (41), high school (44), and university (45, 46), educational careers. Studies have shown that academic stress has been positively associated with depression (41), PSQ (24, 47), and MPA (48) among students. Jayanthi observed that, compared to adolescents who do not experience academic stress, adolescents who experienced academic stress were 2.4 times more likely to have depressive symptoms (41). Other studies have found that there is a relationship between high academic stress and PSQ (47, 49). However, scholars have not adequately addressed the adverse consequences (e.g., depression, PSQ, and MPA) of Chinese students' academic stress. Hence, we propose the following hypotheses:

H1: PAS is positively associated with depression.

H2: PAS is positively associated with MPA.

H3: PAS is positively associated with PSQ.

MPA

MPA is one of the most common behavioral (i.e., non-drug) addictions (48), and is accompanied by negative effects, such as PSQ (50), depression (35), and impaired academic performance (51). The positive relationship between MPA and PSQ has been proved in previous studies, including a longitudinal study conducted among Korean adolescents (52) and a one-year prospective study among Chinese college students (50). Zhang found that among Chinese university students, there is a significant positive relationship between smartphone addiction and bedtime procrastination, which is one of the indicators of PSQ (53). Hence, we propose the following hypothesis:

H4: MPA is positively associated with PSQ.

Similarly, the positive relationship between MPA and depression has been proved in previous studies, including a cross-sectional study conducted among Saudi university students (35), a cross-sectional study among Ukrainian college students (36), and a systematic review of relations between problematic smartphone use, anxiety and depression psychopathology (54). Furthermore, another study based on three cohorts of Korean children and adolescents confirmed the bidirectional relationship between MPA and depression (55). Hence, we propose the following hypothesis:

H5: MPA is positively associated with depression.

Researchers have documented that stress is associated with MPA, and that MPA is associated with depression. For example, according to Wan et al., smartphone addictions are significantly positively associated with both depression and stress among Malaysian public university students (56). However, it is unclear if MPA mediates the relationship between PAS and depression. Hence, we propose the following hypothesis:

H6: MPA mediates the relationship between PAS and depression.

Sleep Quality

Sleep disturbance has complex associations with depression (major depressive disorder) (31), and is a common physical symptom of depression. Numerous studies have confirmed the remarkable association between PSQ and depression (29, 57, 58). For example, Okun et al. found that PSQ is positively related to depression symptoms in postpartum women (29). Hence, we propose the following hypothesis:

H7: PSQ is positively associated with depression.

Scholars have also demonstrated that there are relationships between stress, PSQ, and depression. A prospective birth cohort study showed that PSQ is associated with stress and depression symptoms among Chinese pregnant women (58). Zhang et al. found that perceived stress is associated with sleep quality and depressive symptoms among Chinese nursing students (59). However, it has not been documented if sleep quality mediates the relationship between PAS and depression among Chinese students. Hence, we propose the following hypothesis:

H8: Sleep quality mediates the relationship between PAS and depression.

Mobile Phone Addiction and Sleep Quality and the Relationship Between Perceived Academic Stress and Depression

Scholars have posited that there are significant associations between MPA, depression levels, and sleep quality. Demirci found that there were positive correlations between MPA, depression levels, and sleep quality (60). The results of Kaya's multivariate regression analysis showed a relationship between smartphone usage, PSQ, and depression in university students (57). A recent meta-analysis also found that there are positive correlations between MPA, depression, and sleep quality (61). Another literature review and case study found that depressive symptoms are associated with screen time-induced poor sleep, digital device night use, and mobile phone dependency (62). Although these studies explored the correlations between MPA, sleep quality, and depression among students, several scholars have added academic stress into the relationship—for example, a review found that sleep disturbance, anxiety, stress, and depression have been associated with problematic mobile phone use (63). There still exist gaps in the literature on how PAS influences depression. First, few scholars have focused on PAS, MPA, sleep quality, and depression among Chinese students. Second, the underlying mediating mechanisms that account for this association have been disregarded partly. Based on H6 and H8, it remains unclear if MPA and sleep quality serially mediate the relationship between PAS and depression. Therefore, we propose the following hypothesis:

H9: MPA and sleep quality serially mediate the relationship between PAS and depression.

Study Objectives

In this study, our primary aim was to investigate the prevalence of depression and sleep disturbance among Chinese students. Our secondary aim was to test if there were relationships between PAS, MPA, sleep quality, and depression. First, we tested if there was a relationship between PAS and depression among Chinese students (H1: PAS is positively associated with depression). Second, we tested if MPA was a mediator of the relationship between PAS and depression (H2: PAS is positively associated with MPA, H5: MPA is positively associated with depression, and H6: MPA mediates the relationship between

PAS and depression). Third, we tested if sleep quality was a mediator of the relationship between PAS and MPA (H3: PAS is positively associated with PSQ, H7: PSQ is positively associated with depression, and H8: Sleep quality mediates the relationship between PAS and depression). Finally, we also tested if MPA and sleep quality together played a serial mediating role in the influence of PAS on depression (H4: MPA is positively associated with PSQ and H9: MPA and sleep quality serially mediate the relationship between PAS and depression).

METHODS

Survey

Data were collected from a cross-sectional questionnaire survey that was conducted from September to December 2018 in Heilongjiang Province, China, by the Heilongjiang Center for Disease Control and Prevention. A multistage cluster sampling method was used. In the first stage, three cities of Heilongjiang province were randomly selected by economic characteristics. In the second stage, one urban district and one rural township were chosen at random. In the third stage, two middle schools were randomly selected in each urban district and rural township; Since nine-year compulsory education was implemented in China, high school education is not included in the nine-year compulsory education, high schools are more in urban districts than in rural townships, two high schools and one high school were randomly selected in urban district and rural township, respectively; Since vocational high schools and universities are scarce in rural townships, one vocational high school and one college were randomly selected from the urban district. In the fourth stage, two classes were randomly selected from each grade of middle school, high school, vocational high school, and from grades 1, 2, and 3 in college. Since senior students may have been looking for a job or working as an intern, some of them were not on campus, they were not been investigated. Finally, four middle schools, three high schools, one vocational high school, and one college were randomly selected within each city (Harbin, Jiamusi, and Jixi) of Heilongjiang Province. Data were collected through a self-administered questionnaire distributed in class. Students completed the survey within 1 h, while a well-trained member of the research group supervised. All the students were informed of the purpose of the study and assured that their identities would remain confidential. Students and their parents provided written informed assent to participate in the study.

Participants

Finally, we recruited 6,480 students in our investigation; 6,430 (99.23%) valid questionnaires were analyzed after excluding those with incomplete information. Participants were included in the sample if they had one constant internet-accessible mobile phone, which is similar with previous studies (64–68). A total of 5,109 (79.46%) participants reported having one constant internet-accessible mobile phone at the time of the survey. The final sample comprised 1,904 middle school students from grades 1, 2, and 3, respectively; 1,859 high school students from grades 1, 2, and 3, respectively; 660 vocational high school students from grades 1, 2, and 3, respectively; and 686 college students from grades 1, 2 and 3, respectively. Of these participants, there were 2,422 (47.41%) boys and 2,687 (52.59%) girls; on average, the mean age of participants was 15.53 years, with a standard deviation of 2.22, ranging from 11 to 25 years. Approval was obtained from the Medical Research Ethics Committee of Harbin Medical University and the principals of the participating schools.

Measures

Perceived Academic Stress

Consistent with previous studies (69–71), PAS was measured using one self-report item "How much academic stress did you feel in the study during the past month?" using a 5-point Likert scale where 1 = "No," 2 = "relatively low," 3 = "average/general," 4 ="relatively high" and 5 = "extremely heavy," with a higher score indicating more PAS.

Depression

Center for Epidemiologic Studies-Depression Scale. The 20-item CES-D developed by Radloff (72) is a self-report measure that has been widely used to assess depressive symptoms in different populations (73). The reliability and validity of the CES-D have been tested among Chinese populations (74). The CES-D, when used in Chinese adolescents and university students, has shown good reliability (75–78), as well as good validity (77, 78). There are four components of CES-D, namely somatic and retarded activity, depressed affect, positive affect, and interpersonal relationships. Among the 20 items, four (items 4, 8, 12, and 16) are reversed scores. All items are evaluated on a 4-point Likert scale in relation to their incidence during the previous week, and are scored from 0 to 3 (0 = not at all, 1 = a little, 2 = some, 3 = a lot); total possible scores thus range from 0 to 60, with higher scores indicating greater number of symptoms (79).

For the original CES-D scale, a total score of 16 or greater is considered as indicative of subthreshold depression (72). Many studies have evaluated the diagnostic accuracy of the CES-D to detect depression among the general population and proposed a variety of cut-off scores, such as a cut-off score of 21 for Chinese patients with type 2 diabetes (80), and a cut-off score of 22 for the older Chinese population (81). However, the cut-off score of 16 has been widely used for Chinese adolescents and university students (7, 76, 82–84). Therefore, the same cut-off score has been used in our study too. Students with CES-D scores between 16 and 21 were defined as "mildly depressed," between 21 and 24 as "moderately depressed," and $\geq$ 25 as "severely depressed" (83). The CFA on the four-factor model showed a good model fit, with $\chi^2 = 16.54$, df = 1, $P < 0.000$, RMSEA = 0.06, SRMR = 0.01, CFI = 0.99, TLI = 0.98. Additionally, the Cronbach's alpha coefficient was 0.84 for the total scale, all four dimensions had acceptable reliability with Cronbach's alpha coefficient of 0.70, 0.83, 0.78, and 0.62.

Mobile Phone Use Situation and Mobile Phone Addiction

Mobile phone use situation was assessed by three items. First, "How many hours do you use your mobile phone every day?"

to which participants answered with one of four options: "less than a half hour," "a half hour to one hour," "one to two hours," or "more than two hours." Second, "How long have you had a mobile phone?" to which participants answered "<1 year," "1–2 years," "2–3 years," or "more than 3 years." Third, "How much do you spend on mobile phone charges every month?" to which participants answered "less 30 yuan," "30–50 yuan," "50–100 yuan," or "more than 100 yuan."

The Mobile Phone Addiction Index (MPAI) was used in our study (85). Participants rated the 17 items on a 5-point Likert scale ranging from 1 (not at all) to 5 (always). Higher scores indicated greater addiction to mobile phones (86). There are four components of MPAI, namely inability to control craving, feeling of anxiety and being lost, withdrawal or escape, and productivity loss. The Confirmatory Factor Analysis (CFA) on the four-factor model showed a good model fit, with $\chi^2 = 6.44$, df = 1, $p < 0.05$, RMSEA = 0.03, SRMR = 0.004, CFI = 0.99, TLI = 0.99. Additionally, the Cronbach's alpha coefficient was 0.90 for the total scale. All four dimensions had satisfactory reliability with Cronbach's alpha coefficient of 0.76, 0.81, 0.85, and 0.75.

TABLE 1 | Participants' mobile phone use.

	N	%
Daily usage time of mobile phone		
<a half hour	195	3.82
A half hour to 1 h	1,108	21.69
1–2 h	1,479	28.95
More than 2 h	2,327	45.55
Duration of owing a mobile phone		
<1 year	842	16.48
1–2 years	1,320	25.84
2–3 years	929	18.18
More than 3 years	2,018	39.5
Mobile phone charges every month		
<30 yuan	2,389	46.76
30–50 yuan	1,942	38.01
50–100 yuan	574	11.24
More than 100 yuan	204	3.99

Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI) was used in our study (87). PSQI scale contains 19 items covering seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component was scored from 0 (no difficulty) to 3 (severe difficulty). The total score was calculated from the seven component scores, ranging from 0 to 21. A score of more than 5 implied poor sleep (87). The CFA on the seven-factor model showed a good model fit, with $\chi^2 = 79.49$, df = 11, $P < 0.000$, RMSEA = 0.04, SRMR = 0.02, CFI = 0.99, TLI = 0.98. Additionally, Cronbach's alpha coefficient was 0.624 for the PSQI scale in our study.

Data Analyses

SPSS version 19.0. and Mplus 7.0 were used to analyse data in our study. Descriptive analyses were first conducted of participants' characteristics, participants' mobile phone use and the prevalence of sleep disturbance, MPA, and depression. We tested the reliability and validity of the MPAI scale, PSQI scale and CES-D scale by examining their Cronbach's alpha coefficient and performing a CFA. Spearman's correlation analysis was performed to examine the general relationships among the four variables—PAS, MPA, sleep quality, and depression. A structural equation model (SEM) was built to examine hypotheses. We tested the mediating role of MPA and sleep quality; the constructed serial mediation model included three latent variables (MPA, sleep quality and depression) and one manifest variable (PAS), PAS was the independent variable, depression was the dependent variable, and MPA and sleep quality were the mediating variables (88). The bootstrapping analyses used 5,000 samples at the 95% confidence interval (CI) to indicate significance.

To determine whether the model fits the data well, multiple indices were tested, including (1) the model χ^2 and its p value, in which non-significance is desirable for good fit. With increasing sample size and a fixed degree of freedom, the χ^2 value increases. It is difficult to get a nonsignificant chi-square (indicative of good fit) when sample sizes are over 200 (89). This can lead to a problem where plausible models might be rejected. Because this statistic is sensitive to the sample size, inspection of the other fit indices is recommended (90). (2) The root mean square error of approximation (RMSEA) in which values ranging from 0.05 to 0.08 represent adequate fit, and values <0.05 indicate good fit. (3) The standardized root mean square residual (SRMR) in which values are ≤0.08 indicate good fit. (4) The comparative fit index (CFI), in which values range from 0.90 to 0.95 indicate an adequate fit and values ≥0.95 indicate a good fit, and (5) the Tacker-Lewis index (TLI) in which values >0.90 indicate a good fit.

RESULTS

Descriptive Statistics

The mean scores of PAS were 2.61 ± 1.03, 2.68 ± 1.06, 2.13 ± 0.98, and 2.29 ±0.96 for middle school students, high school students, vocational high school students, and college school students, respectively.

Among the participants, 45.55% used their mobile phone more than 2 h daily; 39.5% of the participants had a mobile phone for more than 3 years; 53.24% of the participants spent more than or equal to 30 yuan on mobile phone charges every month (**Table 1**). The mean MPAI score of all the participants was 30.62 ± 11.92.

The prevalence of depressive symptoms was 28.69% (n = 1,466) with a mean CES-D score of 12.52 ± 8.86. Prevalence of depression at a mild level (CES-D ≥ 16 and CES-D < 21), moderate level (CES-D ≥ 21 and CES-D < 25), and severe level (CES-D ≥ 25) was 12.62, 6.95, and 9.12%, respectively. The prevalence of depressive symptoms among high school students (33.14%) was the highest, while the prevalence of depressive

TABLE 2 | Depression classifications of participants.

	Classifications	N	%
Depression	No (CES-D < 16)	3,643	71.31
	Mild (CES-D ≥ 16 and CES-D < 21)	645	12.62
	Moderate (CES-D ≥ 21 and CES-D < 25)	355	6.95
	Severe (CES-D ≥ 25)	466	9.12
Learning stage	Middle school	508	26.68
	High school	616	33.14
	Vocational high school	195	29.55
	College	147	21.43
All participants		1,466	28.69

TABLE 3 | Prevalence of sleep disturbance for participants at different education levels.

Learning stage	N	%
Middle school	395	20.75
High school	678	36.47
Vocational high school	177	26.82
College	178	25.95
All participants	1,428	27.95

TABLE 4 | Means, SD, Pearson's correlation coefficient of variables.

	M	SD	1	2	3	4
1. PAS	2.53	1.04	1			
2. MPAI global score	30.62	11.92	0.164*	1		
3. PSQI global score	4.29	2.59	0.253*	0.401*	1	
4. CES-D global score	12.52	8.85	0.236*	0.327*	0.410*	1

*$p \leq 0.01$.

symptoms among college students (21.43%) was the lowest (**Table 2**).

The prevalence of sleep disturbance was 27.95% (n = 1,428) with a mean global PSQI score of 4.29 ± 2.59. The prevalence of sleep disturbance among high school students (36.47%) was the highest, while the prevalence of sleep disturbance among middle school students (20.75%) was the lowest. The average sleep time and sleep latency were 7.40 ± 1.28 h and 15.81 ± 12.48 min, respectively. Among the participants, 14.50% reported that they had bad or very bad sleep quality; 36.29% reported that their sleep latency was more than 15 min; 50.89% reported that they slept ≤7 h a day; 12.62% reported that their sleep efficiency was ≤85%; 67.59% reported that they experienced sleep disturbances; 2.90% of them reported that they used sleep medication; and 78.80% reported that they had daytime dysfunction (**Table 3**).

Means, Standard Deviation (SD) and correlations of the main variables in the mediation model are shown in **Table 4**. The results, indicating that the variables were significantly and positively correlated, provide initial support for the hypotheses of this study, and act as a foundation of the serial mediation model.

Test for Serial Mediation Model

SEM was used to provide the fit indexes of the serial mediation model. A model was constructed with MPA (M1) as a mediator and sleep quality (M2) as another mediator. In this model, PAS was set as the predictor (X) and depression as the outcome (Y). Results of the serial mediation model indicated that the constructed model exhibited a satisfactory fit with the data: χ^2 = 1,196.50, df = 95, $P < 0.000$, SRMR = 0.04, RMSEA = 0.05, CFI = 0.95, and TLI = 0.94.

First, PAS was positively associated with depression (B = 0.10, SE = 0.02, 95% CI = 0.06–0.13). Higher levels of PAS were related to higher levels of depression, and thus H1 was supported. Second, PAS positively predicted MPA (B = 0.18, SE = 0.02, 95% CI = 0.15–0.21). Higher levels of PAS were related to higher levels of MPA, and thus H2 was supported. Third, PAS was positively associated with PSQ (B = 0.23, SE = 0.02, 95% CI = 0.19–0.26). Higher levels of PAS were related to poorer sleep quality, and thus H3 was supported. Fourth, MPA was positively associated with PSQ (B = 0.51, SE = 0.02, 95% CI = 0.47–0.54). Higher levels of MPA were related to poorer sleep quality, and thus H4 was supported. Fifth, MPA was positively associated with depression (B = 0.17, SE = 0.02, 95% CI = 0.13–0.22). Higher levels of MPA were related to higher levels of depression, and thus H5 was supported. Last, PSQ was positively associated with depression (B = 0.44, SE = 0.03, 95% CI = 0.39–0.49). PSQ was related to higher levels of depression, and thus H7 was supported.

Total, Direct, and Indirect Effects

Table 5 shows all possible indirect effects of the mediation model. First, the indirect effect of PAS on depression through MPA was significant (B = 0.08, 95% boot CI = 0.06–0.11), and thus H6 was supported. Second, the indirect effect of PAS on depression through sleep quality was significant (B = 0.27, 95% boot CI = 0.22–0.33), and thus H8 was supported. Third, the indirect effect of PAS on depression through MPA and sleep quality was also significant (B = 0.11, 95% boot CI = 0.08–0.14), and thus H9 was also supported. The total indirect effect was B = 0.46, 95% boot CI = 0.40–0.53, and the mediating effect of MPA and sleep quality were significant ($P < 0.001$), accounting for 64.01% (total indirect effect/total effect) of the total effect. The indirect effect related to sleep quality accounted for 82.61% of the total indirect effect, that is, (indirect effect 2 + indirect effect 3)/total indirect effect (**Table 5**).

DISCUSSION

Although academic stress is a well-known risk factor for depression in students, little is known about the possible psychological mechanisms underlying this association, or how MPA and PSQ—which also are risk factors of depression—operate to have an impact on it. The main aim of our study was to test if there is a relationship between PAS and depression and if MPA and sleep quality together play a serial mediating role in the influence of PAS on depression among Chinese students. To the best of our knowledge, this was the first study to investigate the relationship between the variables using SEM. As expected, the serial mediation model showed that PAS was a

TABLE 5 | Total, direct, and indirect effects.

	Depression outcomes as criterion				
	B	**SE**	**t**	**LLCI**	**ULCI**
Total effect of PAS on depression	0.71	0.05	15.11	0.63	0.81
Total direct effect of PAS on depression	0.26	0.05	5.75	0.17	0.35
Total indirect effect of PAS on depression	0.46	0.03	13.47	0.40	0.53
Indirect effect 1: PAS→ MPA→ depression	0.08	0.01	5.92	0.06	0.11
Indirect effect 2: PAS→ sleep quality→ depression	0.27	0.03	9.50	0.22	0.33
Indirect effect 3: PAS→ MPA→ sleep quality→ depression	0.11	0.01	8.16	0.08	0.14

Number of bootstrap samples for bias-corrected bootstrap CIs: 5,000. Level of confidence for all CIs: 95.
CI, confidence interval; LLCI, low limit confidence interval; ULCI, upper limit confidence interval.

significant predictor of depression. MPA and sleep quality played a mediating role between PAS and depression. Furthermore, MPA and sleep quality together played a serial mediating role in the influence of PAS on depression. In our study, the indirect effect (i.e., the mediating effect of MPA and sleep quality) was significant and accounted for 64.01% of the total effect. Thus, apart from the direct effect of PAS on depression, the indirect effect of PAS on depression should be emphasized. Our findings provide significant insights into the risk factors for depressive symptoms in students.

Depression Among Students

According to studies that have focused on depression among Chinese students, the prevalence of depression varies from 22.0 to 68.5% (5, 91–95). In our study, the prevalence of depressive symptoms was 28.69%. The differences across these studies may have resulted from temporal or regional disparities or variations in depression definitions and assessment methods. Depressive symptoms are related to many negative consequences, such as increased suicide risk among students (96) and increased college withdrawal rates (97). Controlling depressive symptoms among students can both protect human capital value from the societal perspective and maintain students' physical and mental health from the individual perspective. In our study, the most stressed, depressed, and sleep-deprived students were high school students. Thus, Chinese high school students' physical and mental health requires attention. In China, high school students are admitted to colleges and universities based on *gaokao*, the standardized National College Entrance Examination (98). These admission decisions are extremely important, as they impact high school students' future educational opportunities, career paths, and life experiences. Our research results prove that Chinese students experience the most stressful and competitive academic environment of their academic careers when they are in high school.

Mediating Role of Mobile Phone Addiction

Chinese students spend considerable time on mobile phones—45.55% of the participants spent more than 2 h daily on their mobile devices. 39.5% of participants had had a mobile phone for more than 3 years, while the mean age of participants was 15.53 years. Using the mediation model, we illustrated the mediating role of MPA in line with our hypothesis. As H6 predicted, MPA played a role in the path from PAS to depression. MPA could partially explain the association between PAS and depression among Chinese students—hence, MPA was not only an outcome of PAS, but also a catalyst of depression. First, we found that high levels of PAS were associated with high levels of MPA. This finding is consistent with previous research results (48) and suggests that PAS may be a significant trigger for students' negative behaviors—such as MPA. Scholars have posited that young people's digital distraction activities—including playing computer games and online surfing—may be interpreted as a way to avoid problems, reality, and stress (99, 100). High levels of PAS were associated with high levels of MPA, which may be due to students' use of mobile phones to escape from academic stress. Second, we found that high levels of MPA were associated with high levels of depression, which is in line with existing research results (35, 36, 101). Students who experience MPA may neglect real-world social engagement (102) resulting in academic underperformance (103), clinical health symptoms (68), which are related to negative emotions—such as depression. Our findings add to the existing research that suggests that when students are facing academic stress, they may be addicted to their mobile phones to escape from academic stress, and thus the negative consequences of MPA may lead to depression in students.

Mediating Role of Sleep Quality

As H8 predicted, sleep quality is not only an outcome of academic pressure—it is also a catalyst of depression. Moreover, the indirect effect related to sleep quality accounted for 82.61% of the total indirect effect. Thus, compared to MPA, sleep quality played a more important role in the path from PAS to depression. We found that higher levels of PAS were associated with poorer sleep quality. This finding is consistent with previous research findings (24, 47). For example, Waqas et al. demonstrated that perceived stress is a significant predictor of PSQ (47). In China, students exist in a prolonged competitive learning environment and experience unrelenting academic stress. To achieve better academic performance and meet the extraordinarily high expectations of parents and educators, Chinese students have heavy homework burdens and learning burdens, resulting in sleep deprivation. Furthermore, academic

stress decreases sleep quality. According to Almojali et al., students who are not suffering from academic stress are less likely to experience PSQ (104). Previous studies have proved that sleep deficiency and sleep health problems are common among Chinese students (105). Our research results may explain why higher levels of PAS were related to poorer sleep quality.

We also found that high levels of PSQ were associated with high levels of depression, which is consistent with prior research findings (31, 50, 57). Scholars have proved that PSQ is related to multiple negative consequences that may lead to depression—including daytime dysfunction, poor academic performance, and fatigue (106, 107). Our findings add to the existing research that suggests that sleep quality is a mediator between PAS and depression among students, which means that higher levels of PAS were related to poorer sleep quality—such as sleep deficiency and daytime dysfunction—which was related to higher levels of depression.

Serial Mediating Effect of Mobile Phone Addiction and Sleep Quality

As per H9, MPA and sleep quality together play a serial mediating role in the influence of PAS on depression. The results of our study showed that higher levels of PAS were related to higher levels of MPA, which was associated with poorer sleep quality, which was associated with higher levels of depression. Numerous studies have documented that there is a positive relationship between MPA and PSQ (50, 52). For example, Kang et al. found that there were bidirectional longitudinal relationships between MPA and PSQ (50). Scholars have posited that the more screen time young people use, the less sleep time they have (108). Moreover, young people often use their mobile phone in the bedroom—bedtime mobile phone use is related to higher insomnia scores and increased fatigue (109), and both insomnia and fatigue are related to depression (110, 111). This may explain why MPA and PSQ together play a serial mediating role in the influence of PAS on depression. Our findings suggests that Chinese students are likely to distract themselves from PAS by using their mobile phones, and thus shortening their sleep duration, decreasing their sleep quality, leading to PSQ, and resulting in depressive symptoms.

Measures to Reduce Depressive Symptoms Among Chinese Students

To reduce depressive symptoms among students, their PAS should be managed. Given the multiple, negative consequences (MPA, PSQ, and depression) of PAS, stakeholders—family members, educators (including teachers, school administrators, and school health professionals), and policy makers—should take preventative measures to help students manage and relieve academic stress, such as provide counseling services (112), foster their psychological resilience (113), and increase social support (19) to improve their overall well-being. Second, students' sleep quality should be ensured to reduce depressive symptoms. Stakeholders should actively promote counseling and intervention for students experiencing sleep disturbances. Third, given that higher levels of MPA are associated with poorer sleep quality and higher levels of depression, stakeholders should develop mitigating strategies to manage mobile phone use to ensure students' sleep quality and to relieve their depressive symptoms. Rational and normative mobile phone use should be advocated and classroom management strategies enforced to ensure that students use their mobile phones at restricted times and places for positive purposes, such as online learning. Fourth, regular psychological assessment of depression, MPA, and PSQ will help stakeholders detect and manage students' health problems. Last, parents and family members, educators, and policy makers should encourage students to exercise more to alleviate MPA (114), improve sleep quality (115), and reduce depression (116).

Limitations

This study has several limitations. First, although we conducted our research based on previous studies, due to the cross-sectional design of our study, we could not confirm causal relationships among the study variables. Second, the study period was September to December 2018, which was more than 2 years ago. However, we believe that the results of our study are valuable for understanding the mechanisms of how PAS influences students' depression through MPA and sleep quality, and our study can provide a basis for future research. Third, the study measured the participants' perceived academic stress using a single item, which may not have captured various other relevant stressors, such as parental learning expectations. Future studies should use a multiple-item scale to assess the participants' perceived academic stress. Forth, this study was limited to middle school, high school, vocational high school, and college students. Future research on Chinese students at all education levels from primary school to postgraduate levels is necessary. Fifth, perceived academic stress can increase during stressful conditions (117), such as during exams or major change in life (e.g., from high-school student to freshman). While our study was conducted in 27 schools in three cities, it is impossible that we conducted the survey when the participants had no examinations or changes. Future studies can control for stressful academic conditions in the analyses to enhance their accuracy. Last, gender, age, and other factors are important influencing factors of PAS, MPA, sleep quality, and depression. Since the main aim of this study was to test if there was a relationship between PAS and depression and if MPA and sleep quality together play a serial mediating role in the influence of PAS on depression, the aforementioned factors were not considered in this study. Future studies should consider these factors and test the relationships between PAS, MPA, sleep quality, depression, and other health indicators.

CONCLUSIONS

Our study's results showed that Chinese students face the risk of depression and sleep disturbance, and the most stressed, depressed, and sleep-disturbed students are those in high

school. Second, the results of the serial mediation model indicated that PAS predicted depression, and MPA and sleep quality played a mediating role between PAS and depression. Furthermore, MPA and sleep quality together play a serial mediating role in the influence of PAS on depression. Our study extends the understanding of how PAS is associated with depression among Chinese students. Considering the harmful effects of depression, stakeholders—including parents and family members, educators, and policy makers—should take preventative measures to alleviate Chinese students' depression and depressive symptoms.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation. Requests to access these datasets should be directed to wuqunhong@163.com.

AUTHOR CONTRIBUTIONS

XZ, FG, ZK, and QW: conceptualization. XZ, HZ, JW, and HL: formal analysis. FG, JZ, JL, JY, HZ, and BL: investigation. XZ, FG, ZK, and BL: data curation. XZ, FG, and ZK: writing—original draft preparation. QW and BL: writing—review and editing. All authors have read and agreed to the published version of the manuscript.

FUNDING

This research was funded by QW of The National Key Social Science Fund of China (Grant No.19AZD013).

ACKNOWLEDGMENTS

The authors would like to express our appreciation to all of the individuals for their involvement in the study, including each of students and teachers for their support during the data collection.

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frontiers in Public Health

SYSTEMATIC REVIEW
published: 25 January 2022
doi: 10.3389/fpubh.2021.773296

Effects of Mindfulness Exercise Guided by a Smartphone App on Negative Emotions and Stress in Non-Clinical Populations: A Systematic Review and Meta-Analysis

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

Received: 09 September 2021
Accepted: 24 December 2021
Published: 25 January 2022

Citation:
Wu J, Ma Y, Zuo Y, Zheng K, Zhou Z, Qin Y and Ren Z (2022) Effects of Mindfulness Exercise Guided by a Smartphone App on Negative Emotions and Stress in Non-Clinical Populations: A Systematic Review and Meta-Analysis. Front. Public Health 9:773296. doi: 10.3389/fpubh.2021.773296

Background: Studies have acknowledged that mindfulness exercise guided by a smartphone app has a positive impact on mental health and physical health. However, mindfulness guided by a smartphone app on mental health is still in its infancy stage. Therefore, we conducted a meta-analysis evaluating the effect of mindfulness intervention guided by a smartphone app on negative emotions and stress in a non-clinical population with emotional symptoms.

Methods: We searched major databases, namely, Web of Science, PubMed, Scopus, China National Knowledge Infrastructure (CNKI), and Wanfang, to identify all of the relevant studies published in English or Chinese from their inception until November 9, 2021. The methodological quality of the included studies was assessed with Cochrane risk-of-bias bias assessment tool. Two researchers independently conducted document retrieval, study selection, data extraction, and methodological quality evaluation.

Result: A total of eight studies were included in the study, with 574 subjects (experimental group: 348; control group: 226). A random effects model was selected to combine effect sizes. The results of the meta-analysis showed that mindfulness exercise guided by a smartphone app reduced negative emotions [standardized mean difference (SMD) = −0.232, 95% CI: −0.398 to −0.066, $p = 0.006$], depressive symptoms (SMD = −0.367, 95% CI: −0.596 to −0.137, $p = 0.002$), and anxiety symptoms (SMD = −0.490, 95% CI: −0.908 to −0.071, $p = 0.022$).

Conclusions: The findings indicate the potentially beneficial effect of mindfulness exercise guided by a smartphone app on symptoms of depression and anxiety among

individuals in a non-clinical population with emotional symptoms. Considering the small number and overall methodological weakness of the included studies and lack of randomized controlled trials (RCTs), the results should be interpreted with caution, and future rigorously designed RCTs are warranted to provide more reliable evidence.

Keywords: smartphone, app, mindfulness, negative emotions, anxiety, depression, stress

INTRODUCTION

The WHO reported that about 8% of the world's population has an emotional disorder (e.g., depression or anxiety), which is one of the leading causes of disability and mortality (1). Patients with emotional disorders often have adverse psychological and physiological effects at the same time, which not only threaten personal health and reduce the quality of life, but also burden families and society (2, 3). At present, the main treatment methods for patients with emotional disorders are psychotherapy and drug therapy. However, clinical drug treatment causes different side effects in patients, along with a high cost of treatment and limited treatment effectiveness (2). Research has shown that, through the development of appropriate mental health projects and plans, early prevention and screening can effectively prevent these mental health problems (2). However, if emotional symptoms are not regulated through intervention, there will be even more negative emotional consequences or they can develop into depression, anxiety, and other emotional disorders (4, 5). Hence, prevention (instead of intervention) among the non-clinical population with emotional symptoms is of great importance.

Mindfulness is an awareness that emerges through a conscious, present, and uncritical way of focusing on the experience that is present from moment to moment (6, 7). Its benefits include enhancing consciousness, strengthening self-regulation, strengthening openness and acceptance of current experience, and looking at problems from different perspectives (6, 7). At present, mindfulness-based interventions include the Buddhist tradition of Vipassana and Zen, which are now standardized group meditation exercises (e.g., mindfulness decompression and mindfulness-based cognitive therapy), and mindfulness-based psychological intervention [e.g., dialectical behavior therapy and Acceptance and Commitment Therapy (ACT)] (8). A large number of studies have confirmed that mindfulness therapy has a strong psychological impact on clinical and non-clinical populations, such as increased attention, reduced stress, less anxiety, and fewer negative emotions (9–12). Therefore, mindfulness therapy is an effective intervention for traditional medicine and psychotherapy globally (2). However, traditional mindfulness exercise takes a long time, learning costs are high, and teachers are relatively scarce. Moreover, effective mindfulness delivery media have been shown not only to assist in face-to-face mindfulness intervention but also to help those who cannot actively seek professional help or are prone to discontinue treatment for some reason (13, 14).

With the continuous development of health-related smartphone apps or smartphones, this emerging field is increasingly becoming a trend. People regularly use smartphones to acquire health knowledge or seek more healthy methods of living from the smartphone, which has enabled people to think about whether it is possible to combine apps in smartphones with psychological research (8). At present, intervention measures based on smartphone apps may further break the space-time limitation of training, improve training motivation, and broaden application prospects (15). Mani et al. (14) evaluated 23 apps in the apple app store found some smartphone apps that specialize in mindfulness intervention have a sharing function or provide access to an app community directly within the app, which can help users share and discuss their mindfulness experiences and challenges in routine exercises, motivate users to participate in health activities, and improve users' mental health level and wellbeing (14). Moreover, the unlimited time and place characteristics of these apps can meet the needs of modern people, which can not only assist in face-to-face mindfulness intervention but can also help those who are unable to seek professional help actively or who are prone to discontinue treatment for some reason, especially young people who enjoy their smartphones but lack the willingness to actively ask for help. Thus, choosing as smartphone app for mindfulness training is the right choice for many people. Studies have shown that electronic health intervention based on mindfulness and relaxation has a positive impact on the physical and mental health of patients with diseases (16). Another study found that mindfulness exercise guided by a smartphone app had a positive effect on relaxing and distracting children with chronic diseases (17). In addition, mindfulness intervention based on network and smartphone device media has been proven effective in reducing stress (18). The above findings indicate that mindfulness-guided exercise by a smartphone app has a positive impact on mental health and physical health.

Therefore, the primary purpose of this study was to analyze the effectiveness of mindfulness exercise guided by a smartphone app on negative emotions and stress in a non-clinical population to provide evidence of mindfulness exercise guided by a smartphone app on mental health.

METHODS

Search Strategy

The procedure for this systematic review adopted the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) (18). We used a wide range of search strategies. We searched three English databases (PubMed, Web of Science, and Scopus) and two Chinese databases (China

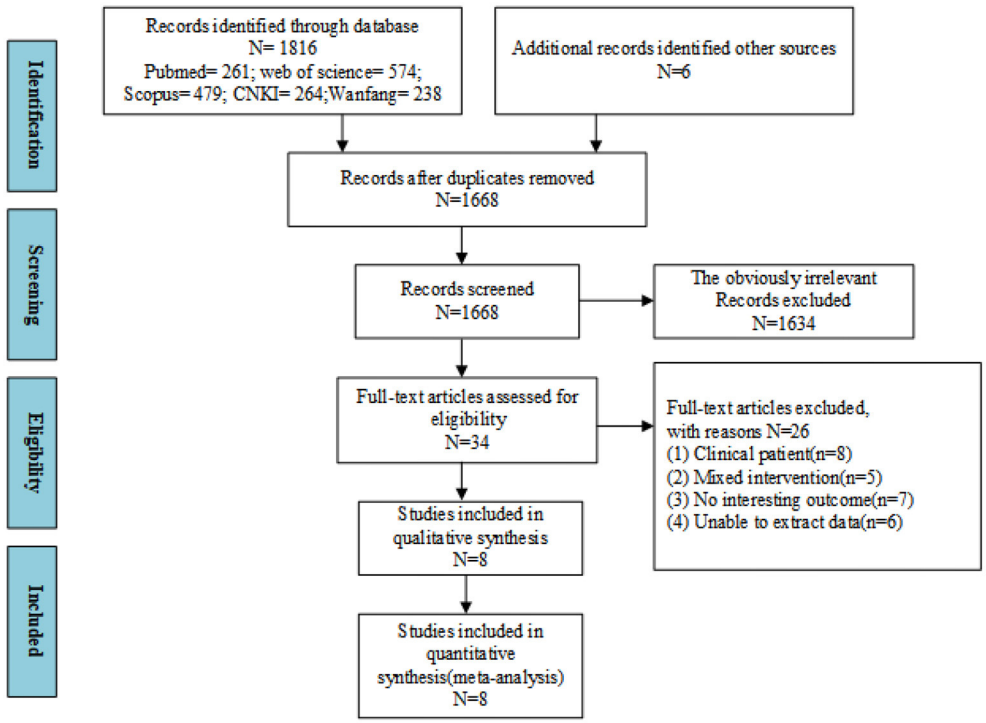


FIGURE 1 | The detailed process of trial selection.

National Knowledge Infrastructure (CNKI) and Wanfang). The search time frame was from the establishment of the database to November 9, 2021, and there was no language restriction. To maximize relevant research, we used three sets of keywords: (1) "smartphone" OR "App" OR "Application" OR "mobile"; (2) "mindfulness" OR "meditation"; and (3) "affective" OR "mood" OR "emotion" OR "depression" OR "anxiety "OR "stress." The PubMed search strategy is provided as an example (**Supplementary Appendix 1**). In addition, the reference lists of eligible studies were manually searched to ensure that all meta-analysis studies were included as much as possible.

Inclusion Criteria and Study Selection

First, two researchers independently screened based on the title and abstract. They considered studies involving the impact of a mindfulness intervention on a non-clinical population with emotional symptoms using smartphone apps, eliminating repetitive, irrelevant, and review literature, and determining the full-text literature. Studies could be included in this review only when they met the following inclusion criteria: (1) experimental research published in peer-reviewed journals; (2) participants had no physical and/or emotional disorders related diseases; (3) any intervention research on mindfulness exercise guided by a smartphone app as an intervention means (mindfulness intervention only) or as a major component but not the only component of a therapy (integrated mindfulness intervention), and the mindfulness intervention part of the smartphone apps being mainly based on self-guided software rather than by a therapist; (4) at least one outcome measure associated with negative emotions (depression and/or anxiety) or stress; and (5) available quantitative data for effect size calculation. Studies that did not meet the above inclusion criteria were excluded. If there was any discrepancy between the two researchers, a third researcher was consulted until a consensus was reached.

Descriptive Data Extraction

Descriptive data were extracted independently by two researchers after reading the full text that includes the following four parts: (1) participants (i.e., age, the proportion of women, and sample size); (2) intervention plan (i.e., weekly dose and total time); (3) results (i.e., depression, anxiety, or/and stress) and tools; and (4) to study the beneficial effects of a mindfulness intervention on negative emotions in smartphone apps, we also extracted quantitative data (on depression, anxiety, or/and stress). If there were two tools to measure depression, we extracted both tools and data.

Assessment of Risk of Bias

The risk of bias was assessed using the Cochrane risk-of-bias bias assessment tool (19). This measure comprises six areas of the trial design: sequence generation, allocation concealment, blinding of assessors, incomplete outcome data, selective outcome reporting, and other sources of bias. Items were rated as high risk, low risk, or unclear risk of bias. Disagreements about the risk of bias assessments were resolved by consensus or by consulting the third author.

TABLE 1 | Characteristics of eligible studies.

References	Study design	Study area	Profession	Sample size (*N*)	Female (%)	Mean age (years)	Type of APPs	Weekly dosage	Duration	Emotion outcomes
Carissoli et al. (22)	Randomized controlled design	Italy	Workers	EG: 20 CG: 18	Total: 84.21%	Total: 38.11 ± 6.92	Designed by the researchers	210 min	3 weeks	Depression, anxiety: MSP
Wen et al. (23)	Prospective, pilot design	USA	Hospital staffs	EG: 30	EG: 60%	NR	Freely download (head space)	More than 70 min	4 weeks	Negative emotions: NAS
Mistretta et al. (24)	Randomized controlled design	USA	Hospital staffs	EG: 23 CG: 15	EG: 78.3% CG: 93.3%	EG: 43.7 ± 14.7 CG: 46.1 ± 10.5	Designed by the researchers	120 min	6 weeks	Depression: DASS-Depression Anxiety: DASS-Anxiety Stress: DASS-Stress
Yang et al. (25)	Prospective, randomized controlled design	USA	Medical students	EG: 44 CG: 44	Total: 64	NR	Freely download (head space)	70–140 min	30 days	Stress: PSS
Moffitt-Carney et al. (26)	Pretest–posttest design	USA	College students	EG: 59	EG: 74.6	EG: 19.92 ± 3.87	Pay to download	420 min	5 weeks	Depression: CESD-R Anxiety: STAI
Bostock et al. (27)	Randomized controlled design	UK	Company staffs	EG: 108 CG: 81	EG: 60 CG: 58	EG: 36 ± 8.3 CG: 35 ± 6.9	Freely download (head space)	70–140 min	8 weeks	Depression: HADS-Depression Anxiety: HADS-Anxiety
Hwang et al. (28)	Randomized controlled design	South Korea	Nurses	EG: 26 CG: 30	EG: 83.3 CG: 93.3	<30 years old: 14 31–40: 30 >40 years old: 12	Designed by the researchers	More than 70 min	4 weeks	Depression: PHQ-9 Anxiety: GAD-7 STRESS: PSS-10; KOSS
Wu et al. (29)	Randomized controlled design	China	Nurses	EG: 38 CG: 38	EG: 100 CG: 100	EG: 29.84 ± 4.66 CG: 31.92 ± 4.82	Freely download	140–420 min	8 weeks	Depression:SCL-Depression Anxiety: SCL-Anxiety

EG, Experimental Group; CG, Control Group; NR, Not Reported; MSP, The Mesure du Stress Psychologique; NAS, The PANAS [Positive Affect Scale [PAS] and Negative Affect Scale]; DASS-21, The Depression, Anxiety, and Stress Scales; PSS, Perceived Stress Scale; CESD-R, The Center for Epidemiologic Studies Depression Scale Revised; STAI, The State-Trait Anxiety Inventory; HADS, The Hospital Anxiety and Depression Scale; PHQ-9, The Patient Health Questionnaire; GAD-7, The Generalized Anxiety Disorder; PSS-10, The assessed self-awareness of stress; KOSS, The Korean Occupational Stress Scale; SCL-90, Self-reporting inventor.

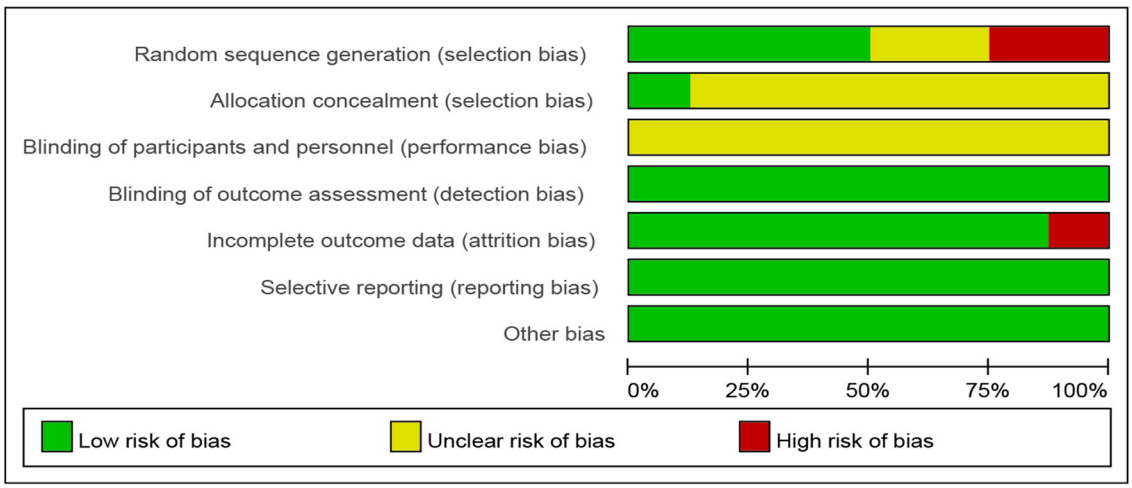


FIGURE 2 | Risk of bias graph: each risk of bias item is presented as percentages.

Data Analysis

To extract data accurately, one researcher extracted the data, while another researcher confirmed the extracted data to ensure the accuracy of the data. In this study, Comprehensive Meta-analysis Version 2 was used to carry out the combined effect size after data extraction, and all studies in analysis share a common true effect, we choose fix-effects to calculate effect sizes, if not, we choose the random-effects model (20).The standard mean difference (SMD) was selected as the effect scale index for statistics. The effect size indicated the degree of influence of mindfulness therapy guided by the smartphone app on the negative emotions of a non-clinical population with emotional symptoms (20). The size of the collective effect was calculated (standardized mean difference: negligible effect: 0–0.19; small effect: 0.2–0.49; moderate effect: 0.5–0.79; large effect: >0.8) (20). Furthermore, I^2 was used to evaluate the heterogeneity of the selected studies. The larger the I^2 statistic, the greater the heterogeneity; the low-, medium-, and a high degrees of heterogeneity were expressed by I^2 statistics of 25, 50, and 75%, respectively (20). Funnel plot and Egger tests were used to assess publication bias in more than five studies (21). The "leave-one-out" method was used for sensitivity analysis to determine the source of its heterogeneity (20). For studies that did not provide the above data, the author was contacted by email to obtain the data to improve the quality of this study.

RESULTS

Literature Search

In this study, a total of 1,822 records were retrieved through an electronic database and manual search. First, the search records were checked for duplication, and a total of 154 duplicate records were deleted. The remaining 1,668 records were further screened according to the study signs (title and abstract), and 1,634 records that did not meet the criteria of this study were deleted. Finally, 34 studies were evaluated for full-text qualification, and 26 studies were found not to meet the predetermined inclusion criteria. Finally, eight studies were identified for meta-analysis. The flow chart of the literature search and research selection is shown in **Figure 1**.

Research Characteristics

All of the research characteristics are summarized in **Table 1**. We summarized eight studies on the impact of mindfulness intervention in the smartphone app on a non-clinical population with emotional symptoms. These studies were published from 2015 to 2020; among the eight studies, one (22) was conducted in Italy, four (23–26) were conducted in the United States, one (27) was conducted in the United Kingdom, one (28) was conducted in South Korea, and one (28) was an experiment conducted in China. A total of 574 people were enrolled (experimental group: 348; control group: 226). The subjects were mainly workers (22), hospital staff (23, 24, 28, 29), students (25, 26), and company staffs (27). Six studies (22, 24, 25, 27–29) compared the mindfulness exercise guided by a smartphone app group with a control group, and two studies (23, 26) only researched mindfulness exercise guided by a smartphone app group. There were individual differences in the intervention time, ranging from 70 to 420 min per week and duration ranging from 3 to 8 weeks. Moreover, two studies (22–24) measured the overall negative emotion variables, five studies (24, 26–29) measured depression variables, five studies (24, 26–29) measured anxiety variables, and three (24–26, 28) studies measured stress variables.

Risk of Bias

Across studies, the risk of bias for blinding, incomplete outcome data, selective reporting, and other biases was sufficient in >80% of the studies. Random sequence generation was sufficient in >50% of the studies. One study (12.5%) sufficiently allocated concealment. The risk of bias across studies is reported in

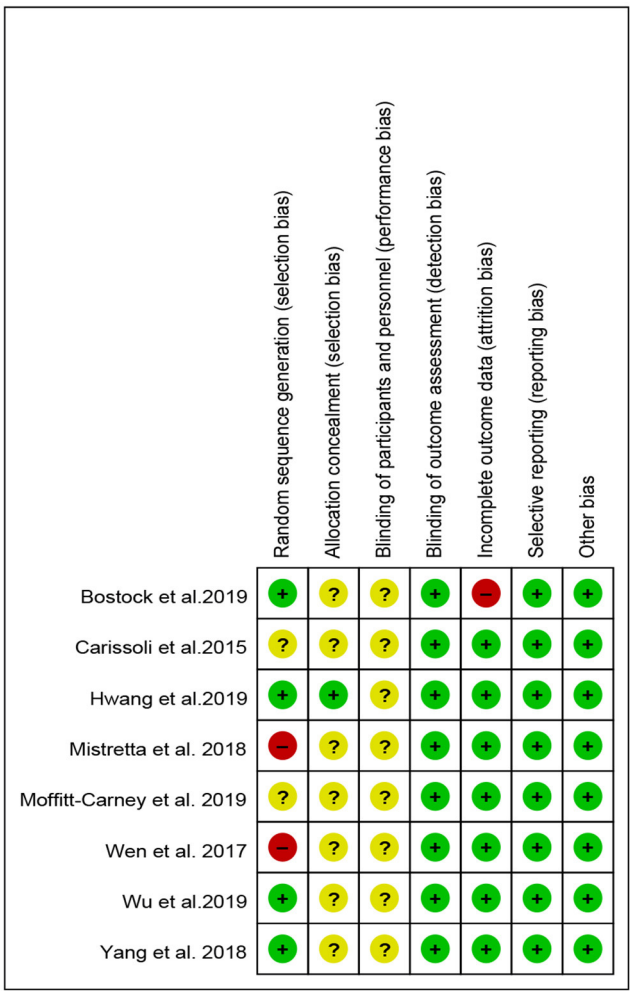


FIGURE 3 | Risk of bias of included studies. Green: low risk of bias; yellow: unclear risk of bias; red: high risk of bias.

Figure 2. Furthermore, the risk of bias per study at the item level is shown in **Figure 3**.

Effect of Mindfulness Exercise Guided by a Smartphone App on Negative Emotions

All of the selected studies were included in a random model to analyze the effect of mindfulness intervention in the smartphone app on negative emotions (depression and anxiety). Conservatively, if a study contained more than one negative emotion, the tiniest change score of negative emotion was selected for analysis. The funnel diagram is obtained by combining the random effect model, as shown in **Figure 4** (Egger's regression intercept = 1.370, $p = 0.389$). The meta-analysis of the random model showed that mindfulness exercise guided by a smartphone app had small effects on negative emotions (SMD = −0.232, 95% CI: −0.398 to −0.066, $I^2 = 6.503\%$, $p < 0.01$, **Figure 5**). The sensitivity analysis of "leave-one-out" was subsequently carried out (SMD = −0250 to −0.167).

Effect of Mindfulness Exercise Guided by a Smartphone App on Depression

Of the seven included studies, five studies (24, 26–29) used depression as the main outcome, and a meta-analysis was conducted to test the overall effect of mindfulness intervention in a smartphone app. Owing to the difference in measurement results, a random effect analysis was performed to combine the results, and the funnel map of depression was obtained, as shown in **Figure 6** (Egger's regression intercept = 1.925, $p = 0.385$). The meta-analysis showed that mindfulness exercise guided by a smartphone app had small effects on depression (SMD = −0.367, 95% CI: −0.596 to −0.137, $I^2 = 24.091\%$, $p < 0.01$ 0.002, **Figure 7**). Subsequently, the sensitivity analysis of "leave-one-out" was carried out (SMD = −0.427 to −0.306).

Effect of Mindfulness Exercise Guided by a Smartphone App on Anxiety

Of the seven included studies, five studies (24, 26–29) used anxiety as the main outcome, and a meta-analysis was conducted to test the overall effect of mindfulness intervention in a smartphone app. Owing to the difference in the outcome measurement, a random effect analysis was performed to combine the results, and the funnel map of anxiety was obtained, as shown in **Figure 8** (Egger's regression intercept = −1.795, $p = 0.641$). The meta-analysis showed that, compared with the control group, the mindfulness exercise guided by a smartphone app had small effects on anxiety (SMD = −0.490, 95% CI: −0.908 to −0.071, $I^2 = 75.233\%$, $p < 0.05$, **Figure 9**). Subsequently, the sensitivity analysis of "leave-one-out" was carried out (SMD = −0.619 to −0.327).

Effect of Mindfulness Exercise Guided by a Smartphone App on Stress

Of the seven included studies, four studies (24–26, 28) considered the stress variable as the main outcome, and a meta-analysis was conducted to test the overall effect of mindfulness exercise guided by a smartphone app. Owing to the difference in the outcome measurement, a random effect analysis was performed to combine the results. The meta-analysis showed that, compared with the control group, mindfulness exercise guided by a smartphone app had no effect on stress (SMD = −1.380, 95% CI: −2.780 to 0.021, $I^2 = 95.299\%$, $p > 0.05$, **Figure 10**).

DISCUSSION

This study involved a meta-analysis evaluation of the effects of mindfulness intervention guided by a smartphone app on negative emotions (depression and anxiety) and stress on a non-clinical population with emotional symptoms. Specifically, our study showed that mindfulness intervention guided by a smartphone app had a small-to-medium improvement effect on the negative emotions of the non-clinical population with emotional symptoms. The meta-analysis results were as follows:

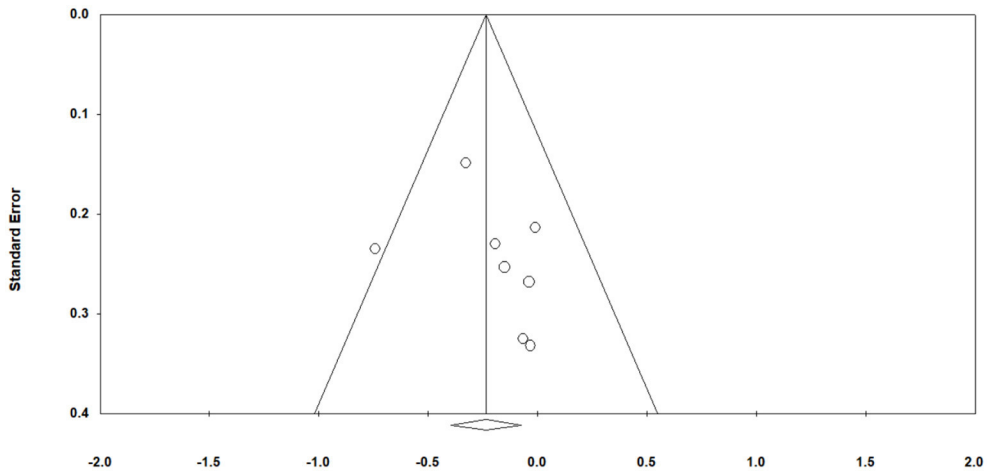


FIGURE 4 | Funnel plot for negative emotions.

Study name	Outcome	Statistics for each study						
		Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Wen et al. 2017	NAS	-0.150	0.253	0.064	-0.646	0.346	-0.591	0.554
Carissoli et al. 2015	MSP	-0.066	0.325	0.106	-0.703	0.571	-0.204	0.838
Wu et al. 2019	SCL-Depression	-0.192	0.230	0.053	-0.643	0.259	-0.836	0.403
Mistretta et al. 2018	DASS-Depression	-0.032	0.332	0.110	-0.682	0.619	-0.096	0.923
Moffitt-Carney et al. 2019	CESD-R	-0.741	0.235	0.055	-1.200	-0.281	-3.157	0.002
Bostock et al. 2019	HADS-Depression	-0.327	0.149	0.022	-0.619	-0.036	-2.199	0.028
Hwang et al. 2019	PHQ-9	-0.037	0.268	0.072	-0.562	0.488	-0.138	0.891
Yang et al. 2018	PPS	-0.010	0.213	0.045	-0.427	0.408	-0.045	0.964
		-0.232	0.085	0.007	-0.398	-0.066	-2.740	0.006

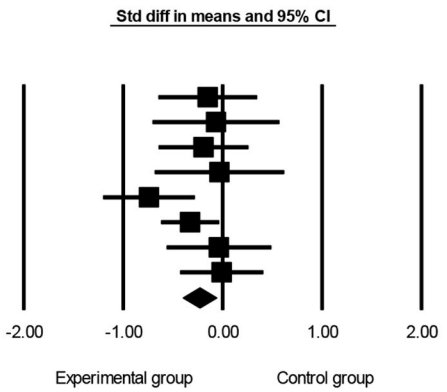


FIGURE 5 | Forest plot for negative emotions.

negative emotions (SMD = −0.272), depressive symptoms (SMD = −0.367), and anxiety symptoms (SMD = −0.490). The novel findings based on available evidence indicate that a favorable effect of mindfulness exercise guided by a smartphone app on reducing anxiety was found in the treated group compared to the untreated group. However, more studies with high homogeneity in methodology are needed to confirm these findings. The details of the study follow.

We included items of negative emotion data, four items of depression data (24, 26, 28, 29), and one item of stress data (25) from two studies (22, 23) to analyze the effect of mindfulness exercise guided by a smartphone app on negative emotions. The subjects included were mainly workers, students, nurses, and hospital staff. We speculate that the reason the researchers chose this kind of population is that the experimental subjects were relatively concentrated. Because of the particularity of each work or study, there was a higher chance of reducing negative emotions, especially medical workers. Our meta-analysis found that practitioners who practiced mindfulness exercises guided by a smartphone app exhibited a moderate effect of reduced negative emotions. This result was encouraging and indicates that mindfulness exercise guided by a smartphone app is effective in reducing negative emotions. Similarly, depression and anxiety calculations gave very similar results, both were also believed to be reduced through mindfulness exercise guided by a smartphone app. These benefits from the mindfulness exercise guided by a smartphone app to select text, audio, or video may be provided in these apps to explain mindfulness, which can help users practice mindfulness step by step and can provide long-term, detailed, and instructive mindfulness education for practitioners. Wen et al. found that the generation of negative emotions of medical workers was related not only to stress but also a factor of negative

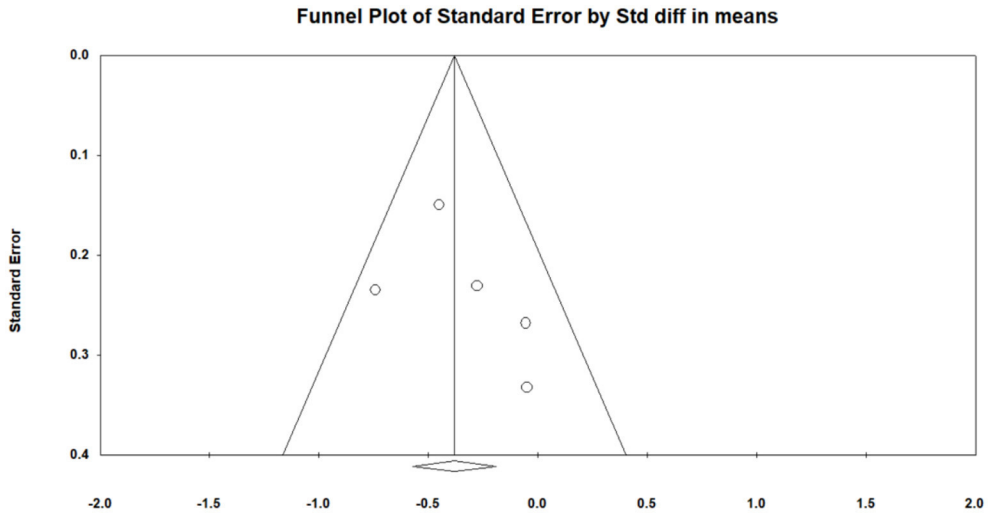


FIGURE 6 | Funnel plot for depression.

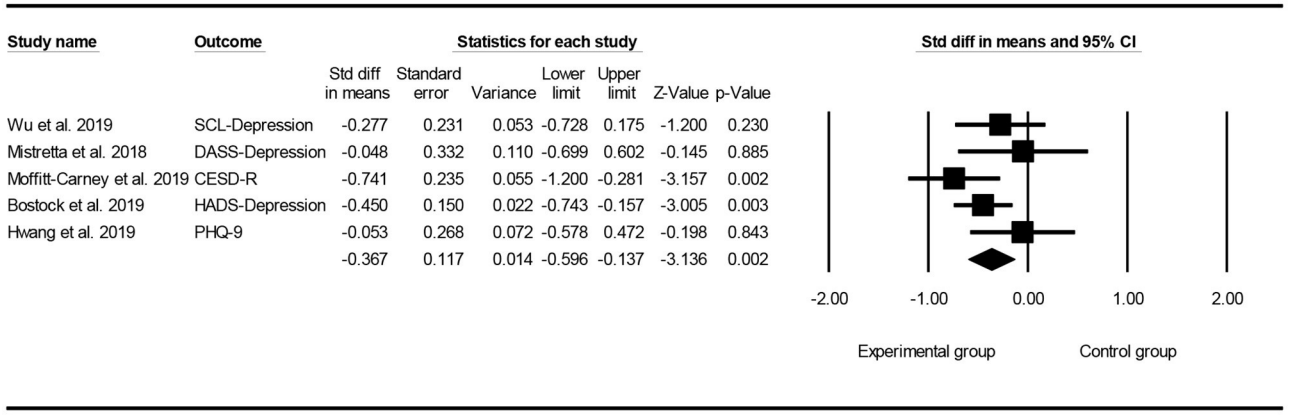


FIGURE 7 | Forest plot for depression.

emotions in high-intensity medical work and that practicing mindfulness could help reduce the degree of fatigue of medical workers (23). Carissoli et al. pointed out that the mindfulness intervention time for the mindfulness exercise guided by a smartphone app should be more than 3 weeks to ensure that the practitioners have confidence (22). However, Bostock et al. found that 4 weeks of intervention exercises were not enough. To improve the benefits of mindfulness exercise, and thereby improve depression and anxiety, the development of mindfulness apps is necessary for the future (27).

In terms of reduced stress, we included a total of four studies. The meta-analysis results showed that the p was 0.054, which was higher than 0.05. Besides, the result had high heterogeneity, which led to this result. Potential sources of heterogeneity may include different tools to measure stress from four studies. After detailed analysis and interpretation of each study, Mistretta et al. found that there were significant differences in the stress variables of the mindfulness intervention group guided by the smartphone app, and studies have shown that such interventions are limited in reducing stress (24). A study by Hwang et al. found that mindfulness exercise guided by a smartphone app not only reduced nurses' feelings of pressure but also improved their self-efficacy (28). Therefore, we have reason to believe that mindfulness exercise guided by a smartphone app is a promising method for reducing personal stress.

Although mindfulness intervention with a smartphone app has certain advantages, the quality and intervention effect of many apps still needs to be explored. We speculate that there may be certain reasons why mindfulness exercise guided by a smartphone app has a small effect on students' depression and anxiety: (1) some apps may not thoroughly explain the concept of mindfulness, and some apps may not necessarily be related to mindfulness or meditation in terms of their functions or features. There is still no perfect standard for the concept of mindfulness and the steps of mindfulness training. (2) The functions of smartphone apps related to mindfulness training are limited, and most of them are aimed at short-term individual practices. There is

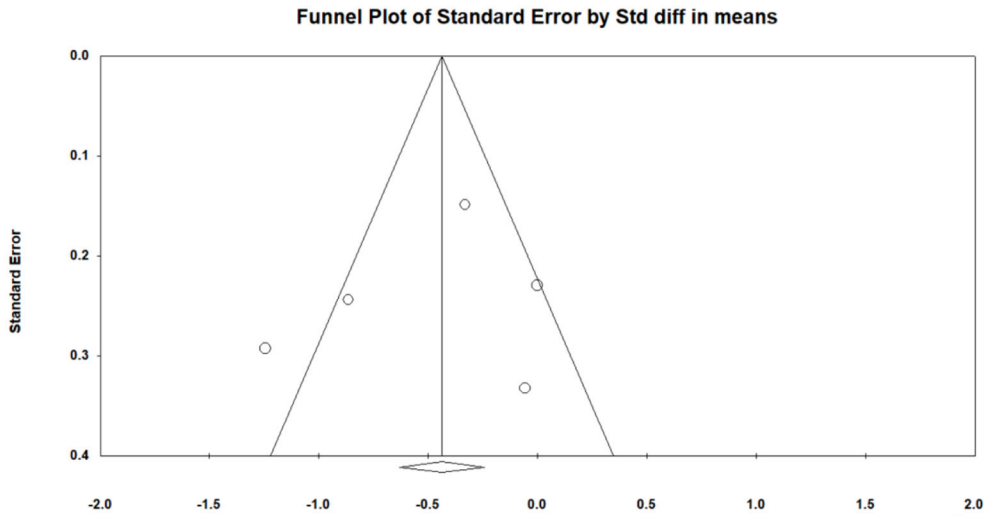


FIGURE 8 | Funnel plot for anxiety.

Study name	Outcome	Statistics for each study						
		Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Wu et al.2019	SCL-Anxiety	-0.000	0.229	0.053	-0.450	0.450	-0.000	1.000
Mistretta et al.2018	DASS-Anxiety	-0.056	0.332	0.110	-0.707	0.595	-0.169	0.866
Moffitt-Carney et al.2019	STAI-S	-0.865	0.244	0.059	-1.342	-0.387	-3.550	0.000
Bostock et al.2019	HADS-Anxiety	-0.329	0.149	0.022	-0.621	-0.038	-2.213	0.027
Hwang et al.2019	GAD-7	-1.243	0.293	0.086	-1.817	-0.670	-4.250	0.000
		-0.490	0.214	0.046	-0.908	-0.071	-2.293	0.022

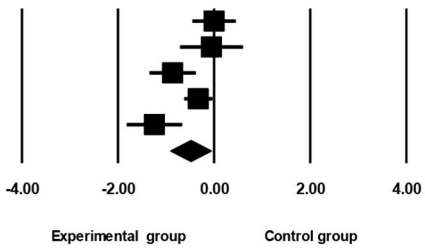


FIGURE 9 | Forest plot for anxiety.

Study name	Outcome	Statistics for each study						
		Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Mistretta et al.2018	DASS-Stress	-0.375	0.335	0.112	-1.030	0.281	-1.119	0.263
Yang et al. 2018	PPS	-0.010	0.213	0.045	-0.427	0.408	-0.045	0.964
Hwang et al.2019	Blank	-3.014	0.391	0.153	-3.780	-2.247	-7.707	0.000
Hwang et al. 2019	KOSS	-2.200	0.339	0.115	-2.865	-1.535	-6.487	0.000
		-1.380	0.715	0.511	-2.780	0.021	-1.931	0.054

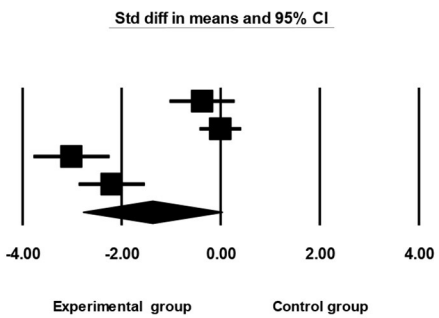


FIGURE 10 | Forest plot for stress.

no app for mindfulness professionals or those who want to carry out mindfulness training for a long time. Moreover, there is no possibility of group education or the practice of mindfulness. Therefore, although the smartphone app is a useful auxiliary medium for mindfulness intervention, its potential still needs to be explored to a large extent while improving its existing functions.

STUDY LIMITATIONS

There were limitations to this study. First, the study data were retrieved in November 9, 2021, and the findings of possible related studies (ongoing studies, manuscripts under review, and studies published after that date) were excluded. Second, we only investigated the effect of mindfulness exercise guided by a smartphone app on the negative emotions and stress of a non-clinical population with emotional symptoms, but we did not investigate neural mechanism-related research. Third, only eight studies were included in this study; these relatively small number of studies translated to less overall real data, which may have affected the quality of research. Fourth, owing to the limited number of studies included, it was difficult to conduct subgroup analysis on intervention time and long-term effect after the intervention.

CONCLUSION

The results indicate that mindfulness exercise guided by a smartphone app shows potential advantages in reducing depression and anxiety in a non-clinical population with emotional symptoms. This suggests that mindfulness exercise guided by a smartphone app is of great significance in preventing emotional disorders and promoting mental health.

DATA AVAILABILITY STATEMENT

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

AUTHOR CONTRIBUTIONS

JW, YM, and ZR contributed to the conception and design of the review. JW and YZ applied the search strategy. JW and KZ applied the selection criteria. ZZ and ZR completed an assessment of the risk of bias. YM analyzed and interpreted the data. JW and YM wrote this manuscript. YQ edited this manuscript. ZR is responsible for the overall project. All authors have read and approved the manuscript.

FUNDING

Research Foundation for Young Teacher of Shenzhen University (grant number QNJS0274); High-Level Scientific Research Foundation for the Introduction of Talent of Shenzhen University (grant number RC00228); High-Level Scientific Research Foundation for the Introduction of Talent of Shanwei Institute of Technology (grant number SKQD2021B-028); and the Natural Science Featured Innovation Projects in Ordinary Universities in Guangdong Province (grant number 2021KTSCX297).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.773296/full#supplementary-material

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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.

The reviewer SL declared a shared affiliation with one of the authors, KZ, to the handling editor at the time of review.

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frontiers in Psychiatry

STUDY PROTOCOL
published: 27 January 2022
doi: 10.3389/fpsyt.2021.809679

Evaluating a Psychological First Aid Training Intervention (Preparing Me) to Support the Mental Health and Wellbeing of Chinese Healthcare Workers During Healthcare Emergencies: Protocol for a Randomized Controlled Feasibility Trial

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OPEN ACCESS

Edited by:
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Reviewed by:
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Sikkim Manipal University, India
Giovanna Ricci,
University of Camerino, Italy

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

Received: 05 November 2021
Accepted: 22 December 2021
Published: 27 January 2022

Citation:
Wang L, Norman I, Xiao T, Li Y, Li X and Leamy M (2022) Evaluating a Psychological First Aid Training Intervention (Preparing Me) to Support the Mental Health and Wellbeing of Chinese Healthcare Workers During Healthcare Emergencies: Protocol for a Randomized Controlled Feasibility Trial. Front. Psychiatry 12:809679. doi: 10.3389/fpsyt.2021.809679

Aims/Background: The mental health challenges faced by frontline healthcare workers responding to emergencies have become a prominent public concern. Despite the consensus that Psychological First Aid (PFA) training can effectively support public mental health during emergencies through reducing acute distress and improving self-efficacy, yet it is concerning that previous flexible delivery and neglect for evaluating PFA training has resulted in unintended potential harms which may prevent further proactive uptake of this mental health prevention strategies. Establishing the feasibility of the PFA training through adapting to the local culture, tailoring to frontline healthcare context, and evaluating systematically may be helpful to inform a large trial, or ensure effective and sustained training delivery. This study aims to present a protocol for evaluating the feasibility and acceptability of a well-adapted PFA training intervention (Preparing Me) to address the implementation gap in this mental health promotion approach.

Method: This is a two-armed feasibility randomized controlled trial (RCT) to be conducted among 80 Chinese frontline healthcare workers without prior related mental health training. Participants from the intervention group will receive an adapted PFA training program tailored to the Chinese frontline context to improve their knowledge and skills to support people in crisis. The primary objectives are to evaluate the training intervention's feasibility and the target population's acceptance of this educational intervention. The secondary objective is to obtain preliminary estimates of variability in participants' outcomes over a 3-months period. Measurements are taken pre-intervention (T0), post-intervention (T1), and at 1- and 3-months follow-up (T2–T3). A process evaluation using qualitative research with a subgroup of trainees, their clinical managers as well as trainers will be conducted to gain a comprehensive understanding of the intervention's acceptability and feasibility.

Discussion: This present study protocol will help to establish whether this adapted PFA training intervention is feasible and accepted by the frontline healthcare workers, in preparation for a later effectiveness trial. It is anticipated that the resulted information would be an impetus to maximize usability and acceptance of this low-intensity PFA skillset by a wider population, thus supporting the mental health of frontline healthcare workers in dealing with crises for future emergencies.

Trial Registration: This trial has been approved by the Institution Review Board from Central South University (LYG2020029) and by the Psychiatry, Nursing and Midwifery Research Ethics Committee at King's College London, England (LRS/DP-21/22-23161). It also has been processing registration at the Chinese Clinical Trial Registry.

Keywords: mental health promotion, healthcare workers, psychological first aid training, educational intervention, crisis, randomized controlled feasibility trial protocol

INTRODUCTION

The mental health challenges faced by healthcare workers is a major public health concern threatening health and economic prosperity of leading economies (1, 2). Working in crisis healthcare environments, healthcare workers providing direct services to patients have been experiencing increased patient volume and mounting demands, against a backdrop of limited resources; factors which are significantly associated with increased psychological stress (3, 4). This can in turn lead to burnout (BO), depression, anxiety disorders, sleeping disorders, and other mental illness (5). Health services' responding to the COVID-19 pandemic has been further exacerbated by these issues among frontline healthcare workers across the globe, which can, in turn, have a negative impact on health systems through decreased professionalism, and reduced care delivery and efficiency (6, 7).

The adverse mental health impact of public health crises on healthcare workers is not a new concern and is considered by some as a consequence of an historical underinvestment in mental health prevention for healthcare workers (8). There are two main issues here. Firstly, providing early psychological support to acutely distressed individuals has been well-recognized as critical to prevent the onset of mental illness, but the availability of early support is limited by insufficient onsite mental health professionals, limited resources, and insufficient recognition of the value of prompt psychological support for patients by frontline health workers themselves (7, 9). Secondly, apart from their pivotal role of caring patients, healthcare workers are at high-risk themselves arising from overwhelming stressful situations. Many are trained to prioritize physical problems rather than their own psychological needs—putting patients first; and acting as "heroes" whilst being conscious of the stigma associated with seeking emotional help for their own mental health distress (10, 11). The importance of individual healthcare workers recognizing and managing their own stress seems to be neglected.

Prior evidence has reported on short-term "mood boosters" to support the frontline workforce such as free-lunch, clapping for heroes, or practice telemedicine mindfulness (12, 13). Although these may offer temporary relief, they are no substitute for interventions to address the serious challenges frontline workers face regarding protecting their mental health and well-being. Some further argue that Self-Help Plus and stress management approaches may be ideal for stress and BO reduction (14), yet those appears to be insufficient of empowering them to address patients' need. Thus, investing in and accelerating preventive measures to reduce the workload burden on the healthcare workforce and practice self-care on a more permanent basis is imperative in the long term.

A recent scoping review of the impact of the COVID-19 pandemic on the physical and mental health of healthcare workers highlights the importance of fostering their resilience through proactive optimal provision of education, resilience training, and interventions to increase the confidence of staff in their preparedness to manage health care emergencies (7). Psychological First Aid (PFA) is one such intervention which has potential to deliver these benefits for healthcare staff capable of providing the necessary psychological support and practicing self-care. However, substantial challenges exist in its implementation may prevent its potential of this so-called cost-effective mental health promotion strategy.

The Role of PFA to Support Public Mental Health During Emergencies

Psychological First Aid is an intervention to mitigate acute stress and foster resilience for crisis-affected victims which is promoted by public health authorities. Originally developed as a "do no harm" intervention to ensure the psychological recovery of people who have experienced traumatic stress in aftermath of the disaster (15, 16), PFA is effective to: (A) recognize their vulnerability (e.g., risk for crisis harm) and develop safety plans; (B) calm those who are emotionally distressed by the crisis; (C) improve disaster victims' self-efficacy to meet their emotional and practical needs; (D) support connectiveness and hope to protect individual well-being; and (E) facilitate access to more intensive assessment and intervention when indicated (16, 17).

Psychological First Aid as an early response intervention on reducing acute distress has several potential advantages.

First, unlike traditional psychiatric interventions, PFA does not pathologize acutely distressed people; rather, it normalizes distress reactions and improves the coping abilities of traumatized disaster victims. This potentially reduce the stigma of being problematic in coping with crisis (18). Second, PFA does not involve psychiatric diagnosis; rather it involves approaching people in crisis, active listening, and providing practical assistance if needed via problem-solving, meeting basic needs or referring to professional care (19). Thus, it increases the scalability by training "lay people" to address the shortage of mental health professionals in frontline and reduce the stigma of seeking emotional help among acutely distressed individuals.

With the public emergencies increasingly prevailing across the globe and the emphasis of early psychosocial support in emergencies, PFA training has been widely applied as a first-line capacity-building approach to equip frontline workers within emergency response setting. A few studies conducted with frontline workers in humanitarian, disaster relief, and primary health sectors, have found that training in PFA has positively improved workers' knowledge of appropriate psychosocial responses and skills to support people in crisis situations, and enhanced their resilience to address adversity (20–23). Meanwhile, during the COVID-19 pandemic response, several institutions have started peer support programs of training in PFA for the support of healthcare workers. These reported anecdotal experiences suggest that it is a useful in-person, on-site support programme to foster resilience and self-efficacy (24–26).

The accessibility and utilization of PFA training to prepare especially the healthcare staff to ensure frontline psychosocial response is demanding, yet barriers to extend or proactively uptake PFA training to a wider group are substantial. First, the focus of PFA training on staff working exclusively in disaster settings which may lead to a misconception of PFA as a specific disaster response tool with less applications across non-disaster contexts and populations (27, 28). Second, most PFA training delivery is still the result of disaster-caused emergencies plans which result in just-in-time training. Current training delivery highlights the shortcomings of PFA training including inadequate guidance on adaptation, little motivation to evaluate, unclear training outcomes, and a lack of clarity about the core components of PFA training to ensure high fidelity (29). This is concerning that the previous flexible delivery with little motivation for evaluating PFA training has resulted in unintended potential harm to disaster victims, such as making false promises and confusion about role boundaries (30). Even worse, given the availability of evidence from training implementation science could further influence the therapeutic effect of the PFA intervention. Third, studies on the mechanisms through which PFA skills work to deliver patient benefit is still lacking, that may become the inhibitor to proactive scaling-up of training initiatives; for instance, few studies have investigated the longitudinal impact of PFA educational and implementation outcomes (e.g., trainees' adherence, preparedness, skills in real-world, well-being benefits).

Scholars suggest that PFA training should be accessible as rudimentary skill to increase frontline health care workers' coping ability, reduce their risk of distress and provide them with skills to deliver person-centered care (31). However, before establishing what extend potential benefits of PFA training can be contributed to the healthcare context, it seems to be neglected to determine the feasibility of the PFA training through adapting to the local culture, tailoring to frontline healthcare context, and evaluating systematically. Considering the COVID-19 pandemic is likely accelerate the uptake of PFA training, it is far more urgent to prioritize a well-adapted PFA training intervention thereby to effectively inform a randomized controlled trial (RCT) in a larger sample.

"Preparing Me" Program—Support the Mental Health of Frontline Healthcare Workforce

In China, an inadequate investment to safeguard the mental health and well-being of the healthcare workforce has been well-documented during the COVID-19 pandemic response (32). Chinese healthcare workers have been increasingly required to respond to mental health crises arising from the growing psychosocial support needs of an enormous population, increased incidence of public health emergencies, insufficient, and unevenly distributed mental health resources, poor mental health literacy, and severe stigma toward help-seeking (33–35). The prior study has reported a remaining underdeveloped crisis mental health preparedness of healthcare workers and little attention is paid to capacity building through mental health training in China (36, 37). As highlighted by the COVID-19, it is far more imperative to establish evidence of a frontline capacity building approach to empower Chinese healthcare workers with the ability of recognizing and responding to psychological distress. Thus, this "Preparing Me" project (hereafter referred to as Preparing Me for frontline) comes at the opportune time which aims to adapt, tailor, and evaluate PFA training to frontline healthcare workers in China for use.

Among the three most influential PFA models, each with different priorities are the World Health Organization PFA guide (Psychological First Aid: Guide for Field Workers) (38), the National Child Traumatic Stress Network PFA guide (Psychological First Aid: Field Operations Guide) (39), RAPID model (The Johns Hopkins Guide to Psychological First Aid) (19). Of these, the present study involves adapting the John Hopkins Guide to Psychological First Aid for implementation and evaluation in China. The John Hopkins Model has been selected, over the other two models, because: (A) a small therapeutic RAPID PFA effect of reducing acute stress has been established in two RCTs among individual and group samples (40, 41); (B) its structured stepwise model aligns with empirical validation regarding its knowledge, skills, and attitudes (KSA) format for PFA competency statements so providing a foundation to quantitatively evaluate acquisition of the learning objectives (42); (C) the findings from John Hopkins' PFA capacity-building initiatives reveal a potential value of proactive preparedness to equip their public health workforce with PFA competencies representing 14 preparedness and emergency response centers (43–45). Given its emphasis on meeting the

needs of proactively preparing frontline healthcare workforce for future emergencies, we have obtained permission from the John Hopkins Press (19) and the author (Professor George Everly) to: (A) translate the RAPID PFA guide into Chinese; (B) adapt this training into Chinese frontline context; and (C) evaluate this adapted Chinese PFA training intervention for frontline healthcare workers.

An appropriate adaption of a psycho-educational intervention is essential to maximize the implementation fidelity and enhance program fit (46). Given evidence on proper PFA adaptation resulting in PFA practice dilution (30), therefore, the adaptation of this Chinese PFA training intervention had been systematically conducted in line with these frameworks, i.e., the ADAPT-ITT cultural adaptation framework combined with the Bernal framework (47, 48). The aspects of language, metaphors, content, concept, goals, methods, and the context, as well as environmental and psychological factors had been well-considered when culturally adapting this training. Throughout this process, stakeholder participation in its development was achieved through: (A) conducting individual interviews (n = 15) of healthcare staff to capture their perceived needs (e.g., case range of application context) and training preferences; and (B) conducting three focus groups of frontline healthcare workers (with a total of 33 participants); and (C) using semi-structured discussions with an expert steering group to ensure cultural appropriateness. Drawing on the data collected from these stakeholders, we have identified possible adaptations and refined the PFA training intervention to fit Chinese healthcare practice. Thus, the "Preparing Me" PFA training intervention has been well-tailored to the Chinese frontline healthcare setting (see **Table 1** of detailed PFA training intervention content based on TIDieR checklist) (49). Along with the consultation with experts in simulation and clinical education, this adapted Chinese PFA training program include a brief didactic introduction, role-play, case-simulation, and associated learning tools following an interactive and practice-based curriculum design (50–52). These will be delivered over 1-day face-to-face simulation training course (7 h) and two follow-up practice supervision sessions (1 h each); with a focus on improving the trainers' knowledge, skills, and self-efficacy related to support people in acute stress. All six modules comprise didactic information on mental health response to critical incidents and PFA, and each is framed by common challenges in frontline practice to increase its salience and provide practical approaches to implementing PFA into frontline healthcare practice. Training sessions are standardized via the use of a structured trainers' guide including up to 20 trainees. Since prior evidence on 1-day PFA training resulting in inconsistent PFA practice (30), we have added the two follow-up sessions to further support knowledge acquisition and skills development into their clinical practice.

Thus, as a prerequisite to conducting a main RCT to evaluate its effectiveness in a larger sample, this present study is designed with the overall aim to establish the feasibility of this Chinese PFA training intervention ("Preparing Me") to inform future design and process. It is the second phase of an inter-linked project, with the interest in exploring the potential of a capacity building program in response to vulnerable frontline health workers combatting COVID-19. It is anticipated that the resulted information would be an impetus to maximize usability and acceptance of this low-intensity skillset by wider frontline population, thus achieving the empowerment of the frontline healthcare workforce in dealing with crises through which preparing them the ability to recognize and responding to psychological distress.

OBJECTIVES

This feasibility study is undertaken in preparation for RCT to explore uncertainties and enable us to optimize the intervention or the conduct of the trial. Thus, the primary objective is to determine the feasibility of outcome data collection with this systematically adapted PFA training intervention to the target population and obtain preliminary estimates of variability in participants outcomes, which could inform future sample size estimation for an RCT. The secondary objective is to generate the acceptability of this training intervention. Meanwhile, a nested process evaluation using qualitative methods will be conducted from diverse perspective in parallel to extend the acceptability and feasibility for randomized trial, as well as provide a comprehensive contextual information about potential barriers and facilitators related to PFA training intervention implementation. All detailed study objectives can be found in **Table 2**.

METHODS AND ANALYSIS

Design

Given the implementation of PFA training intervention involves several components, including target a range of the behaviors, the trainers need mental health expertise and those receiving the intervention are experienced frontline healthcare workers, it can be described as a complex intervention. This study design has considered the Medical Research Council (MRC) framework, which is particularly suited to guide the adaptation and assessment of the feasibility/acceptability, with the intention of improving the design and evaluation, thereby to achieve an ultimately effective, sustainable, and scalable training intervention (53). Followed the guidance, this study protocol describes two steps of (A) feasibility trial evaluation following the recommendations of the SPIRIT 2013 statement [Standard Protocol Items: Recommendations for Interventional Trials] (54) and (B) process evaluation. The study flowchart is displayed in **Figure 1**.

(A) Feasibility Randomized Controlled Trial

A two-arm, feasibility randomized control trial will be used to test an adapted PFA training in a Chinese population of frontline healthcare workers. The purpose of the feasibility trial is to achieve two objectives (1) to determine the acceptability and feasibility of outcome data collection; and (2) to generate preliminary estimates of variability in trainee outcomes, which can inform sample size estimation for a large-scale RCT.

TABLE 1 | "Preparing Me" for Chinese frontline healthcare PFA training intervention.

Training session (length)	Description of element content	Learning objectives	Implementation of element	Supporting materials
Session 1: Introduction (30 min) Trainer: Psychologist	• What is PFA? • Theoretical background of PFA: • terms and concepts of early psychosocial support in emergencies • Historical context of PFA and its application	• Increasing awareness of mental health crisis, the context of applying PFA knowledge and skills	Location: Classroom lecture Mechanism: Group discussion	Theoretical dialectic slides Training handbook
Session 2: Establishing rapport (75 min) Trainer: Psychologist	• Reflective listening • Establishing rapport with acutely distressed people	• Increasing reflective listening through a greater awareness of one's emotion. • Fostering the ability to be supportive of one's emotional needs • Approaching people with proper communication skills	Location: Classroom Lecture Mechanism: Cased-based simulation Guided debriefing Group reflection	Theoretical dialectic slides Training handbook Case highlights
Session 3: Assessment and periodization (75 min) Trainer: Psychologist	• Assessment people's needs through listening to their story • Help people to prioritize practical concerns	• Enhancing the ability of assessing and prioritizing people with obvious urgent basic needs	Location: Classroom Lecture Mechanism: Watch video Cased-based simulation Guided debriefing Group reflection	Fast checklist leaflet Training handbook Case highlights
Session 4: Intervention and Referral (75 min) Trainer: Psychologist	• Calm people via cognitive reframing, stress management, etc. • Instill hope and connect people with loved ones and social support • Encouragement with further resources • Follow-up	• Focusing on stress reduction • Improving emotional regulation and thus lowering stress levels known to have a negative impact • Supporting continued care with referral resources based on local circumstances	Location: Classroom Lecture Mechanism: Cased-based simulation Guided debriefing Group reflection	Fast checklist leaflet Training handbook Case highlights Referral resources
Session 5: Selfcare and wrap-up (75 min) Trainer: Psychologist	• Risk factors of being a supporter • Self-care strategy	• Promoting self-care and generate motivation for care for oneself	Location: Classroom Lecture Mechanism: Group discussion	Stress management resources
Supervision session 1 (45 min) Supervisor: Psychologist	• Reflect PFA practice within frontline context	• Reflect real-setting skill practice	Location: WeChat Cased-based learning Mechanism: Practice case counseling	Supervision Handbook Referral resources
Supervision session 2 (45 min) Supervisor: Psychologist	• Proper evaluate PFA delivery • Develop supporting and safety plan	• Review knowledge and skill acquisition	Location: WeChat Cased-based learning Mechanism: Practice case counseling	Supervision Handbook Referral resources

The reporting of this training content has been mapped using TIDieR checklist including theory (why), material and procedures (what), training provider (who), mechanism of delivery and location (how and where), training schedule and intensity (when and how much), adaptation (tailoring), adherence and fidelity (how well).

(B) Process Evaluation

Qualitative research will follow to add the feasibility and acceptability of this adapted PFA training intervention in a large tertiary hospital setting to complete interviews and observations with trainees as well as their clinical ward manager and trainers. Those generated potential contextual information about this feasibility RCT from multiple stakeholders will help to inform future intervention refinements and study design (55, 56).

Feasibility Randomized Controlled Trial

Setting

The recruitment of participants and implementation of the "Preparing Me" PFA training intervention will be conducted in a representative Chinese tertiary hospital (The Second Xiangya Hospital of Central South University) in Hunan Province, the central part of China.

TABLE 2 | Study objectives: Feasibility and acceptability.

Domains	Research questions	Methods	Participants
Primary objectives: Feasibility			
1-1 Recruitment and retention	• Can numbers of frontline healthcare workers be adequately recruited, trained, and retained for outcome analyses?	• Process outputs: trainees (number available in wards, number at training, number at supervision sessions; number completing measurement tools and time 1, 2 and 3)	Trainees
1-2 Adherence	• How many participants attend training sessions/supervision sessions? • What are the reasons for failing to attend training and supervision sessions?	• Attendance record for training and supervision sessions • Observation fieldnotes of training and supervision sessions • Qualitative interviews with expert trainers, and trainees	Trainees, trainers
1-3 Feasibility of measurement tools	• Are the assessment tools acceptable to participants for collecting training outcomes? • Are the measurement tools sensitive to assess the changes?	• Measurement tools completion rate, time for completion, number of missing items • Qualitative interview with participants about appropriateness of outcomes measures	Trainees
1-4 Overtime changes	• Do healthcare trainees' knowledge, attitudes, skills, well-being change after training, and is this sustained at follow up?	• Outcome's assessment pre-and post-training, plus 1- and 3-months follow-up • Calculation with mean score and standard deviation over time	Trainees
Secondary objectives: Acceptability			
2-1 Program evaluation	• Did attending training and supervision lead to trainees' improvement in practice, if so, what were these? • What do trainees think about PFA training program and supervision sessions?	• Qualitative interviews with trainers, trainees, and clinical ward manager think about the PFA training (is the format acceptable, is there anything missing, likes and dislikes, barriers, and challenges to complete the training and supervision) • Observation fieldnotes from training and supervision sessions	• Trainer, trainees, clinical ward manager
• 2-2 Fidelity of training intervention	• Did the trainers deliver the training as intended?	• Analysis of observation fieldnotes and transcripts of training session video recordings. Researcher rated PFA training intervention using a fidelity assessment tool.	• Trainer

It has been selected because of the following three characteristics: First, this is a designated emergency response hospital in China that they have established a national emergency medical rescue team which has been approved by the National Health Commission of the People's Republic of China in 2012. Within China's four-tier response system for public health emergencies that determines what measures a region will implement, with level I the most serious, every designated regional medical institute will take on the responsibility of emergency medical rescue accordingly. Generally, the approved national rescue team will be called out not just national major public health emergency but also regional rescue services. Therefore, as a representative emergency response center, healthcare workers working in this hospital are regularly serving the role of responding to natural disasters, infectious disease outbreaks, and other critical incidents at all levels. According to the hospital administration data, healthcare workers have been dispatched by national authorities to provide emergency rescue services on 80 different occasions for a range of natural, social security, and public health emergencies during the past 7 years. These include national major emergencies (e.g., Ya'an earthquake in 2013, Sinking of Dongfang zhi Xing in 2015, Tianjin Explosion in 2015, Wuhan first wave of COVID-19 pandemic in 2020) and regional emergencies (e.g., Yiyang Floods in 2018, Changde car accident in 2019, Leiyang coal mine flooding accident in 2020, Zhangjiajie 2nd wave of COVID-19 in 2021) (see the Response map in **Figure 2** which summarize of selected national and regional emergency response by the Second Xiangya Hospital of Central South University). Second, it is a represented public emergency preparedness center in the Hunan Province which has developed a centralized response system, thereby instilling an emergency response literacy among their staff team. For example, their centralized working model shows great advantages that makes it contain the spread of COVID-19 effectively to support Wuhan city in 2020, e.g., their massive capacity and comprehensive functions, including "fever-clinics" to screen patients, a COVID-19 department to isolate patients, and many makeshift beds as emergency wards. Under several years of team construction and medical rescue training focus, their future preparedness efforts warrant a focus on improving their capacity-building, especially the mental health response and improving their own workforce's well-being. Third, it is a top-ranked tertiary hospital as well as a key national center for healthcare, education, and clinical research in China which has 3,500 beds, 40 clinical departments, and 127 ward

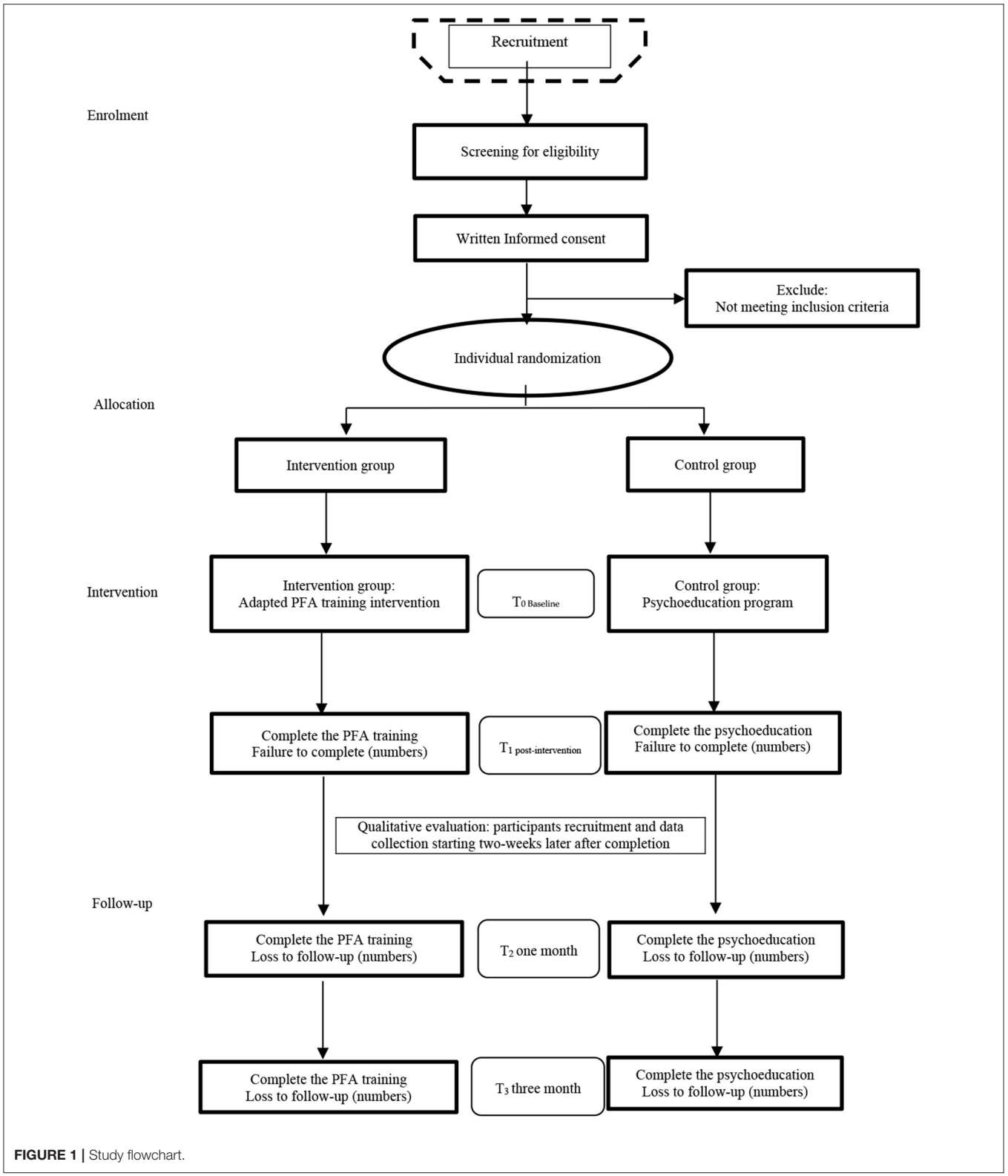


FIGURE 1 | Study flowchart.

areas facing complex healthcare service demands within their regular hospital services in central China which makes them explore the complicated challenges in their practice context. The national simulation centers for experimental teaching and training platform offers an opportunity to design and test this capacity-building project.



FIGURE 2 | Response map—summary of selected national and regional emergency response by the Second Xiangya Hospital of Central South University.

Trial Participants

This trial will sample frontline healthcare workers, who provide services directly to patients and are the first and often only link to essential health services. The sampling frame includes all professional disciplines of frontline healthcare workers, namely nurses, midwives, doctors, pharmacists, who are employed by the Second Xiangya Hospital of Central South University which is part of the national and regional emergency rescue service in China (i.e., they would be called to provide rescue services to individuals in the event of a disaster or public health emergency).

The eligibility inclusion criteria to participate in the trial are: (A) participants must be over 18 years old; (B) participants are employed in departments that would be called to emergency response (e.g., emergency departments, infectious disease, orthopedic, intensive care unit, etc.); (C) participants are non-mental health frontline healthcare workers. The exclusion criteria to participate in the trial are: (A) they say for whatever reason that they are unavailable to participate in the PFA training course for whatever reason; (B) those who have prior knowledge in related mental health areas (e.g., completed education in a mental health related field or similar training or delivery).

Sample Size

A sample size of between 24 and 50 is considered reasonable in a feasibility study, to be able to estimate a participation rate in anticipation of a full trial (57, 58). Informed by this, the target recruitment for this feasibility trial will be $N = 80$, allowing for a 20% loss to follow-up rate and for at least 64 participants to complete the study during the COVID-19. The sample size is projected to provide enough numbers to be able to estimate the likely efficacy and acceptability of the training intervention to inform the design of a future RCT.

Recruitment

Participants will be recruited from the Second Xiangya Hospital of Central South University through the following two ways: (A) Direct methods: access to research participants will be via two gatekeepers. The first gatekeeper will be the Director of the nursing department in the local hospital, who distribute the study information to the clinical departments managers on behalf of the researcher, (i.e., a communication message/talk based on the email/phone recruitment script). The second gatekeepers will be the clinical department managers who will help to identify the staff in service who are interested in participating and ask them to contact the researcher directly. (B) Indirect methods: Advertisement posters will be posted onto the hospital notice board and be disseminated via social media posts through individual WeChat moments. Participants who are interested in participating will be asked to contact the researchers via a dedicated email address, phone number, and WeChat message.

Once potential participants have expressed an interest in being involved, they will be assessed against the eligibility criteria by the researcher, and if they are eligible, they will then be asked if they have read the participant information sheet. Meanwhile, they will be given an opportunity to ask any questions, and if being addressed in satisfaction, they will be asked to give their written informed consent for participation in the trial. They will be asked to complete the baseline assessments and then randomization to either intervention or control group of the trial will occur.

Randomization

The randomization will be performed by an independent researcher not connected with either participant recruitment or data collection, using a 1:1 ratio as per a computer-generated randomization schedule using randomly permuted block sizes by randomization.com. All eligible participants who give written informed consent will be randomly allocated to either the intervention or control arm of the trial. Due to the nature of the study, only the researcher collecting/analyzing the data from trial participants can be masked to the randomization.

As a check on blindness, the researcher will be asked to guess the group allocation of trial participants after they have completed each final follow-up assessment. Unmasking will not occur until databases are closed and the main analysis has been completed.

Intervention

Intervention

The whole process of this PFA training adaptation for delivery to Chinese frontline healthcare workers has been systematically

described elsewhere. A detailed description of the Chinese 'Preparing Me' PFA training content has already been structured using the template for intervention description and replication checklist (TIDieR) in **Table 1**. Four trainers who have teaching and clinical psychological counseling background will be trained to deliver the PFA training intervention. Each of the six modules will be delivered in 75-min session blocks, incorporating didactic lectures, group exercises, role playing, and discussions to encourage active engagement and to improve the acquisition of PFA knowledge, skills, and techniques. All these sessions will be audio-recorded in preparation for the researchers to assess the fidelity using a PFA fidelity assessment tool. To support frontline healthcare participants to be able to apply the knowledge, skills, and techniques to their practice, two WeChat-based online supervision sessions will be offered.

Psychoeducation Programme (Control)

Participants in the control arm will receive the best available alternative to PFA training, which in this setting is the hospital's existing 1 day psychoeducation training course. This involves a series of lectures on basic mental health training topics, including the traditional Chinese culture, understanding psychological crisis and skills, referral resources, and ethics.

This study will attempt to minimize contamination between the two arms through (A) engaging different trainers with equivalent clinical and training experience to deliver the training; and (B) consenting participants in both arms will be asked not to share information regarding the training that they have received with colleagues who might be involved in a different arm of the trial.

Primary Objectives

The primary objective (i.e., the acceptability and feasibility of outcome data collection) will be collected by the researcher (LW, XL). These include data on (A) recruitment and retention, (B) training adherence and (C) the feasibility of the outcome measures which describes as below:

(A) Recruitment and retention

- Number of eligible participants approached and consenting to take part, which is randomized, as well as the number of ineligible participants
- Number of participants who successfully complete training
- Number of participants attending online supervision session/s
- Number of participants lost due to follow-up and dropout rate

(B) Training attendance (adherence)

- Number of sessions attended
- Time dedicated to practice
- Test after all session

(C) Feasibility of measurement tools

- Time taken to fill in questionnaires
- Missing data from questionnaires

Secondary Objectives

The secondary objective (i.e., variability in participants outcomes) will collect two domains of measurement data that capture possible outcomes, mediator, moderator, or covariate to be included in any future effectiveness trial to quantitatively determine the acceptability and feasibility of randomized trial: (A) preparedness via knowledge, skills, and attitudes, and PFA practice in real setting; and (B) related psychological measures of resilience, self-efficacy, coping, post-event symptoms, post-traumatic growth, general health, and quality of life.

(A) Preparedness

- *Knowledge, Skills, Attitude.* The PFA Knowledge, Skills, and Attitudes Survey Form is a self-report, five-point Likert scale composed of 25 items organized by knowledge (10 items), skills (7 items), and attitudes (8 items) used to evaluate the learning effect of the PFA training intervention. It has been adapted from the Johns Hopkins PFA training initiative evaluation study and is empirically supported (44).
- *The PFA Training Follow-up Questionnaire.* It is an 11-item survey distributed to trainees twice, at 1- and 3-months after the training to determine the extent to which trainees have applied PFA knowledge and skills and their views on the acceptability and usefulness of PFA applied to persons who incurred crisis during a disaster event or other incident.

(B) Related psychological measures

- *Brief Resilience Scale.* The Brief Resilience Scale consists of six items identifying one's ability to bounce back from stress developed by Smith {Smith, 2008 #15}. It is a five-point rating scale (1 = strongly disagree; 5 = strongly agree) and scored by reverse-coding Items 2, 4, and 6 and calculating the sum of all six items. This scale has established psychometric properties, exhibiting an acceptable internal consistency with Cronbach's α values equal to 0.76 and 0.72, respectively, in the Hong Kong and mainland samples (59, 60).
- *General Self-Efficacy Scale.* The General Self-Efficacy Scale (GSE) has become a widely used instrument for measuring general self-efficacy (61). The scale consisted of 10 items and each item was scored on a four-point Likert scale from 1 (strongly disagree) to 4 (strongly agree). The Chinese version of this scale has showed good reliability and validity in Chinese population (12).
- *The Impact of Event Scale-Revised.* The Impact of Event Scale-Revised will be used to determine the frequency of post-traumatic symptoms in relation to a recently experienced work-related traumatic event (62). It is a 22-item scale rated on a five-point Likert scale using anchors between 0 (not at all) to 4 (extremely) and total score range is 0–88 (higher score indicates greater severity). Good psychometric properties for the total scale

and each subscale have been previously reported in Chinese sample (63).

- *The Simplified Coping Style Questionnaire*. The Simplified Coping Style Questionnaire (SCSQ) is used to assess the participants' attitudes and actions individuals that would take in the face of the life events (64). It is a 20-item self-report four-point Likert scales (0 = never; 3 = very often) that includes two dimensions: active coping (12-item) and passive coping (8-item). The instrument has demonstrated that the test–retest reliability coefficient of this instrument is 0.89, and Cronbach's α coefficient is 0.90 in Chinese populations (65).
- *Post-traumatic Growth Inventory*. The Posttraumatic Growth Inventory (PTGI) is developed to assess positive outcomes in response to traumatic events (66). The 21-item scale assesses positive psychological change in the wake of struggling with highly challenging event circumstances. Good psychometric properties of this instrument has been established in Chinese population (67).
- *General Health Questionnaire-12*. The General Health Questionnaire-12 is an 12-item self-report checklist devised by Goldberg is one of the most widely applied assessments of the severity of symptoms associated with psychological distress (68). The questionnaire contains 12 items, each scored on a four-point Likert scale from 0 to 3. The Chinese version shows a Cronbach's α coefficient was 0.86 for the overall GHQ-12 (69).
- *Professional Quality of Life*. The Professional Quality of Life Scale (ProQOL-5) is 10 items scale to assess one's perceived quality of life in relation to working as a helper and includes both the positive and negative aspects of this work (70). It is a five-point Likert self-reporting scale and consists of three components of professional QoL: compassion fatigue (CF), (BO, and compassion satisfaction (CS). The Cronbach's α coefficients for each dimension range from 0.758 to 0.821, and the test–retest reliability coefficients range from 0.764 to 0.867 (71).

Data Collection

The schedule of enrolment, interventions, and assessments has been summarized in **Figure 3**. Demographic data will be recorded at baseline only, including age, gender, religion, marital status, living conditions, educational background, professional title, specialities, years of working experience, and experience of coping with crisis. Quantitative data will be collected from participants at three different times: baseline data will be collected before the PFA and psychoeducation training programmes (T0), the initial follow-up data will be collected immediately after training programmes are completion (T1), 1- and 3-months follow up data that will be followed up 1- and 3-months after the programmes are completed (T2, T3). The researcher will conduct data collection by providing each participant with a study pack at each time point. After presenting the information, the participants will be asked to complete these packs of assessment tools. To encourage participants' attendance at baseline and follow-up sessions, participants will be contacted by WeChat message at least 1 week before each data collection timepoint. The 1- and 3-months follow-up post-intervention measurement will be collected online via WeChat Wenjuanxing—a platform providing functions equivalent to Amazon Mechanical Turk. All questionnaires can be seen in **Supplementary Materials**.

Statistical Data Analysis

Since this is a feasibility study and is not testing hypotheses regarding effectiveness of PFA training intervention, inferential statistics will not be employed. The primary objectives will be addressed via generating estimates of dispersion and central tendency (i.e., proportions, means, SDs, etc.). The acceptable levels of eligibility and enrolment will be a 90% or greater screening eligibility rate for frontline healthcare workers referred to the study. A recruitment rate is expected of 15 trainees per week and the target sample size would therefore be achieved in 6 weeks. The acceptable proportion of enrolled trainees who complete all the training sessions will be 80% or greater, given that there's 18% dropout rate of participants in PFA training cluster RCT (23). The feasibility of collecting quantitative outcome data includes (1) <20% missing data at the group level for each time point and (2) generating estimates of effect and variability related to by the independent research facilitator. Quantitative secondary objectives will be addressed via generating bivariate correlations and regression coefficients for the selected measures. Correlations between the baseline and follow-up will be estimated for continuous outcomes. Measures will be examined for multi-collinearity, as well as any needed transformation due to unfavorable skewness and kurtosis (72, 73). Appropriate 95% confidence intervals will be reported, with differences deemed significant at the 5% level.

The Nested Process Evaluation

Research on using qualitative methods for feasibility RCT will be likely of particular value in refining understanding of how the intervention works and facilitating ongoing adaptation of intervention and evaluation design in preparation for a full trial (74). Thus, this study will nest a process evaluation, consisting of (A) qualitative interviews and (B) observations of the training sessions, with the aim to extend a more in-depth understanding of the acceptability and feasibility of PFA training intervention for this feasibility trial. First, individual interviews will be applied with trainees, as well as their clinical managers and trainers to reflect the perceived experience and impact of the PFA training, as well as barriers and facilitators to the training completion and program fit in. In particular, this study adds interview with participants' line managers from the clinical ward, whose role is to provide supervision of trainees practice after training completion, it is in consideration with lacking evidence in real practice from previous PFA training evaluation (29). Second, observations with trainees and trainers in the classroom will be used to expand the immediate response and feedbacks for the training, and to assess the level of intervention fidelity.

Sample

The process evaluation sample will use purposive sampling strategies in order to triangulate findings (75). Participants who will be invited to be interviewed include three different

	Study period					
	Enrolment	Allocation	Post allocation			
			Intervention period/control period			
Timepoint	T_0	0	0	T_1	T_2	T3
ENROLMENT						
Eligibility screen	X					
Informed consent	X					
Allocation		X				
INTERVENTIONS						
PFA training intervention						
Psychoeducation			← →			
ASSESSMENTS			← →			
Objectives: feasibility and acceptability						
Recruitment and retention		X	X			
Training attendance (adherence)		X	X	X		
Feasibility of measurement tools			X	X	X	
Sensitivity/acceptability of the outcome measures			X	X	X	
Knowledge, Skills, Attitude			X	X	X	
Brief resilience scale			X	X	X	
General self-efficacy scale			X	X	X	
The Impact of Event Scale – Revised			X	X	X	
The Simplified Coping Style Questionnaire			X	X	X	
Post-traumatic Growth Inventory			X	X	X	
General Health Questionnaire-12			X	X	X	
Professional Quality of Life			X	X	X	
Program evaluation			X	X	X	
Observations of training sessions			X			
Intervention fidelity			X			

FIGURE 3 | Schedule of enrolment, interventions, and assessments.

participant groups, including (1) trainees ($n = 12$) are those attending all the training sessions; (2) trainers ($n = 4$) who have been involved in this training; (3) clinical ward managers ($n = 5$) from PFA trainers' clinical ward. Maximum variation sampling will be considered via inviting trainees and managers representing diverse levels/types of training to participate and mangers in diverse working context to obtain rich understanding (76). Given the nature of the target qualitative sample participants, we expect this sample size will achieve data sufficiency.

Recruitment

Trainees who receive PFA training sessions and practice PFA after training completion in frontline will be sent an invitation for the interview via WeChat messages, and if they agree, their clinical manager will then be invited. The trainer of the PFA training intervention group will be invited to participate by the researcher prior to the start of the training and supervision sessions.

Data Collection

Interviews

After written informed consent is obtained, qualitative interview with trainees will be conducted at 2 weeks after the training completion, while interview with trainers will be conducted after they have delivered the training and supervision. An indicated topic guide (see **Table 3**) is informed by the objectives of feasibility and acceptability which will guide the qualitative data collection. Interviews will take place on hospital premises, and the length of time taken range from 30 to 40 min.

Observations of Training Sessions

The PFA training adaptation the training sessions will be recorded so the researcher can observe the sessions afterwards. Researchers will make fieldnotes about the delivery of and response to the sessions provided on the program, barriers of training completion, and trainers of task engagement and on its overall structure, delivery, and content of the training (see **Table 4**). Also, the fidelity of the adapted Chinese PFA training programme will be evaluated. Fidelity checklists will be created for each of module session types to measure how closely they adhere to the RAPID PFA model manual and the intended aims of the interventions based on the domains provided by the Health Behavior Change Competency Framework (HBCC) (77). All training and supervision sessions will be video-recorded and watched by the researcher to rate against the fidelity checklists to ensure training and supervision are delivered as intended (see **Table 5**). Field notes completed by the trainers during the supervision will also be documented to evaluate whether the participants follow the actions of PFA which may be relevant to the study analysis.

Qualitative Data Analysis

Transcripts of interviews with trainees, managers and trainers, as well as field notes will be imported into NVivo software for

TABLE 3 | Indicative topic guide after the PFA training completion.

Trainees	
Acceptability and feasibility	How would you describe your experience of completing this training program? How do you value the PFA in your clinical practice? Any indicative changes in behaviors? How would you describe your experience of supporting your patients or colleagues through providing them PFA skills?
Satisfaction	How satisfied are you overall with training module? How clear do you find the concepts and ideas in the module?
Suggestions for further improvement	What do you think could be improved about? Is there anything missing?
Barriers	Are there any difficulties to taking part? What are the barriers to completing training course, and applying training to practice? What are the challenges to complete the assessment, with questions relating to reasons for not taking part/ discontinuation or dropping out?
Process of change	Are there any changes in your perspective of coping acute distress? If the answer is "Yes", what are they?
Trainers	
Acceptability and feasibility	What they thought about the training, what worked, what didn't work?
Satisfaction	How satisfied are you overall with the training session adaptation and development? How well do you find the concepts and ideas organized in the module?
Suggestions for further improvement	What do you least like about the program? What do you think could be improved about? Is there anything missing?
Barriers and facilitators	Are there any difficulties to deliver the training? What are the barriers to deliver training course? What are the challenges to improve training refinement?
Clinical ward managers	
Acceptability and feasibility	What is your perspective on the value of psychological first aid for supporting your staff's work? Can you talk about your experience of supporting your staff to participate this training?
Satisfaction	How satisfied of your staff's practice after training completion?
Suggestions for further improvement	What do you least like about the program? What do you think could be improved about? Is there anything missing?
Barriers and facilitators	Are there any difficulties to make them participate the training and practice PFA on frontline? What kind of support would need to enable your team's participation in this training opportunity?
Process of change	Are there any changes in your perspective of your staff to responding to acute distress? What important aspects of diversity you feel when you take a view on this psychological first aid in clinical practice?

TABLE 4 | Observation checklist of PFA training delivery.

To what standard are the core content being delivered?
Are the standard manual and resources being used?
To what extent are the key learning outcomes of each session achieved?
Rate the facilitator 1) Variety of approach to each session using facilitation, presentation, coaching, activities 2) Engagement/rapport with group 3) Group management/involvement 4) Challenge negative behavior within group 5) Positively addressed resistance to program
Additional comments:

data management and analysis using direct content analysis; thematic analysis and summative content analysis (78–80). This combined method focuses on developing common themes that are represented in the data and using open coding of a selection of transcripts, initial key themes, and emerging patterns will be identified, thus enabling development of a coding frame which will be refined and applied to the full dataset. Direct content analysis will establish a codebook with a set of a codes corresponding to the acceptability and feasibility objectives, while using the reflective thematic analysis and analytical memoing would expand the codebook through identifying new concepts, constructs, and factors. To further quantify the number and salience of finalized codes within and across interviews from the data sources, summative content analysis, and constant comparison will be conducted. The initial code book will be created by the researcher LW and be validated by the team members discussion with expertise in qualitative research methods, clinical education, and mental health science to achieve a consensus-based codebook. The analysis will be conducted in the original Chinese language, and final themes will be translated into the English language by two researchers that could ensure the accuracy and transparency of the data.

Data Monitoring

Data quality is ensured through several mechanisms, including referential data rules, valid values, range checks, and consistency checks. Checks are applied at the time of data entry into

TABLE 5 | Fidelity checklist of PFA training delivery.

Domain	Assessment method	Quality criteria
Training intervention design	• Assess whether PFA training manual reflect the underlying theoretical model	Prior to study implementation, investigators, and optimally a protocol advisory, should review PFA training manual to ensure that the active ingredients of the RAPID PFA model are fully operationalized. The degree to which the measures reflect the hypothesized theoretical constructs and mechanisms of action should be assessed.
Trainers	• Assess trainers' skills acquisition	Ensure trainers are trained to a well-defined performance Trainers' role-plays should be evaluated for both adherence to PFA components and adherence to process (e.g., interactional style)
Receipt of all PFA training sessions	• Assess degree to what extent of participants understood intervention • Assess participants ability to perform the skills	Verify the participants' understanding of the PFA training information provided Verify that they can use the skills and recommendations discussed (via pre–post-tests, recordings).

a specific field and monitored by a central data safety and monitoring group.

Adverse Events Reporting and Harms

The main risk factor is psychological distress among trainees during the training sessions simulation or practice. A contingency plan regarding the use of videotaped testimonials and provision of a stand-by counselor to provide immediate care to the trainees when required has already developed which is explained in the participant information sheet. All changes resulting from adverse events or serious adverse events will be documented. Any participants who become distressed or require additional support during the study's training will stop the training and the person will be invited to a private room and provide a leaflet with information about appropriate sources of support they can access. The trainer who can provide on-site counseling will be able to respond to their needs. If the participant needs a further referral, e.g., medication, or treatment, the researcher will help to receive mental health care and contact.

Ethical and Dissemination

This trial has been approved by the Institution Review Board from Central South University (XTXL20200610) and by the Psychiatry, Nursing and Midwifery Research Ethics Committee at King's College London, England (LRS/DP-21/22-23161). It also has been processing registration at the Chinese Clinical Trial Registry. Also, this project has been supervised by the PhD researcher's supervisors who are experienced in mental health research. All participants will be asked to provide their written and informed consent acknowledged that all identifying information will be removed.

Several key deliverable and knowledge dissemination strategies will be employed. Findings will be summarized to submit to open-access journals and results will be shared broadly with the policy, practice and academic communities via conference attending and seminars. The use of digital and social medic will be adopted to disseminates project updates and results, as well as generate brief, professionally produced infographics and summaries for dissemination.

DISCUSSION

Prioritizing the mental health and well-being of healthcare workers is considered an urgent global public health priority (6). Training in PFA has been considered effective to support public mental health in emergencies through reducing acute distress and improving self-efficacy, public health authorities disseminate the training across the globe with the expectation to enhance population level of mental health preparedness and resilience in emergencies. However, a flexible delivery with a neglect for evaluating PFA training has resulted in unintended potential harms, and further prevent generating large effects, which may hamper future proactive uptake and achieve a large level of preparedness, especially for the frontline healthcare workforce. Before establishing what extend potential benefits of PFA training can be contributed to the healthcare context, it has been neglected that determining the feasibility of the PFA training through adapting to the local culture, tailoring to frontline healthcare context, and evaluating systematically is crucial. Considering the COVID-19 pandemic is likely accelerate the uptake of PFA training, it is far more urgent to determine the feasibility of a well-adapted PFA training intervention thereby to effectively inform a RCT in a larger sample. Thus, this study protocol presents a randomized controlled feasibility trial protocol to determine the feasibility and acceptability of a well-adapted PFA training programme for Chinese frontline healthcare workers to improve their ability to provide early emotional support to those in need and self-care, especially in relation to responding to public health emergency situations.

This study has several strengths. First, to our knowledge, this is the first rigorous evaluation of a systematically adapted PFA training intervention for use by frontline healthcare workers which could help to decide the larger follow-on studies of this low-intensity capacity-building programme. Second, as a feasibility-controlled trial combined with a process evaluation, the combination of data regarding retention rate, the ability of the training program to lead to changes in the secondary objectives of interest (i.e., increased preparedness and self-efficacy, reduced burn-out, and secondary traumatic stress, etc.) gained will shape the design and inform a sample size calculation for a future trial. Experience from the training practice will

generate a rich and comprehensive understanding of how PFA training might be delivered in the context of a frontline health service and so potentially widen its application to Chinese population. Third, considering that the sample setting has the combing role of emergency response and regular health service in frontline healthcare context, it may contribute to enhance the understanding of its relevance and applicability of findings in different regions, especially in non-disaster frontline settings. Given the overall aim of developing preventive strategies to improve mental health crisis preparedness for frontline healthcare workers, it is consistent with objectives of addressing frontline challenge in public mental health during complex emergencies (81).

LIMITATIONS

There are some limitations of this project. First, the design and evaluation of the feasibility trial has predominately focused on the outcomes associated with the frontline healthcare workers rather than the outcomes for recipients of PFA following a disaster, public health emergency, or other crisis. Second, the timeframe for follow up outcome measures is only 3 months, which may be insufficient time for PFA trainees to apply their knowledge and skills in practice evaluation.

CONCLUSIONS

Psychological First Aid training has been widely proposed as a mental health prevention approach of providing early support to acutely distressed individuals and improving self-efficacy of frontline healthcare workers in responding to crisis, yet it has not been fully evaluated which result in significant flaws of its implementation. This study protocol is designed to evaluate the feasibility and acceptability of a well-adapted PFA training intervention (Preparing Me) for future effectiveness assessment. If it could achieve an 80% retention rate in the end, a main RCT of this educational intervention will be decided, expecting the overall aim of promoting their capacity of recognizing and managing stress when confronted with healthcare emergencies, with an expectation to boost evaluation effort to improve this prevention training approach to achieve a population preparedness. It is anticipated that the resulted information would be an impetus to maximize usability and acceptance of this low-intensity PFA skillset by the wider frontline population, thus achieving the empowerment of the frontline healthcare workforce in dealing with crises at a population level in future emergencies.

ETHICS STATEMENT

This trial has been approved by the Institution Review Board from Central South University (LYG2020029) and by the Psychiatry, Nursing and Midwifery Research Ethics Committee at King's College London, England (LRS/DP-21/22-23161). All participants will be asked to provide their written and informed consent.

AUTHOR CONTRIBUTIONS

IN, ML, and LW were responsible for the research concept development. LW drafted the manuscript, IN and ML contributed to the text and critically revised the manuscript. XL contributed to methodology and trial registration. YL, TX, and LW obtained funding and support from the local authorities. All authors approved the final version of the manuscript.

FUNDING

It is supported by the health research project from Health Commission of Hunan Province (20190365) and the innovative education project of Central South University (2018CXKZ06).

ACKNOWLEDGMENTS

The authors acknowledge all the participants who has provided valuable comments on earlier draft of the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.809679/full#supplementary-material

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ORIGINAL RESEARCH
published: 31 January 2022
doi: 10.3389/fpubh.2022.811165

Heterogeneity of Urban and Rural Areas in Association of Fringe Benefits and Depression: A Cross-Sectional Study

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Background: Fringe benefits are an important social support in the work scenario, but empirical research on their effect on the mental health of employees is lacking. This study aims to analyse the relationship between different fringe benefits and depression in urban and rural areas.

Methods: Chi-square analysis was used to describe the distribution differences of individual characteristics between urban and rural areas in depression groups. Logistic regression was used to further estimate the relationship between fringe benefits and depression between urban and rural areas.

Results: People with free lunch in urban areas are less likely to suffer from depression. People with food subsidies in rural areas are also less likely to suffer from depression. The abnormal result is people with housing subsidies in rural areas are more likely to be depressed. The effects of job type and contract on depression were different between urban and rural areas.

Conclusions: Employers in urban areas should focus on providing free lunch and the quality of lunch, whereas in rural areas, catering subsidies may be a more appropriate way to improve the mental health of employees. The psychological status of rural workers who receive housing subsidies and have contracts also needs attention.

Keywords: depression, fringe benefits, urban and rural, heterogeneity, cross-sectional study

OPEN ACCESS

Edited by:
Harshavardhan Sampath, Sikkim Manipal University, India

Reviewed by:
Prabhleen Jaggi, National Health Service, United Kingdom
Anmol Pradhan, Sikkim Manipal University, India

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

Received: *08 November 2021*
Accepted: *10 January 2022*
Published: *31 January 2022*

Citation:
Luo T, Yan C and Zhang X (2022) Heterogeneity of Urban and Rural Areas in Association of Fringe Benefits and Depression: A Cross-Sectional Study. Front. Public Health 10:811165. doi: 10.3389/fpubh.2022.811165

BACKGROUND

Depression is very common worldwide and is a growing public health concern. More than 260 million people are affected, resulting in 43.1 million full age disability adjusted life years (DALY) (1). In China, from 1990 to 2017, the prevalence of depression of all ages per 100,000 increased from 3,224.6 (95%UI: 2,976.6–3,509.1) to 3,990.5 (95%UI: 36,677.8–4,353.0). The DALY rate per 100,000 increased from 525.1 (95%UI: 373.5–719.0) to 607.4 (95%UI: 427.7–820.2) (2).

Social support could have a positive effect on alleviating depression. Depressed patients with poor social support have poor symptoms and rehabilitation results (3). A Chilean study showed that maintaining and improving perceived levels of social support can significantly improve the depression of caregivers (4). A Chinese study also found that people with less social support had more severe depression, and the relationship was mediated by hope (5).

Studies on the relationship between social support and depression focus on the formal support of policies, the social network of individuals and families and the application of specific substances. Disability support pensions in Australia significantly improve the mental health of people with disabilities (6). The expansion policy of Medicaid significantly increases the ability of patients with depression to seek medical services (7). A South Korean study found that diversified and solo-restricted groups had higher levels of depression (8). Higher levels of depression are associated with being unmarried, living alone and lack of family and friend networks (9). An Iranian study found that people who used online social media scored significantly lower on depression (10). However, few studies have focused on the relationship between fringe benefits and depression among workers in general employment scenarios.

In the stable employment situation, the fringe benefits may be related to the mental health of employees. The number of fringe benefits provided by the work unit is one of the basic indicators of work quality (11, 12). In addition, fringe benefits could improve employee job satisfaction (13, 14). Therefore, fringe benefits represent a higher evaluation and recognition of the work quality of the employees by the work unit. Thus, they could alleviate the negative impact of hard work and burnout on mood during the work process. However, the relationship between fringe benefits and depression has not been empirically studied. A comparative study of different groups has not been conducted. The relationship between the content of fringe benefits and depression may be different among regions that greatly differ in terms of economic development level and welfare policy.

In China, great differences exist in the level of economic development, welfare and resource allocation between rural and urban areas. In 2018, the per capita disposable income of urban residents reached 39,251 yuan and that of rural residents was 14,617 yuan, which represents a big difference (15). In addition, rural areas receive less formal government support than urban areas, including pension, welfare and mental health services (16, 17).

This study aims to do the following: (1) analyse the distribution of specific fringe benefits between urban and rural depression groups; and (2) analyse the differences in the relationship between specific fringe benefits and depression in urban and rural areas. This study fills the gap in research on the relationship between social support-fringe benefits and depression in the employed population.

This study contributes to the precise intervention of depression. Firstly, the research on the relationship between fringe benefits and depression is conducive to the rational allocation of work welfare resources and to the alleviation of fatigue and burnout caused by work, thereby improving the happiness of employees. Secondly, the research on China's urban and rural areas has implications for other developing countries and regions to effectively adjust their employee welfare policies.

Abbreviations: CES-D, Center for Epidemiologic Studies Depression Scale; DALYs, Disability adjusted life years; CHARLS, China Health and Retirement Longitudinal Study; SRH, Self-rated health; ADL, Activities of daily living.

METHODS

Data Sources

The data used in this study were obtained from China Health and Retirement Longitudinal Study (CHARLS) targeting the middle-aged and older population (45+ years) in China. The data used in the study came from the China Health and Retirement Longitudinal Survey (CHARLS), a large-scale survey conducted by the National Development Research Institute of Peking University and jointly implemented by the Chinese Social Science Survey Center of Peking University and the Youth League Committee of Peking University. Interdisciplinary survey project. The national baseline survey was carried out in 2011. Survey visits were carried out in 150 counties and 450 communities (villages) in 28 provinces (autonomous regions and municipalities) across the country in 2011, 2013, 2015, and 2018. Due to the large number of samples lost in the longitudinal study (withdraw from the survey). The study used data from the most recent survey in 2018, and a total of 1,891 samples entered our analysis.

Variables and Definitions

Depression

The 10-item (frustrated by small things; hard to concentrate on doing things; feeling down; struggling to do anything; hopeful for the future; feeling scared; poor sleep; feeling very happy; feeling lonely; unable to Continue to live) Center for Epidemiologic Studies Depression Scale (CES-D10) was used to describe the depression symptoms. The responses for CES-D10-based questionnaire were coded on a four-point scale from 0 to 3. Therefore, the individual's depression score range is 0–30; 0 means perfect mental state, whereas 30 reflects the most serious depression symptoms. A CES-D10 score $\geq$12 the mental health of employees indicates depression (18, 19). Therefore, the study used CES-D10-based binary variable to reflect the individual's depression. The reliability and validity of the scale meet the standards (Cronbach'$\alpha = 0.789$, KMO $= 0.871$).

Fringe Benefits

Individuals with stable employment were asked *via* questionnaire whether they have the following nine fringe benefits (Free lunch, Free breakfast, Free dinner, Meal allowance, Transportation allowance, Free housing, Housing allowance, Company car and Company shuttle bus). To examine the relationship between the diversity of fringe benefits and depression, these variables were assigned values according to the respondent's "Yes" and "No," and a binary variable was used to represent the individual's status in each fringe benefit.

Control Variable

The SES variables analyzed in this study included gender, age, marital status, education, income, living arrangement and lifestyle. Age was divided into three subgroups, namely, 45–50, 51–60, and 61 years old or older. Education in this study was divided into four levels, namely, primary school or below, junior middle school and senior high school and above. Marital status is defined as a binary variable, which means that married couples who live with or temporarily do not live with their spouse have a

spouse, whereas other marital statuses indicate having no spouse. Family income was used to measure the economic status of the respondent, and quintile was used to show their economical level. Based on whether the respondents lived in the same town or city as their children, the respondents' living arrangements were divided into two groups. Smoking and drinking were included in the study and classified by lifestyle of smoking or drinking in the year before the survey.

The state of physical health was represented by chronic disease, disability and self-rated health (SRH). Chronic disease variable was divided into three groups, namely, no chronic disease, only one chronic disease and two or more chronic diseases. Self-perceived health is divided into four groups, namely, very good, good, fair, poor or very poor. Disabilities were divided into two groups based on whether or not they answered "yes" in the ADL (dressing, bathing, eating, getting into and out of bed and toileting and controlling urination and defecation) survey. Based on whether the respondents lived in the same town or city as their children, the respondents' living arrangements were divided into two groups.

To control the confounding effects of job-related variables, the study also included the type of work unit, the position of the employee, the professional and technical level of the employee, the presence or absence of contract, the form of wage payment and job satisfaction as the control variables. The type of work unit is divided into four groups, as follows: government, public institutions or NGO; Firm; Individual firm; and Individual household. According to whether the employee has leadership position and professional skill level, occupation type and professional skill are divided into dichotomous variables. Salary payment method was divided into two categories, namely, monthly salary and other. Job satisfaction is divided into three categories, as follows: completely satisfied and very satisfied; relatively satisfied; not very satisfied; and not at all satisfied.

Statistical Methods

Chi-square analysis was used to test the differences in respondents' characteristics among depression groups within urban and rural areas. Then, logistic regression on urban and rural areas with depression as the outcome variable was performed to explore the association between fringe benefits and depression.

STATA software 13 was used to execute the Chi-square analysis and logistic regression with statistical significance at $p < 0.05$.

Ethical Approval

Ethical approval for data collection in CHARLS was obtained from the Biomedical Ethics Review Committee of Peking University (IRB00001052–11015). All interviewees gave written informed consent before recruitment.

RESULTS

Table 1 describes the basic characteristics of the sample and its distribution among the depressed groups. The following were the most common characteristics in urban and rural areas: male, 51–60 years old, with a spouse, self-rated fair health, no chronic illness, no smoking, drinking, no disability, no leadership position, no professional skills, no employment contract and somewhat job satisfaction. In terms of fringe benefits, the following sample characteristics are more common: with free lunch, no free dinner and breakfast, no meal allowance, no transportation allowance, no housing allowance and no company car and shuttle bus. Gender, education, marital status, SRH, chronic disease, physical disability, contract, job satisfaction, family income and transportation allowance were all significantly different among depression groups within urban and rural areas. Smoking, drinking, type of work unit, occupation type, professional skill and salary payment method were only significant among depression groups within urban areas. Meal allowance was only significant among depression groups within rural areas.

Table 2 describes the relationship between fringe benefits and other characteristics of the sample and depression. In urban areas, people with free lunches are less likely to be depressed. In rural areas people who have meal allowance are less likely to have depression symptoms. Free breakfast and lunch are not significantly associated with depression in urban and rural areas. A more unusual result is that people in rural areas who receive housing allowance are more likely to be depressed. None of the fringe benefits associated with transportation allowance had a significant relationship with depression. Transportation allowances, free housing, and company shuttle buses are not significantly associated with depression in urban and rural areas.

We also found that in urban areas, people who are employed in individual households are more likely to be depressed, but there was no significant association in rural areas. People with employment contracts in rural areas are more likely to be depressed. These results suggest that there are differences in the factors affecting depression between urban and rural areas, which is worthy of further discussion.

DISCUSSION

We found that people with free lunch in urban areas were less likely to be depressed. People with food allowance in rural areas were also less likely to be depressed. People with housing allowance in rural areas are more likely to be depressed. The effects of job type and contract on depression were different between urban and rural areas.

Urban and rural economic development and working conditions are different. Compared with rural employees, urban employees may enjoy a higher-quality lunch, which also reduces the mental pressure brought about by the economic burden of life to a certain extent. The quality and value of free lunch in rural areas is limited, so it may not significantly improve the mental state of employees. One study indicates that the satisfaction degree of working meal is related to food quality and service level (20). And the enterprises in urban areas have relatively strict performance and attendance evaluation system. Therefore, the free lunch provided by the work unit can reduce the dining time of employees to reduce the attendance pressure. Furthermore,

TABLE 1 | Sample characteristics and univariate analysis results.

Variables	Urban				Rural			
	Total	Depression		*p*	Total	Depression		*P*
		No	Yes			No	Yes	
Gender				0.001				<0.01
Male	509	451 (88.6)	58 (11.4)		738	603 (81.7)	135 (18.3)	
Female	288	230 (79.9)	589 (20.1)		356	247 (69.4)	109 (30.6)	
Age				0.463				0.669
45–50	279	237 (84.9)	42 (15.1)		279	222 (79.6)	57 (20.4)	
51–60	380	330 (86.8)	50 (13.2)		564	435 (77.1)	12 (22.9)	
>60	138	114 (82.6)	24 (17.4)		252	193 (76.6)	59 (23.4)	
Education				0.005				<0.01
≤Elementary school	250	200 (80)	50 (20)		621	451 (72.6)	170 (27.4)	
Junior high school	244	209 (85.7)	35 (14.3)		333	280 (84.1)	53 (15.9)	
≥High school	303	272 (89.8)	31 (10.2)		140	119 (85)	21 (15)	
Marital status				0.040				0.013
Partnered	743	640 (86.1)	103 (13.9)		1,013	796 (78.6)	217 (21.4)	
Single	54	41 (75.9)	13 (24.1)		81	54 (66.7)	27 (33.3)	
Living with children				0.545				0.087
Yes	371	314 (84.6)	57 (15.4)		593	449 (75.7)	144 (24.3)	
No	426	367 (86.2)	59 (13.8)		501	401 (80)	100 (20)	
SRH				<0.01				<0.01
Very good	140	135 (96.4)	5 (3.6)		185	165 (89.2)	20 (10.8)	
Good	171	161 (94.2)	10 (5.8)		150	132 (88)	18 (12)	
Fair	401	330 (82.3)	71 (17.7)		595	468 (78.7)	127 (21.3)	
Poor or very poor	85	55 (64.7)	30 (35.3)		164	85 (51.8)	79 (48.2)	
Chronic disease				0.013				0.002
None	482	425 (88.2)	57 (11.8)		686	556 (81)	130 (19)	
One	195	162 (83.1)	33 (16.9)		281	206 (73.3)	75 (26.7)	
Two or more	120	94 (78.3)	26 (21.7)		127	88 (69.3)	39 (30.7)	
Smoking				0.024				0.131
Yes	323	287 (88.9)	36 (11.1)		454	363 (80)	91 (20)	
No	474	394 (83.1)	80 (16.9)		640	487 (76.1)	153 (23.9)	
Drinking				0.001				0.059
Yes	434	387 (89.2)	47 (10.8)		556	445 (80)	111 (20)	
No	363	294 (81)	69 (19)		538	405 (75.3)	133 (24.7)	
Disability				<0.01				<0.01
No	766	662 (86.4)	104 (13.6)		1,021	811 (79.4)	210 (20.6)	
Yes	31	19 (61.3)	12 (38.7)		73	39 (53.4)	34 (46.6)	
Type of work unit				<0.01				0.195
Government, public institution or NGO	207	186 (89.9)	21 (10.1)		89	73 (82)	16 (18)	
Firm	264	237 (89.8)	27 (10.2)		294	236 (80.3)	58 (19.7)	
Individual firm	260	213 (81.9)	47 (18.1)		491	380 (77.4)	111 (22.6)	
Individual household	66	45 (68.2)	21 (31.8)		220	161 (73.2)	59 (26.8)	
Occupation type				0.046				0.389
No leadership position	624	525 (84.1)	99 (15.9)		942	736 (78.1)	206 (21.9)	
With leadership position	173	156 (90.2)	17 (9.8)		152	114 (75)	38 (25)	
Professional skill				0.003				0.278
No technical title	625	522 (83.5)	103 (16.5)		1,039	804 (77.4)	235 (22.6)	
With technical title	172	159 (92.4)	13 (7.6)		55	46 (83.6)	9 (16.4)	
Contract				0.026				<0.01

(Continued)

TABLE 1 | Continued

Variables	Urban				Rural			
	Total	Depression		*p*	Total	Depression		*P*
		No	Yes			No	Yes	
Yes	308	274 (89)	34 (11)		228	198 (86.8)	30 (13.2)	
No	489	407 (83.2)	82 (16.8)		866	652 (75.3)	214 (24.7)	
Salary payment method				0.008				0.151
Monthly pay	636	554 (87.1)	82 (12.9)		533	424 (79.5)	109 (20.5)	
Others	161	127 (78.9)	34 (21.1)		561	426 (75.9)	135 (24.1)	
Job satisfaction				<0.01				<0.01
Very satisfied	157	140 (89.2)	17 (10.8)		251	200 (79.7)	51 (20.3)	
Somewhat satisfied	528	461 (87.3)	67 (12.7)		703	566 (80.5)	137 (19.5)	
Not satisfied	112	80 (71.4)	32 (28.6)		140	84 (60)	56 (40)	
Family income				0.001				<0.01
1	160	123 (76.9)	37 (23.1)		233	156 (67)	77 (33)	
2	174	143 (82.2)	31 (17.8)		227	166 (73.1)	61 (26.9)	
3	147	130 (88.4)	17 (11.6)		197	151 (76.6)	46 (23.4)	
4	169	149 (88.2)	20 (11.8)		219	184 (84)	35 (16)	
5	147	136 (92.5)	11 (7.5)		218	193 (88.5)	25 (11.5)	
Free lunch				0.954				0.402
No	321	274 (85.4)	47 (14.6)		324	257 (79.3)	67 (20.7)	
Yes	476	407 (85.5)	69 (14.5)		770	593 (77)	177 (23)	
Free breakfast				0.097				0.676
No	553	480 (86.8)	73 (13.2)		627	490 (78.1)	137 (21.9)	
Yes	244	201 (82.4)	43 (17.6)		467	360 (77.1)	107 (22.9)	
Free dinner				0.540				0.655
No	535	460 (86)	75 (14)		610	477 (78.2)	133 (21.8)	
Yes	262	221 (84.4)	41 (15.6)		485	373 (76.9)	111 (23.1)	
Meal allowance				0.071				0.005
No	630	531 (84.3)	99 (15.7)		1,001	767 (76.6)	234 (23.4)	
Yes	167	150 (89.8)	17 (10.2)		93	83 (89.2)	10 (10.8)	
Transportation allowance				0.015				0.032
No	675	568 (84.1)	107 (15.9)		1,044	805 (77.1)	239 (22.9)	
Yes	122	113 (92.6)	9 (7.4)		50	45 (90)	5 (10)	
Free housing				0.148				0.583
No	567	491 (86.6)	76 (13.4)		546	428 (78.4)	118 (21.6)	
Yes	230	190 (82.6)	40 (17.4)		548	422 (77)	126 (23)	
Housing allowance				0.713				0.403
No	761	651 (85.5)	110 (14.5)		1,074	836 (77.8)	238 (22.2)	
Yes	36	30 (83.3)	6 (16.7)		20	14 (70)	6 (30)	
Company car				0.085				0.560
No	780	664 (85.1)	116 (14.9)		1,064	828 (77.8)	236 (22.2)	
Yes	17	17 (100)	0		30	22 (73.3)	8 (26.7)	
Company shuttle bus				0.509				0.674
No	737	628 (85.2)	109 (14.8)		1,037	807 (77.8)	230 (22.2)	
Yes	60	53 (88.3)	7 (11.7)		57	43 (75.4)	14 (24.6)	

it also expresses the enterprise's sense of identity to employees. Rural workers who have lunch allowances have more choices when they have more time.

Urban and rural housing system and social environment may be the potential explanatory factors of the relationship between housing allowance and depression in rural areas. Housing subsidy is given by employers to employees who do not have their own housing. China's rural housing system is the homestead system, which means that farmers can build their own houses on their own on collective land (21). On one hand, under this

TABLE 2 | Multivariate analysis results of fringe benefits on depression.

	Urban	Rural
Gender (ref: male)	1.568 (0.828, 2.969)	2.160*** (1.355, 3.443)
Age (ref: 45–50)		
51–60	0.975 (0.586, 1.623)	1.292 (0.859, 1.944)
>60	0.966 (0.482, 1.937)	1.185 (0.730, 1.925)
Education (ref: ≤elementary school)		
Junior high school	0.849 (0.481, 1.498)	0.597** (0.405, 0.882)
High school	1.093 (0.532, 2.246)	0.657 (0.366, 1.179)
Marital status (ref: partnered)		
Single	1.571 (0.703, 3.513)	1.282 (0.734, 2.240)
Living with children (ref: yes)		
No	0.807 (0.501, 1.301)	0.931 (0.667, 1.299)
SRH (ref: very good)		
Good	1.770 (0.568, 5.513)	1.179 (0.579, 2.402)
Fair	4.490 (1.709, 11.792)***	2.034*** (1.191, 3.471)
Poor or very poor	9.561 (3.259, 28.049)***	5.673*** (3.094, 10.401)
Chronic disease (ref: none)		
One	1.376 (0.814, 2.324)	1.254 (0.866, 1.818)
Two or more	1.326 (0.730, 2.407)	1.104 (0.674, 1.810)
Smoking (ref: yes)		
No	0.954 (0.525,1.733)	0.833 (0.550,1.262)
Drinking (ref: yes)		
No	1.162 (0.707,1.908)	0.844 (0.586,1.215)
Disability (ref: no)		
Yes	2.081* (0.882,4.910)	2.298*** (1.324,3.990)
Type of work unit (ref: government, public institution, or NGO)		
Firm	0.866 (0.415, 1.810)	1.218 (0.597, 2.487)
Individual firm	1.191 (0.549, 2.582)	1.065 (0.537, 2.114)
Individual household	2.773 (1.101, 6.983)**	0.956 (0.456, 2.006)
Occupation type (ref: no leadership position)		
With leadership position	0.720 (0.377, 1.376)	1.528* (0.961, 2.429)
Professional skill (ref: no technical title)		
With technical title	0.621 (0.289, 1.333)	1.716 (0.719, 4.095)
Contract (ref: yes)		
No	0.969 (0.552, 1.700)	1.647* (0.986, 2.752)
Salary payment method (ref: monthly pay)		
Others	1.293 (0.731, 2.288)	1.091 (0.754, 1.579)
Job satisfaction (ref: very satisfied)		
Somewhat satisfied	1.020 (0.540, 1.924)	1.008 (0.671, 1.513)
Not satisfied	2.439 (1.142, 5.212)**	2.520*** (1.495, 4.246)
Family income (ref: lowest)		
2	0.992 (0.536, 1.837)	0.773 (0.493, 1.211)
3	0.741 (0.363, 1.514)	0.810 (0.495, 1.327)
4	1.114 (0.531, 2.339)	0.595** (0.355, 0.996)
5 (highest)	1.131 (0.460, 2.776)	0.452** (0.253, 0.808)
Free lunch (ref: no)		
Yes	0.514 (0.272, 0.971)**	1.031 (0.623, 1.705)
Free breakfast (ref: No)		
Yes	1.432 (0.767, 2.671)	0.843 (0.529, 1.344)
Free dinner (ref: no)		
Yes	0.762 (0.398, 1.461)	1.050 (0.613, 1.799)
Meal allowance (ref: no)		
Yes	0.701 (0.337, 1.461)	0.434** (0.194, 0.974)

(Continued)

TABLE 2 | Continued

	Urban	Rural
Transportation allowance (ref: no)		
Yes	0.536 (0.220, 1.303)	0.564 (0.199, 1.601)
Free housing (ref: no)		
Yes	1.235 (0.728, 2.094)	1.330 (0.892, 1.983)
Housing allowance (ref: no)		
Yes	1.846 (0.635, 5.365)	3.775** (1.225, 11.634)
Company car (ref: no)		
Yes		1.038 (0.388, 2.778)
Company shuttle bus (ref: no)		
Yes	0.708 (0.279, 1.795)	1.274 (0.630, 2.573)
_cons	0.044*** (0.009, 0.204)	0.064*** (0.019, 2.215)
Obs.	780	1,094
Pseudo R^2	0.167	0.156

95% confidence intervals are in parenthesis.
****p < 0.01.*
***p < 0.05.*
**p < 0.1.*

system, most of the farmers have their own houses because of the collective ownership of rural land in China. Therefore, it is rare for people without housing to enjoy a housing allowance. On the other hand, housing allowance cannot fundamentally change the state of no self-owned housing. In rural China, traditional family and neighborhood relationships are the main components of the social network; thus, this kind of social network is limited but stable (22, 23). The information of individual without house may spread in the rural social network, thereby forming an unfriendly social environment. The adverse effect on mental health may exceed the mitigation effect of housing allowance. In China's urban areas, no self-owned housing is generally more popular because of the high degree of marketisation of housing and registered residence. Compared with the high housing prices in urban areas, housing allowance may have limited effect on alleviating the mental problems of workers.

The lack of formal support, such as social welfare, may be responsible for the relationship between work unit type and depression. Individual households are different from individual industrial and commercial households in terms of the types of employers. Individual households comprise informal employers that rely on social relations and rules for governance. They lack formal business registration. Therefore, formal social welfare, such as industrial, commercial and unemployment insurance, cannot be handled for employees. Compared with the social welfare support provided by a large number of formal enterprises in urban areas, this relative mental deprivation will be more intense, thereby aggravating the symptoms of depression. In rural areas, small and medium-sized and small and micro enterprises are the main employment agencies (24). The heterogeneity of employment agencies is small. The gap of relative deprivation is small. Therefore, no significant relationship exists between employment types and depression in rural areas.

Conflict governance mechanism of social relations may be the potential reason for the relationship between contract and depression. Social relations in rural areas in China are social networks composed of acquaintances, such as relatives and neighbors (25). The governance mechanism of implicit contracts, such as trust, verbal promises and private coordination, has become the main way to coordinate interests. Therefore, formal contracts in rural areas dominated by informal governance mechanisms may cause greater mental pressure on employees.

LIMITATIONS

Firstly, the types of fringe benefits in the study include basic life support. In fact, the types of extra benefits may include life support and recreational activities (public travel, public entertainment and paid vacation) and holiday gifts. However, no relevant items are found in the questionnaire. Thus, more research on non-life support is needed. In addition, more samples with more balanced characteristics need to be further analyzed when future data becomes available.

Secondly, this is a cross-sectional study that did not consider the effects of time and longitudinal changes. Although the survey of the data source is a longitudinal survey, a sample with fringe benefits information is missing too much from the longitudinal survey. Moreover, the study only used samples over 45 years old due to the age limit of the survey respondents.

Moreover, the study includes family surveys and excluded high-risk groups, such as those who could not recover from hospitalization for major mental illness. However, this situation also shows that the results are relatively robust.

CONCLUSIONS

The relationship between fringe benefits and depression in urban and rural areas differs. Employees in urban areas who have free lunches are less likely to be depressed. Employees in rural

areas who have subsidized meals are less likely to be depressed. People with housing allowance in rural areas are more prone to developing depression. Employers in urban areas need to pay attention to the free provision and quality of lunch, whereas in rural areas, providing catering allowance may be a more appropriate way to improve the mental health of employees. In addition, the mental state of employees who have received housing allowance and have contracts in rural areas needs to become a focus of research.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

All procedures performed in this study involving human participants comply with the Ethical Standards of Institutions and/or National Research Committees, as well as the 1964 Helsinki Declaration and its subsequent amendments or similar ethical standards. Ethical approval for data collection in CHARLS was obtained from the Biomedical Ethics Review Committee of Peking University (IRB00001052–11015). All interviewees gave written informed consent before recruitment. The management agency of Peking University's public data approved our data use application.

AUTHOR CONTRIBUTIONS

TL wrote the manuscript. CY conceived the idea and provided suggestions for the discussion of the manuscript. XZ critically revised the paper. All authors read and approved the final manuscript.

FUNDING

This research was funded by National Science Foundation of China (Grant Number: 72074084). The funding body only provided financial support for the research, and did not participate in any part of the research, such as research design, data analysis, manuscript writing, etc.

ACKNOWLEDGMENTS

The authors would like to thank the CHARLS team for collecting the data and providing an open access platform for the data and the respondents who participated in the longitudinal survey.

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frontiers in Psychiatry

ORIGINAL RESEARCH
published: 03 February 2022
doi: 10.3389/fpsyt.2022.818295

Mediating Effect of Sleep Disorder Between Low Mental Health Literacy and Depressive Symptoms Among Medical Students: The Roles of Gender and Grade

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Objective: In this study, we aimed to disentangle the mediating effect of sleep disorder between mental health literacy (MHL) and depressive symptoms in Chinese medical students, especially focusing on the impact of gender and grade.

Methods: Pooled longitudinal data of 5,504 medical students was collected between November 2019 and June 2020 to assess the MHL, sleep disorder and mental health of medical students in Anhui province, China. Mediation analyses were tested by using bootstrapping procedures.

Results: Sleep disorder were negatively correlated with adequate MHL, but positively correlated with depressive symptoms. The relationships between MHL and depressive symptoms were mediated by sleep disorder in total samples and the indirect effect accounted for 13.59% of the total effect. However, the ratio was 20.82% in female students, whereas no mediating effect was found in the male students. Moreover, the ratio was found higher in freshmen (15.11%) than that in sophomores (11.56%).

Conclusion: Improving the sleep disorder by enhancing MHL is an effective way to reduce depressive symptoms in Chinese medical students. Further investigations elaborately considered by using more gender-balanced population with higher grade and lower level of education.

Keywords: mental health literacy, sleep disorder, depressive symptoms, medical students, gender, grade

OPEN ACCESS

Edited by:
Harshavardhan Sampath, Sikkim Manipal University, India

Reviewed by:
Chunping Ni, Fourth Military Medical University, China
Anmol Pradhan, Sikkim Manipal University, India

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

Received: *19 November 2021*
Accepted: *10 January 2022*
Published: *03 February 2022*

Citation:
Hu J, Wang J, Li D, Huang X, Xue Y, Jia L, Zhang Z, Wan Y, Song X, Wang R, Fang J, Sun Y and Zhang S (2022) Mediating Effect of Sleep Disorder Between Low Mental Health Literacy and Depressive Symptoms Among Medical Students: The Roles of Gender and Grade. Front. Psychiatry 13:818295. doi: 10.3389/fpsyt.2022.818295

INTRODUCTION

Depression is a common mental disorder. More than 264 million people of all ages suffer from depression in the world (1). In China, the weighted prevalence of any mental disorder (excluding dementia) was 9.3%, and depressive disorders, anxiety disorders and alcohol use disorders were the common class of disorders (2). Depression is a leading cause of disability worldwide and is a major contributor to the overall global burden of disease (1). Depressive and anxiety disorders will continue to be the major contributors to mental, neurological, and substance use disorder burden, accounting for about 39% of the populations in China (3). In addition, Rotenstein et al. showed that the prevalence of depression or depressive symptoms and suicidal ideation among medical students were 27.2% and 11.1%, respectively, and these symptoms were more common in medical students than other students (4). Many mental disorders relate to poor mental health literacy (MHL). Those youth who have poor MHL levels are more reluctant to seek help, leading to worse health outcome (5). That MHL is related to depression is an important concept and adequate health literacy (HL) is helpful for the prevention, early diagnosis of depression, as well as to improve the prognosis of depression through interventions (6).

MHL refers to knowledge and beliefs about mental disorders which is helpful for the recognition, management or prevention of diseases. MHL has many components, including (a) knowledge of how to prevent mental disorders, (b) recognition of the disease when a disorder is developing, (c) knowledge of help-seeking options and available treatments, (d) knowledge of effective self-help strategies for milder problems, and (e) first aid skills to support others who are developing a mental disorder or are in a mental health crisis (7). Previous studies have shown that improvements in MHL assisted in promoting early detection of mental disorders, and the mental disorders could be halted and even reversed by elevating MHL level, particularly for those individuals who exhibit depression and anxiety (8–10).

A strong link has been elucidated between MHL and depressive symptoms (11), but little is known about the modulating mechanisms or pathway between MHL and depressive symptoms. Understanding the potential pathways modulating the interaction of MHL and depressive symptoms in different populations may thus have a positive impact on intervention strategies. Stewart et al. found that social support (total and subscale scores) mediated the effect of health literacy on depression (12). Previous studies suggested that students who had sleep problems with low HL are at risk of exhibiting anxiety symptoms and depressive symptoms (13). Sleep, as a natural physiological behavior, is closely related to health outcomes (e.g., obesity, cancer, depressive symptoms) (14). The negative aspects of MHL, including discrimination and stigma, may increase one's negative emotions, which is also linked to sleep disorder (15). In contrast, sleep plays an important role in maintaining effective cognitive and interpersonal functions (16). Other positive aspects of MHL, such as effective self-help strategies and help-seeking options may regulate emotional reactivity, which is associated with sleep (17). Namely, emotional support relations are associated with better sleep quality.

A growing number of studies have further indicated the relation between sleep disorder and depressive symptoms (14, 18). A cohort study demonstrated that sleep deprivation also increased the risk of depressive symptoms in which a reciprocal effect existed (19). Moreover, a meta-analysis of randomized controlled trials showed that non-pharmacological sleep interventions could improve the severity of depression symptom efficiently (20). Despite methodological shortcomings, these studies clearly implied that depression could be improved in the context of sleep quality by using intervention strategies. Taken together, a strong link exists between low MHL and depressive symptoms in which sleep disorder may play a critical role for mediating this relation. However, so far, most studies regarding this issue tend to treat the respondents as a homogeneous group, but the group differences are less considered.

Previous studies found the distinct distribution pattern of MHL, sleep disorder and depressive symptoms in male and female, which suggested gender may potentially impact the mediating effect of sleep disorder between low MHL and depressive symptoms (21, 22). Meanwhile, the grade of students (i.e., the age) was found to a key factor associated with MHL, sleep disorder and depressive symptoms (23–25). In this context, it is important to investigate the potential impact of demographic characteristics of the population, especially gender and grade differences, in the interaction of MHL and mental disorders, which may have important implications for school intervention policies. For this aim, in this study we identified the associations between low MHL, sleep disorder, and depressive symptoms, especially focusing on the impact of gender and grade on the mediating effect of sleep disorder in the associations between low MHL and depressive symptoms.

METHODS

Design and Participants

This longitudinal study was performed between November 2019 and June 2020 to assess the MHL, sleep quality and depressive symptoms in medical students. Participants were recruited from two medical colleges by a cluster sampling method in Anhui province, China. The participants of this study consisted of freshmen and sophomores, and excluding participants who have a history of psychiatric disorders or are being treated with psychiatric medication. We first carried out the baseline survey in November 2019 and the follow-up surveys were completed in June 2020 (6-month follow up) (**Figure 1**). Written informed consents were obtained from all participants prior to the implementation of the investigation. A link was given to the students, allowing them to access the electronic questionnaire. The students were asked to complete an anonymous questionnaire. Completion of the questionnaire took approximately 20–30 min. A research staff was responsible for the quality control of the questionnaire to answer the questions from the recipients and to proofread the questionnaire.

Data on demographic information, MHL and sleep disorder were collected through electronic questionnaire in the baseline

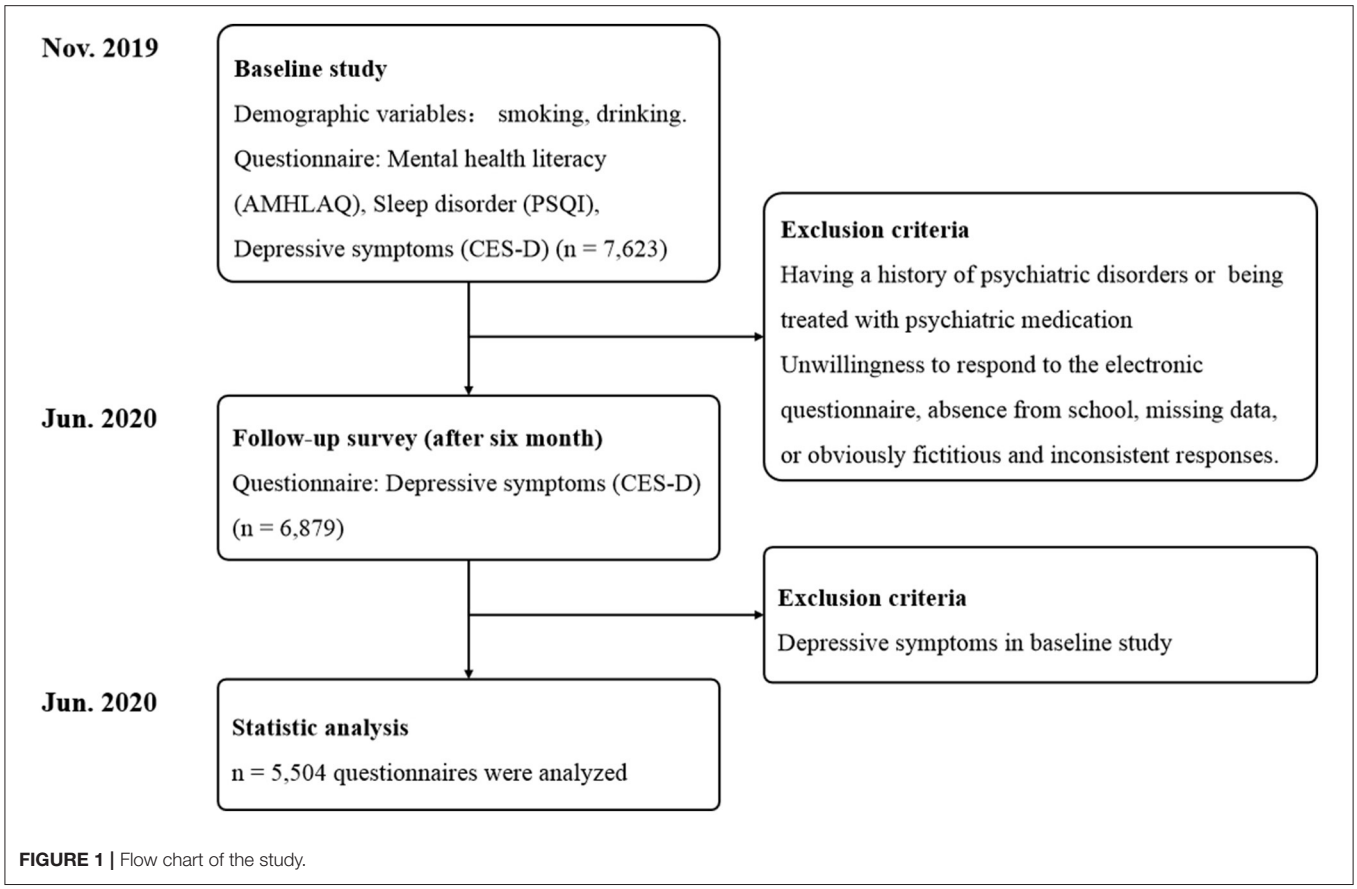


FIGURE 1 | Flow chart of the study.

study. A total 7,623 adolescents (1,971 males, 5,652 females) aged 19.66 years (SD = 1.11) who had complete baseline data of MHL and sleep disorder, were selected for the follow-up study, which mainly focused on the mental health of the participants (**Figure 1**). Among those students qualified the follow-up study, 744 students were excluded from the study because of an unwillingness to respond to the electronic questionnaire, absence from school, missing data, or obviously fictitious and inconsistent responses. Accordingly, the data from 6,879 (90.24%) participants were collected in follow-up study. Given that follow-up depressive symptoms may be the continuance of the symptoms at the time of baseline study, we only analyzed participants without depressive symptoms in baseline study. Finally a total of 5,504 students were selected in this study, with a mean age of 19.65 ± 1.11 years, among which there were 1,347 male students, 4,157 female students, 3,046 freshmen and 2,458 sophomores (**Figure 1**). The demographic characteristic of participants was presented in (**Table 1**).

Variables

MHL

The measurement of MHL was based on the Adolescent Mental Health Literacy Assessment Questionnaire (AMHLAQ), which consists of 22 questions in 4 dimensions, as follows: (1) 6 items regarding knowledge (e.g., "The duration of symptoms of mental problems is an important factor in the diagnosis of mental illness."); (2) 5 items regarding recognition (e.g., "People with social phobia usually become extremely nervous and anxious when communicating with others or participating in group activities."); (3) 6 items regarding attitude (e.g., "I think people with mental illness usually come from low-income families."); and (4) 5 items of practice of (e.g., "If my relatives or friends had mental illness, I would listen to her/him without judging or criticism.") (26). Participants selected an answer by using 5-point Likert responses (strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree). The scores for all items ranged between 22 and 110. A higher total score indicates a higher level of MHL. In this study, the Cronbach's α coefficient for AMHLAQ was 0.841, and Cronbach's α of each dimensions was 0.681–0.805.

Sleep Disorder

Sleep disorder were evaluated by the Pittsburgh Sleep Quality Index (PSQI), which is a self-reported questionnaire containing 7 domains, i.e., sleep quality, habitual sleep efficiency, sleep latency, sleep disturbances, medication use, sleep duration, and diurnal dysfunctions, over the past month (27). The total of scores range 0–21, where higher scores regard poorer sleep quality. Previous studies using PSQI indicated the strong reliability and validity, and moderate structural validity of PSQI in a variety of samples, with the Cronbach's α coefficient ranged from 0.70 to

TABLE 1 | The demographic characteristic of participants.

Variable	Total sample (%)
Gender	
Male	1,347 (24.47)
Female	4,157 (75.53)
Grade	
Freshman	3,046 (55.34)
Sophomore	2,458 (44.66)
Registered residence	
Rural	3,533 (64.19)
Urban	1,971 (35.81)
Any siblings	
Yes	4,354 (79.11)
No	1,150 (20.89)
Father's educational level	
No father	116 (2.11)
<High school degree	4,052(73.62)
≥High school degree	1,336 (24.27)
Mother's educational level	
No mother	66 (1.20)
<High school degree	4,584 (83.28)
≥High school degree	854 (15.52)
Self-reported family economy	
Bad	1,878 (34.12)
Normal	3,445 (62.59)
Good	181 (3.29)

0.83, suggesting the utility of this tool (28). The Cronbach's α coefficient for PSQI was found 0.744 in this study.

Depressive Symptoms

The Center for Epidemiologic Studies Depression Scale (CES-D) compiled by Radloff was used to evaluate depressive symptoms by measuring the frequency of events and ideas (29). CES-D is a 20-item instrument with 4 options ranging from 0 ("rarely or none of the time") to 3 ("most or all of the time"). The total score ranges from 0 to 60 and a higher score indicates a greater risk of depressive symptoms. Previous study suggested a good reliability and validity of CES-D for assessing subthreshold depression in Chinese university students (30). In this study, the Cronbach's α coefficient for the scale was 0.864.

Covariates

The potential correlations of depressive symptoms with demographic characteristics including age, gender, grade, registered residence, any siblings, parental educational level, self-reported family economy, smoking and drinking, were also investigated in this study.

Analyses

All data were performed using SPSS (version 23.0, SPSS Inc., Chicago, IL, USA). First, descriptive analysis was performed to explore the possible of gender and grade differences. Given the gender and grade difference in description, we conducted a stratified analysis between male and female, as well as between freshman and sophomore. Next, we performed spearman correlation analysis to test the associations among MHL, sleep disorder and depressive symptoms. Then, the mediation pathway from MHL to depressive symptoms through sleep disorder was tested as recommended by Hayes, using bootstrapping procedures with 5,000 random samplings (31). The index of the indirect effect is regarded statistically significant if the 95% confidence interval does not contain 0. Finally, we examined whether sleep disorder mediated the relationship between low MHL and depressive symptoms in different gender and grade.

RESULTS

Correlations Among of MHL, Sleep Disorder and Depressive Symptoms Among Chinese Medical Students

Gender and grade differences in descriptive statistics related to different dimensions of MHL, sleep disorder and depressive symptoms were presented in (**Table 2**). Correlation analysis between key variables were presented in (**Table 3**). Although we used stratified analysis in this study, we also reported the results of the correlation analysis of the total samples. Spearman correlation analysis among these key variables were in expected directions (e.g., sleep disorder was negatively correlated with adequate MHL, but positively correlated with depressive symptoms). The exceptions were that in male no significant correlations were found for knowledge, attitude and recognition with sleep disorder. Also, in female no significant correlations were found for recognition with depressive symptoms. In addition, with regard to recognition, between freshmen and sophomore participants, no statistically significant differences were found for depressive symptoms and sleep disorder ($p > 0.05$, **Table 3**).

Mediation Effects of Sleep Disorder in the Relationship Between MHL and Depressive Symptoms

To investigate possible role of sleep disorder in the mediation pathway of depressive symptoms, a series of mediating analyses were carried out by using a stratified analysis. Mediation models were only tested if the 95% CI do not include 0 in all three pathways (a, b, c) (32). The relationship between MHL and depressive symptoms was mediated by sleep disorder in total samples; in the model 4, the indirect effect accounted for 13.59% of the total effect in the total samples (**Table 4**). However, the ratio of MHL on depressive symptoms was inconsistent according in different genders and grades. Results showed that sleep disorder did not mediate the relationship between MHL and depressive symptoms in male samples, whereas the mediation ratio was 20.82% in the model 2 in female samples. In the model 3, the indirect effect accounted for 15.11% of the total effect among freshmen, while the ratio among sophomores was 11.56% (**Table 4**). The relationship between different dimensions of MHL and depressive symptoms was not mediated by sleep disorder in males, except for practice

TABLE 2 | Descriptive statistics for variables.

Variable	Total (n = 5,504) Mean ± SD/ M (P_{25}, P_{75})	Sex		Grade	
		Male (n = 1,347) Mean ± SD/ M (P_{25}, P_{75})	Female (n = 4,157) Mean ± SD/ M (P_{25}, P_{75})	Freshman (n = 3,046) Mean ± SD/ M (P_{25}, P_{75})	Sophomore (n = 2,458) Mean ± SD/ M (P_{25}, P_{75})
Mental health literacy	85.96 ± 6.97	85.72 ± 8.26	86.04 ± 6.50	85.82 ± 6.80	86.14 ± 7.18
Knowledge	24.08 ± 2.57	24.16 ± 2.95	24.05 ± 2.43	23.90 ± 2.57	24.30 ± 2.55
Recognize	19.62 ± 2.41	19.48 ± 2.79	19.67 ±2.27	19.55 ± 2.43	19.70 ± 2.37
Attitude	22.25 ± 2.35	21.93 ± 2.58	22.35 ± 2.27	22.37 ± 2.28	22.09 ± 2.43
Practice	20.02 ± 2.17	20.16 ± 2.45	19.97 ± 2.06	19.99 ± 2.13	20.05 ± 2.22
Sleep Disorder	4.00 (3.00, 6.00)	4.00 (3.00, 6.00)	4.00 (3.00, 6.00)	5.00 (3.00, 6.00)	4.00 (2.00, 6.00)
Depressive symptoms	7.00 (3.00, 12.00)	8.00 (4.00, 12.00)	7.00 (3.00, 12.00)	8.00 (4.00, 12.00)	7.00 (3.00, 12.00)

SD, standard deviation; M, median; P_{25}, lower quartile; P_{75}, upper quartile; The normally distributed data is described as Mean ± SD; The non-normally distributed data is described as M (P_{25}, P_{75}).

dimension. In addition to recognition dimension, sleep disorder plays a mediating role between cognition, attitude and practice, and depressive symptoms among freshmen and sophomores. Sleep disorder mediated the relationships between all dimensions of MHL and depressive symptoms in females (refer to attached **Tables A1–A4**).

DISCUSSION

In this study we explored the association between MHL and depressive symptoms among Chinese medical students. Moreover, our study adds to the literature by emphasizing that sleep disorder is the mediator between MHL and depressive symptoms and this mediating effect is varied by gender and grade. Our study found that adequate MHL was related negatively with sleep disorder and depressive symptoms. Though previous study has already indicated that low HL was related with sleep disorder and depressive symptoms; the evaluation tool of MHL was not used directly (13). The current study is not only a support of previous results but also an extension of the research. It has been commonly understood that sleep disorder often precede the onset of depression and constitute an independent risk factor for depression (33). In line with those findings, our present study indicated that poor sleep quality was positively associated with depressive symptoms.

Stewart et al. indicated that inadequate HL had an indirect impact on depression through its association with social support (12). Moreover, previous studies showed that sleep disorder, as a mediating mechanism, linked psychosocial stressors (e.g., self-blame, self-shame, self-stigma, discrimination) to mental disorder (15, 34). Individuals who were characterized by more shame, self-stigma, less perceived knowledge, higher satisfaction with their mental health that may be barriers to help-seeking, usually companied with low MHL (35). Also, such negative thoughts could adversely affect sleep quality, contributing to mental disorders (15). In accordance with previous psychological studies, our results concluded that inadequate MHL showed an indirect relationship with depressive symptoms that is likely to be achieved by sleep disorder. Interestingly, in male students, the effect of MHL on depressive symptoms seemed not to be affected by sleep disorder in adjusted models. There is evidence that, the masculinity has been regarded as association with low MHL and mental health help-seeking and males may be inclined to conceal their symptoms and experience of depression compared to females so that their behavior conforms to social conventions (36). Masculinity emphasis on competition, strength, avoiding emotions and perceived femininity, an action-orientation, and the acceptability of anger and violence (37). Males are at risk of psychological stress when they are unlikely to seek help for their problems. Namely, males may suppress their emotional expression, or may be ill-equipped to recognize signs of negative emotion and to respond due to low MHL. This may also be the reason why males are less affected by sleep disorder compared with females. On the contrary, the important finding in this study was that low MHL might lead to decreased sleep quality, thus contributing to depressive symptoms in females. Further studies are warranted to confirm this notion which is of importance for the design of the intervention program for university students to improve their mental health.

When covariates were adjusted, the ratio of total effect of MHL on depressive symptoms that was explained by mediation *via* sleep disorder and individuals with freshmen was higher than sophomores. It is not surprising that attending college for the first time can be a challenging experience for freshmen. Studies on transition theory have shown that a passage from one fairly stable state to another fairly stable state, is a process triggered by changes (38). There are many risk factors, such as academic achievement, financial situation, socializing and living environment that affect college student' health (39). To adapt to

TABLE 3 | Correlations of MHL, sleep disorder and depressive symptoms among Chinese medical students.

Variable		1	2	3	4	5	6	7
Gender								
Male	1.MHL	1						
	2.Knowledge	0.811**	1					
	3.Recognition	0.744**	0.659**	1				
	4.Attitude	0.568**	0.233**	0.141**	1			
	5.Practice	0.771**	0.602**	0.482**	0.304**	1		
	6.Sleep disorder	−0.070**	−0.048	−0.026	−0.033	−0.079**	1	
	7.Depressive symptoms	−0.199**	−0.110**	−0.085**	−0.221**	−0.192**	0.188**	1
Female	1.MHL	1						
	2.Knowledge	0.757**	1					
	3.Recognition	0.673**	0.550**	1				
	4.Attitude	0.583**	0.191**	0.135**	1			
	5.Practice	0.678**	0.448**	0.320**	0.253**	1		
	6.Sleep disorder	−0.115**	−0.103**	−0.038**	−0.047**	−0.151**	1	
	7.Depressive symptoms	−0.144**	−0.067**	−0.018	−0.157**	−0.164**	0.212**	1
Grade								
Freshman	1.MHL	1						
	2.Knowledge	0.770**	1					
	3.Recognition	0.688**	0.552**	1				
	4.Attitude	0.572**	0.200**	0.132**	1			
	5.Practice	0.691**	0.454**	0.325**	0.281**	1		
	6.Sleep disorder	−0.121**	−0.103**	−0.052**	−0.055**	−0.139**	1	
	7.Depressive symptoms	−0.152**	−0.071**	−0.025	−0.175**	−0.175**	0.197**	1
Sophomore	1.MHL	1						
	2.Knowledge	0.775**	1					
	3.Recognition	0.697**	0.612**	1				
	4.Attitude	0.592**	0.213**	0.149**	1			
	5.Practice	0.715**	0.539**	0.408**	0.245**	1		
	6.Sleep disorder	−0.079**	−0.050*	−0.005	−0.044*	−0.127**	1	
	7.Depressive symptoms	−0.167**	−0.071**	−0.050*	−0.190**	−0.160**	0.204**	1
Total	1.MHL	1						
	2.Knowledge	0.770**	1					
	3.Recognition	0.692**	0.577**	1				
	4.Attitude	0.578**	0.200**	0.138**	1			
	5.Practice	0.702**	0.489**	0.362**	0.263**	1		
	6.Sleep disorder	−0.103**	−0.089**	−0.035*	−0.042**	−0.134**	1	
	7.Depressive symptoms	−0.158**	−0.076**	−0.037**	−0.176**	−0.168**	0.206**	1

*$p < 0.05$; **$p < 0.01$; MHL is mental health literacy.*

the new environment, individuals have to deal with the problems, challenges and needs in daily life (40). Previous study has shown that across the transitional first year of college, freshmen experience significantly declines in psychological wellbeing and cognitive-affective strengths as well as remarkable increases in psychological distress and cognitive-affective vulnerabilities (41). Furthermore, Evans et al. indicated that students in upper classes had higher HL, namely, with the increase of academic level, the level of HL is also improving (42). Therefore, freshmen may not be able to solve their predicaments due to inadequate MHL, and they are prone to negative coping styles. Once those with a negative tendency of coping style showed signs of sleep disorder, the possibility of mental problems increased significantly (43).

Medicine is a challenging major with a very stressful environment, and the students are usually required to participate in a wide range of courses, numerous academic requirements and various types of examination (44). The reactions of individuals to stress are quite different, if it is not recognized or managed correctly and timely, stress may manifest in unfavorable ways, such as impaired sleep quality and depressive symptoms (43). In light of the present results, interventions targeting those with low MHL should include improving sleep quality to promote mental health. More specifically,

TABLE 4 | Mediating effect of sleep disorder between MHL and depressive symptoms.

Variable	Model	a	b	Direct effect	Boot CI		Indirect effect boot CI			Mediation ratio, %
				c'	LLCI	ULCI	(a × b)	LLCI	ULCI	(a × b)/(a × b + c')
Gender										
Male	1	−0.0162	0.3729**	−0.1354**	−0.1746	−0.0963	−0.006	−0.0139	0.0007	-
	2	−0.0134	0.3577***	−0.1303***	−0.1694	−0.0912	−0.0048	−0.0123	0.0015	-
Female	1	−0.0483***	0.5401**	−0.096**	−0.1234	−0.0687	−0.0261	−0.0338	−0.0188	21.38
	2	−0.0476***	0.5242***	−0.0952**	−0.1226	−0.0678	−0.0250	−0.0327	−0.0178	20.82
Grade										
Freshman	1	−0.0406***	0.487**	−0.1153***	−0.1473	−0.0833	−0.0198	−0.0285	−0.0124	14.67
	3	−0.0411***	0.4836***	−0.1118***	−0.1439	−0.0797	−0.0199	−0.0286	−0.0123	15.11
Sophomore	1	−0.0312**	0.4681***	−0.1055***	−0.1362	−0.0747	−0.0146	−0.0225	−0.0076	12.17
	3	−0.0289***	0.4673***	−0.1032***	−0.1340	−0.0724	−0.0135	−0.0215	−0.0067	11.56
Total	1	−0.0371***	0.4919***	−0.1111***	−0.1334	−0.0888	−0.0183	−0.0242	−0.0128	14.14
	4	−0.0357***	0.4762***	−0.1081***	−0.1304	−0.0858	−0.0170	−0.0227	−0.0119	13.59

***p < 0.01; ***p < 0.001; a: Effect of MHL on sleep disorder; b: Effect of sleep disorder on depressive symptoms.*
MHL is mental health literacy.
Model 1: Single factor analysis.
Model 2: Adjusted for age, grade, registered residence, any siblings, parents' education level, self-reported family economy, smoking, drinking.
Model 3: Adjusted for age, gender, registered residence, any siblings, parents' education level, self-reported family economy, smoking, drinking.
Model 4: Adjusted for age, gender, grade, registered residence, any siblings, parents' education level, self-reported family economy, smoking, drinking.

gender and grade differences should also be considered for targeted MHL approaches. Once individuals have sleep disorder, females and freshmen with low MHL were more likely to have depressive symptoms. In this context, intervention to enhance MHL of medical students should be performed as soon as possible to prevent the potential knock-on effects on health, especially among females. Moreover, it should also be noted that though sleep disorder is an important issue, intervention for MHL but not only for sleep disorder, may be more effective in improving health because MHL constitute an independent risk factor for sleep disorder and depressive symptoms.

STRENGTHS AND LIMITATIONS

The main contribution of this study is to demonstrate what extent MHL is associated with depressive symptoms through sleep disorder. To our knowledge, our study is the first to examine whether the gender and grade moderate the mediating effects of sleep disorder between low MHL and depressive symptoms in Chinese medical students, which may help to understand the potential negative effects of low MHL and sleep disorder, and to design targeted intervention programs to promote mental health. In addition, strengths of the study also include its longitudinal design, large sample size, and a low level of missing information among participants. However, some limitations exist in this study. Firstly, electronic questionnaires were collected through self-report measure which may be subject to reporting bias. Secondly, although the study samples are enough for difference analysis, and the response rate is relatively high (i.e., 90.24%), the generalizability of the findings is limited as a result because all participants were from two medical colleges. Thirdly, only freshmen and sophomores were included in the sample, and they were all in lower grades and could not reflect all medical students. Finally, although a series of covariates were adjusted in the analyses, some variables that are known to have associations with depressive symptoms, such as family medical history, have not been measured.

CONCLUSION

In this study, we demonstrate that sleep disorder is not only a consequence of low MHL, but also a risk factor for depressive symptoms, and it mediates the association between low MHL and depressive symptoms, which the mediating effect is more pronounced in females and freshmen. Our findings suggest that improvement of the sleep disorder of Chinese medical students by enhancing MHL is an effective way to reduce depressive symptoms. Further study using a sample with a more gender-balanced, more types of schools, and different levels of education, is warranted to support and confirm this notion.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Anhui Medical University (approval number 20170290). Written informed consent to

participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

JH, JW, XS, and RW were involved in data collection. JH, JW, DL, XH, YX, LJ, and ZZ conducted the Statistical analysis. JH and JW wrote the first draft of the paper, which was critically revised by SZ, YS, and JF. SZ, JW, and JF provided funding for the project. The final manuscript was approved by all authors and contributed to interpretation of the findings.

FUNDING

This research was funded by National Ministry of Education Humanities and Social Science Research Planning Fund Project (21YJAZH120), National Natural Science Foundation of China (81402699 and 81573512) and the Natural Science Foundation in Higher Education of Anhui (KJ2020A0209 and KJ2020A0208). The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

ACKNOWLEDGMENTS

We frankly thank all participants and the schools involved in the survey, as well as other staff members on the scene.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.818295/full#supplementary-material

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frontiers in Public Health

ORIGINAL RESEARCH
published: 07 February 2022
doi: 10.3389/fpubh.2022.793619

Effort-Reward Imbalance in Emergency Department Physicians: Prevalence and Associated Factors

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Objectives: To examine the prevalence of effort-reward imbalance and explore its associated factors among emergency department physicians in China.

Methods: A cross-sectional survey was conducted in the Chinese emergency department in 2018. A total of 10,457 emergency department physicians completed a structured questionnaire containing demographic characteristics, work-related data, and effort-reward imbalance scale. All the data were analyzed using descriptive analysis and stepwise logistic regression.

Results: The prevalence of effort-reward imbalance was 78.39% among emergency department physicians in China. The results showed that the male emergency department physicians with a bachelor's degree, an intermediate title, long years of service, a high frequency of night shift, and who suffered workplace violence were at a higher risk of effort-reward imbalance. In contrast, physicians with higher monthly income and perceived adequate staff were associated with a lower risk of effort-reward imbalance.

Conclusions: The situation of effort-reward imbalance was serious among emergency department physicians in China. Administrators should pay more attention to key groups and take measures from the perspectives of effort and reward to improve the effort-reward imbalance in emergency department physicians.

Keywords: emergency department, physicians, effort-reward imbalance, workplace violence, mental health

OPEN ACCESS

Edited by:
Harshavardhan Sampath, Sikkim Manipal University, India

Reviewed by:
Rudy Foddis, University of Pisa, Italy
Tao Sun, Hangzhou Normal University, China

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

Received: *12 October 2021*
Accepted: *03 January 2022*
Published: *07 February 2022*

Citation:
Tian M, Zhou X, Yin X, Jiang N, Wu Y, Zhang J, Lv C and Gong Y (2022) Effort-Reward Imbalance in Emergency Department Physicians: Prevalence and Associated Factors. Front. Public Health 10:793619. doi: 10.3389/fpubh.2022.793619

INTRODUCTION

Emergency department (ED) physicians are crucial in the emergency medical service system. However, due to the special working environment of ED, ED physicians are under high time pressure, workload, and psychological pressure (1). On the one hand, this is since ED mainly treats patients with acute and critical illness, and on the other hand, it is because ED is an open and complicated department; it is more chaotic and prone to violence incidences (1–3). A previous study revealed that ED physicians faced a higher level of work stress than general ward physicians (4).

Effort-reward imbalance (ERI) is a classical theory of work stress, which asserts that the imbalance between effort and reward of work (e.g., salary, promotion prospects, job security, and self-esteem) will evoke great negative emotions in employees, thereby causing intense stress reaction (5). Nowadays, the theory of ERI has been widely applied to the physicians' group. Previous studies in Japan (6) and Switzerland (7) reported that the prevalence of ERI in physicians was 57% and 64.9%, respectively. However, studies in Germany (8) and Norway (9) on physicians showed that the proportion was 25.1% and 10.3%, respectively. The prevalence of ERI in physicians varied widely between countries and regions, which may be relevant to differences in health care systems and cultural backgrounds. Because of the particularities of ED, ED physicians may face a more severe situation of ERI. However, up to now, the occurrence of ERI in ED physicians has been seldom studied. As an adverse working condition, the imbalance between high effort and low reward has a series of negative effects on employees' health and work performance (7, 10–13). Studies have shown that ERI was highly associated with chronic fatigue (11), cardiovascular disease (10), and depression (12). Besides, it was also related to increased turnover intention (7) and sickness absence (13). Therefore, it is necessary to explore the current situation and related factors of ERI in ED physicians.

In China, emergency medical services cover various fields, including pre-hospital care, disaster medicine, and in-hospital care. And these services play an important role in major medical treatment and multidisciplinary diagnosis and treatment (14). At present, Chinese hospitals have established EDs, and China has formed a relatively complete emergency medical system (14). However, with the rapid increase in emergency service demands, overcrowding in ED has become increasingly severe in China (15). According to the research, Chinese emergency patients exceeded 166.5 million in 2017 (16). EDs still face the problem of insufficient numbers of physicians and heavy workloads (17). The above reasons may make Chinese ED physicians more prone to ERI. Thus, this large cross-sectional study was conducted among ED physicians in China, aiming to understand the prevalence of ERI and explore its associated factors in Chinese ED physicians, which would provide an empirical basis for the improvement of ERI among ED physicians.

METHODS

Ethics Statement

This study was designated as exempt human research by the Research Ethics Committee in Hainan Medical University (HYLL-2018-035). Each physician was voluntary, and all the data would keep confidential.

Study Design

This was a part of a national, cross-sectional study on emergency medical resources in China. We conducted this online survey from July to August 2018 in coordination with the Medical Administration Bureau of the National Health Commission of the People's Republic of China. The questionnaire link was distributed to the ED physician work platform of the pre-hospital emergency facility configuration monitoring department, inviting ED physicians to participate in the survey. The questionnaire link was posted to the work platform every seven days to alert ED physicians to participate in the survey until the investigation was complete. Participants took part in the survey through access to the link, but all participants were required to read and agree to the electronic informed consent statement before answering. The data were administered by an online survey platform in China (platform name: Questionnaire Star, website: https://www.wjx.cn).

In this study, we included physicians who worked in ED and volunteered to participate in the survey and excluded those interns who had not yet obtained a practicing certificate. In all, 15,288 physicians clicked the questionnaire link, and 10,457 physicians completed the questionnaire. The response rate was 68.4%.

Measurements

Data were collected using a standard structured questionnaire developed based on literature review and pre-tested in a pilot study of 30 ED physicians to ensure that the questions were clear and understandable (5, 6, 8, 9). The questionnaire consisted of three parts in this study: sociodemographic characteristics, work-related factors, and ERI.

The sociodemographic characteristics covered sex, age, marital status, and educational level. Work-related factors included professional title, monthly income, years of service, frequency of night shift, perceived shortage of physicians, frequency of suffering from workplace verbal and physical violence in the past year. Among these factors, educational level was categorized as "associate degree or vocational diploma," "bachelor degree," "master degree or above," In China, an associate degree or vocational diploma indicates 12–15 years of education. A bachelor's degree indicates 17 years of education. A master's degree or above refers to 20 years and above of education. The perceived shortage of physicians was examined by one question: "Do you think the current number of physicians in ED can meet the needs of daily work?" ("Not meet demands," "General," "Meet demands").

In the third part of the questionnaire, ERI was assessed by the Chinese version of the ERI scale (18, 19), which originated from Siegrist in 1996 (5). The Chinese version of the ERI questionnaire has good reliability and validity in Chinese medical staff, and the Cronbach's alpha of the effort and reward subscales is 0.78 and 0.81, respectively (19). We used two subscales of the ERI to evaluate the balance between job effort and job reward. Job effort included six items (time pressure, interrupting work, responsibility, extra work, physical labor, and increased workload), with a total range from 6 to 30. Every item was scored on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Job reward contained 11 items, including three dimensions of esteem, job promotion, and job security. In this subscale, every item was rated on a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree), and the total score was between 11 to 55. Based on the above, the effort-reward

Abbreviations: ED, emergency department; ERI, effort-reward imbalance; ERR, effort-reward ratio; OR, odds ratios; 95% CI, 95% confidence intervals.

ratio (ERR) was calculated according to the formula: ERR = (11*effort)/(6*reward) (20). When the value of ERR is beyond 1.0, it indicates that ED physicians experienced the ERI (20). In this study, job effort had a Cronbach's alpha value of 0.86, and job reward had a Cronbach's alpha value of 0.93.

Statistical Analysis

All data were analyzed using the Statistical Analysis System (SAS) version 9.4 for Windows (SAS Institute Inc., Cary, NC, USA). Firstly, Chi-square tests were conducted to describe sociodemographic characteristics and work-related factors in different effort-reward status groups. All the categorical variables were reported using frequencies and percentages. As appropriate, continuous variables were compared using the Student's *t*-test or Mann-Whitney *U* test. The continuous variables were reported using mean (standard deviation) or median (25th−75th percentiles). Then, a stepwise logistic regression was conducted to assess the association between variables and the two groups of effort-reward status. The results were reported by adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) for each variable. We used Spearman's Rho correlations to examine multicollinearity between independent variables. Spearman's Rho correlations were <0.7, indicating that no multicollinearity was detected (**Supplementary Table 1**). The statistical significance was at a *P*-value of < 0.05.

RESULTS

Characteristics of the Participants

The general characteristics of ED physicians are presented in **Table 1**. Among 10,457 ED physicians, the median age was 31, 72.98% were male, 27.02% were female. Of the participants, most had a bachelor's degree, accounting for 74.49%. The marital status of ED physicians was mainly married, accounting for 84.42%. Only 13.13% of ED physicians had senior titles. About half of them had more than five years of service, and 53.87% had 6–10 times night shifts per month. More than two-thirds of ED physicians (73.32%) perceived that the number of physicians was inadequate in ED. About workplace violence, 81.81% of ED physicians suffered verbal violence, and 27.63% suffered physical violence in the past year.

The Prevalence of ERI and Its Related Factors

Of the respondents, 8,197 (78.39%) experienced ERI. The relationships between demographic characteristics or work-related factors and ERI are shown in **Table 1**. There were statistically significant differences in the prevalence of ERI among all the groups of demographic characteristics and work-related factors ($P < 0.05$). To present the data more comprehensively, we also conducted the univariate analysis of the effort-reward ratio values, which was shown in **Supplementary Table 2**.

The independent factors associated with ERI are shown in **Table 2**. The ERI was significantly associated with being male ($OR = 1.45$, 95%CI: 1.30–1.62). ED physicians with bachelor's degrees were more likely to experience ERI than those with associate degrees or vocational diplomas ($OR = 1.20$, 95%CI: 1.05–1.38). In contrast, ED physicians with intermediate titles had higher risks of ERI than those with junior or lower titles ($OR = 1.45$, 95%CI: 1.28–1.64). In the aspect of monthly income, ED physicians with a monthly income of 6001 yuan or more would be less likely to experience ERI ($OR = 0.68$, 95%CI: 0.60–0.78). On the contrary, ED physicians who had long years of service ($OR = 1.57$, 95%CI: 1.30–1.90), more than 11 times night shifts every month ($OR = 1.41$, 95%CI: 1.21–1.65), had higher risks of exhibiting ERI. Compared to ED physicians with a perceived staff shortage, when the staffs were adequate, the risk of ERI in ED physicians markedly decreased ($OR = 0.28$, 95%CI: 0.24–0.33). In addition, in terms of workplace violence, whether verbal violence ($OR = 3.61$, 95%CI: 3.11–4.21) or physical violence ($OR = 1.57$, 95%CI: 1.35–1.82) could significantly increase the risk of ERI among ED physicians.

DISCUSSION

This study described the current situation of ERI and explored its associations with demographic characteristics and work-related factors among ED physicians in China. Our study found that 78.39% of Chinese ED physicians experienced ERI. The proportion was higher than the prevalence of 21.9%–64.9% in general physicians (6–8, 21), which reflected that ED physicians bore a higher level of work stress than general physicians. However, due to the lack of international investigation of ERI among ED physicians, it was hard to make comparisons among different countries. A multinational study on the prevalence of ERI among ED physicians needs to be carried out to understand its occurrence and severity worldwide.

Previous studies have shown that gender differences existed in the prevalence of ERI among medical workers, but the conclusions have not been unified (22). In our study, male ED physicians had a higher prevalence of ERI than females. A survey of Chinese medical workers in the in-patient wards also found that ERR in male medical workers was higher (19). However, studies among physicians in Greece (23) and Sweden (24) pointed out no gender difference in ERR, inconsistent with our result. The difference may be related to different social backgrounds and cultures in various countries. In China, traditional gender role attitudes and motivations expose males more often to work stress of success and react by high effort, which increases the risk of ERI among male ED physicians (19).

In addition, we found that ED physicians with bachelor's degrees were more likely to experience ERI, which might be determined by the context of the medical professions. The medical industry had high demands for knowledge and ability, and the competition was also intense (25). In our study, ED physicians with bachelor's degrees were in the middle level. Compared to ED physicians with low educational levels, ED physicians with bachelor's degrees had to do more work to achieve their own higher job expectations. Still, their rewards were more limited than ED physicians with high educational levels (26). This study also found that ED physicians with intermediate titles were more prone to ERI. Yan et al. obtained similar results that ED physicians with intermediate titles

TABLE 1 | Comparisons of characteristics in different effort-reward status groups among physicians in the emergency department.

	Total *N (%)*	**Effort-reward balance** *N (%)*	**Effort-reward imbalance** *N (%)*	χ^2	*P*
Total	10,457 (100)	2,260 (21.61)	8,197 (78.39)		
Sociodemographic characteristics					
Age[&]	31 (28–35)	34 (29–40)	36 (31–42)	$Z = -9.20$	<0.001**
Sex				146.81	<0.001**
Male	7,632 (72.98)	1,423 (62.96)	6,209 (75.75)		
Female	2,825 (27.02)	837 (37.04)	1,988 (24.25)		
Educational level				47.54	<0.001**
Associate degree or vocational diploma[#]	1,684 (16.10)	447 (19.78)	1,237 (15.09)		
Bachelor degree	7,789 (74.49)	1,557 (68.89)	6,232 (76.03)		
Master degree or above	984 (9.41)	256 (11.33)	728 (8.88)		
Marital status				50.00	<0.001**
Unmarried/other	1,629 (15.58)	1,800 (79.65)	7,028 (85.74)		
Married	8,828 (84.42)	460 (20.35)	1,169 (14.26)		
Work-related factors					
Title				126.92	<0.001**
Junior or less	4,972 (47.55)	1,307 (57.83)	3,665 (44.71)		
Intermediate	4,112 (39.32)	686 (30.35)	3,426 (41.80)		
Senior	1,373 (13.13)	267 (2260)	1,106 (13.49)		
Monthly income (YUAN)				8.72	0.013*
≤4,000	3,862 (36.93)	850 (37.61)	3,012 (36.75)		
4,001∼6,000	3,562 (34.06)	714 (31.59)	2,848 (34.74)		
≥6,001	3,033 (29.00)	696 (30.80)	2,337 (28.51)		
Years of service				213.29	<0.001**
<1	1,448 (13.85)	484 (21.42)	964 (11.76)		
1–5	3,965 (37.92)	949 (41.99)	3,016 (36.79)		
6–10	2,458 (23.51)	412 (18.23)	2,046 (24.96)		
≥11	2,586 (24.73)	415 (18.36)	2,171 (26.49)		
Frequency of night shift (per month)				178.39	<0.001**
0∼5	2,033 (19.44)	641 (28.36)	1,392 (16.98)		
6∼10	5,633 (53.87)	1,183 (52.35)	4,450 (54.29)		
≥11	2,791 (26.69)	436 (19.29)	2,355 (28.73)		
Perceived shortage of physicians				852.27	<0.001**
Not meet demands	7,667 (73.32)	1,132 (50.09)	6,535 (79.72)		
General	1,856 (17.75)	673 (29.78)	1,183 (14.43)		
Meet demands	934 (8.93)	455 (20.13)	479 (5.84)		
Workplace verbal violence (times)				892.34	<0.001**
0	1,902 (18.19)	835 (36.95)	1,067 (13.02)		
1∼3	4,130 (39.50)	964 (42.65)	3,166 (38.62)		
≥4	4,425 (42.32)	461 (20.40)	3,964 (48.36)		
Workplace physical violence				310.01	<0.001**
Yes	2,889 (27.63)	293 (12.96)	2,596 (31.67)		
No	7,568 (72.37)	1,967 (87.04)	5,601 (68.33)		

**P-value < 0.05, **P-value < 0.001.*

[&] Considering the non-normal distribution of age, it was compared by Mann-Whitney U test and reported using median (25th−75th percentiles).

[#] An associate degree refers to students graduating from senior middle school (grade year 10 to year 12) receiving 3 years of education in college, or students graduating from junior middle school (grade year 7 to year 9) receiving 5 years of education in college.

A vocational diploma refers to students graduating from senior middle school receiving 2 years of education in vocational schools or students graduating from junior middle school receiving 3 years of education in vocational schools.

were more likely to suffer from burnout (27). In Chinese hospitals, physicians with intermediate titles are the backbone of medical services. They not only have to engage in busy clinical diagnosis and treatment work but also undertake heavy teaching and scientific research tasks (28, 29). Moreover, the proportion of physicians with intermediate titles is higher than

TABLE 2 | Binary logistic regression examining factors associated with ERI.

	OR (95%CI)	*P*
Sex		
Female	1.00 (reference)	
Male	1.45 (1.30–1.62)	<0.001**
Educational level		
Associate degree or vocational diploma#	1.00 (reference)	
Bachelor degree	1.20 (1.05–1.38)	0.010*
Master degree or above	1.15 (0.93–1.41)	0.189
Title		
Junior or less	1.00 (reference)	
Intermediate	1.45 (1.28–1.64)	<0.001**
Senior	1.20 (0.99–1.45)	0.063
Monthly income (YUAN)		
≤4000	1.00 (reference)	
4,001∼6,000	0.91 (0.80–1.03)	0.122
≥6,001	0.68 (0.60–0.78)	<0.001**
Years of service		
<1	1.00 (reference)	
1–5	1.11 (0.96–1.29)	0.155
6–10	1.42 (1.19–1.69)	<0.001**
≥11	1.57 (1.30–1.90)	<0.001**
Frequency of night shift (per month)		
0∼5	1.00 (reference)	
6∼10	1.11 (0.98–1.27)	0.100
≥11	1.41 (1.21–1.65)	<0.001**
Perceived shortage of physicians		
Not meet demands	1.00 (reference)	
General	0.40 (0.36–0.45)	<0.001**
Meet demands	0.28 (0.24–0.33)	<0.001**
Workplace verbal violence (times)		
0	1.00 (reference)	
1∼3	1.93 (1.70–2.19)	<0.001**
≥4	3.61 (3.11–4.21)	<0.001**
Workplace physical violence		
Yes	1.57 (1.35–1.82)	<0.001**
No	1.00 (reference)	

**P-value < 0.05, **P-value < 0.001.*

#An associate degree refers to students graduating from senior middle school (grade year 10 to year 12) receiving 3 years of education in college, or students graduating from junior middle school (grade year 7 to year 9) receiving 5 years of education in college.
A vocational diploma refers to students graduating from senior middle school receiving 2 years of education in vocational schools or students graduating from junior middle school receiving 3 years of education in vocational schools.

that with senior titles, and the number of physicians with intermediate titles is relatively large (30). Therefore, physicians with intermediate titles must work harder to get promoted (30). These intertwined pressures make them more prone to ERI. This suggested that hospital administrators should pay more attention to ED physicians with bachelor's degrees or intermediate titles, take measures such as reducing workload, and providing opportunities for further training to improve the situation of ERI.

Work-related factors were also considered as the important associated factors of ERI. According to our study, ED physicians with long years of service had a higher risk of ERI. One possible explanation may be that ED physicians of seniority have endured long work hours and frequent call duty, which could result in greater emotional exhaustion and fatigue, thereby leading to a higher sense of job efforts (31). Higher frequencies of night shifts could also increase the risk of ERI. Previous studies on the night shift confirmed that in addition to increasing work stress of ED physicians, frequent night shift could also lead to sleep disorders and have hazards on their physical and mental health, which was unfavorable to the balance of effort and reward for ED physicians (32, 33). Besides, our study also illustrated that perceived adequate staffs and monthly income of 6001 yuan or more were protective factors for ERI of ED physicians. Sufficient staff in ED could reduce the workload of ED physicians (34). Higher monthly income could allow ED physicians to perceive more rewards. Both above two factors helped reduce the risk of ERI for ED physicians. In consequence, hospital administrators should focus on ED physicians with long years of service, schedule night shift scientifically, replenish ED physicians timely, and establish a proper salary system to reduce the level of ERI in ED physicians.

Workplace violence was also a risk factor for ERI in ED physicians. ED was at a high risk of workplace violence (35). Both 81.81% incidence of verbal violence in this study and 78.1% incidence of workplace violence in another study among Turkish ED physicians confirmed the high incidence of workplace violence in ED (36). A previous study has also found that verbal violence or physical violence significantly increased the risk of ERI among ED physicians (37). This suggests that hospital administrators should strengthen hospital security work to reduce the frequency of workplace violence. At the same time, timely psychological counseling should be conducted for ED physicians who encounter workplace violence to reduce the adverse impact of workplace violence on the ERI of ED physicians.

Strengths and Limitations

To our knowledge, this is the first national cross-sectional study on ERI among ED physicians in China. But the study also has some limitations. Firstly, the cross-sectional design of this study could not provide definitive causal conclusions, and further prospective studies are needed. Secondly, the participants in this study were only ED physicians, who were not representative of all physicians in China; therefore, the results of our study should be generalized with caution. Finally, more related factors of ERI among ED physicians, such as family-related factors, need to be explored.

CONCLUSION

ERI was highly prevalent among ED physicians in China, especially males, who had bachelor's degrees, intermediate titles, and long years of service. While paying attention to these focus groups, hospital administrators should reduce the efforts of ED physicians by increasing the number

of ED physicians, optimizing night shift schedules, and tightening security. At the same time, ED physicians should be strongly supported in skills training, salary, and promotion, to reduce the imbalance between effort and reward for ED physicians.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Research Ethics Committee in Hainan Medical University, Haikou, China (HYLL-2018-035). All participants provided informed consent. Moreover, each physician was voluntary, and all the data would keep confidential.

AUTHOR CONTRIBUTIONS

MT, CL, and YG designed this study. CL and XY collected the data. XZ, NJ, YW, and JZ completed data analysis. CL, XZ, and YG supervised all the processes in this study. MT and XZ drafted the main manuscript text. All authors reviewed and approved the manuscript.

FUNDING

This study was supported by the Department of Science and Technology of Hainan Province, Major Science and Technology Projects under Grant number ZDKJ202004 and the Department of Science and Technology of Hainan Province, and Key Research and Development Program under Grant number ZDYF2020112. The funder had no role in the study design or implementation, data collection, management, analysis, interpretation, manuscript preparation, review, or approval, or the decision to submit the manuscript for publication.

ACKNOWLEDGMENTS

We thank all the participants who give their time to this survey.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.793619/full#supplementary-material

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frontiers in Public Health

STUDY PROTOCOL
published: 11 February 2022
doi: 10.3389/fpubh.2022.807792

Applied Mindfulness for Physician Wellbeing: A Prospective Qualitative Study Protocol

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Background: Physician burnout has significant adverse impacts on the wellbeing of individual physicians, and by extension the healthcare delivery systems of which they are part. Mindfulness is consistently cited as a pragmatic approach to effectively address burnout and enhance physician wellbeing. However, very few empirical studies have been published on Mindfulness Based Interventions (MBIs) for physicians. Moreover, the majority of these studies have been quantitative, leaving a gap in understanding the practical application of mindfulness in the context of physicians' daily lives.

Objectives: This paper outlines the rationale, development and design of a novel prospective qualitative study examining the acceptability, feasibility, and pragmatic application of a mindfulness intervention for physician wellness.

Methods: The study will be conducted in three groups of at least 8 practicing physicians from a broad range of medical specialties at a tertiary care hospital in a large urban center in Eastern Canada. The intervention will consist of an innovative program based on the teachings of internationally renowned scholar and Zen Master Thích Nhất Hạnh. It will include 5 weekly 2-h mindfulness sessions delivered by two health providers trained in mindfulness and in the teachings of Thich Nhat Hanh. The primary outcome measure will be an in-depth Thematic Analysis of post-program semi-structured interviews. Field data will also be collected through participant observation. The study will be theoretically grounded within the interpretive paradigm utilizing "the Mechanisms of Mindfulness Theory". An external advisory committee formed by four senior members of Thích Nhất Hạnh's community will provide guidance across all phases of the study.

Discussion: Our innovative approach provides a new framework to further understand the mechanisms by which mindfulness interventions can impact physician wellbeing, and by extension their patients, colleagues, and broader healthcare systems. Through a clear articulation of the rigorous application of accepted procedures and standards used in our protocol, this paper seeks to provide a roadmap for other researchers who wish to develop further studies in this area. Lessons learned in the preparation and conduction of this study can be applied to other healthcare contexts including non-physician health provider wellbeing, clinical care, and population-level mental health.

Keywords: mindfulness, wellbeing, burnout, physicians, qualitative, protocol, intervention, applied

OPEN ACCESS

Edited by:
Giorgio Di Lorenzo, University of Rome Tor Vergata, Italy

Reviewed by:
Eron Grant Manusov, The University of Texas Rio Grande Valley, United States
Esther Chow, City University of Hong Kong, Hong Kong SAR, China

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

Received: *02 November 2021*
Accepted: *20 January 2022*
Published: *11 February 2022*

Citation:
Weisbaum E and Chadi N (2022) Applied Mindfulness for Physician Wellbeing: A Prospective Qualitative Study Protocol. Front. Public Health 10:807792. doi: 10.3389/fpubh.2022.807792

INTRODUCTION

Physician wellness can positively impact the quality of patient care, frequency of medical errors, patient satisfaction and clinician professionalism (1–7). Calls have been made across the literature, and from international medical associations, for further research to be conducted on pragmatic approaches to effectively address physician burnout and enhance physician wellbeing (1, 4, 8–11). Prevalence of physician burnout is characterized as nearing or exceeding 50% of training and practicing physicians (4, 10, 12). Risk factors related to physician burnout are difficult to address, as they are situated at a complex intersection of the occupational environment, individual behaviors and the broader culture of medicine (3).

Physician burnout can lead to absenteeism, tardiness, reduced job commitment and increased physician turnover (5, 13, 14). The costs associated with replacing a single physician have been estimated at two to three times a physician's annual salary (15). Conversely, moderate investments spent on wellness programs have can directly reduce costs associated with medical leave and absenteeism (16, 17). Across the literature, it is recognized that the burden of addressing burnout should be a shared endeavor between individual physicians and the wider healthcare system. Therefore, an integrative and collaborative effort that brings together multiple modalities—including interventions, trainings, research and resources—to create internal and external change at the individual and systemic levels is necessary to address this global epidemic within healthcare (8, 15, 16, 18).

Mindfulness-based interventions are consistently recommended across the literature as a promising approach for addressing physician burnout and enhancing physician wellbeing (15, 18). Mindfulness is described by acclaimed scholar and Zen master Thích Nhất Hạnh as the observational awareness of what is happening inside and around oneself in the present moment (e.g., awareness of relevant stimuli's impacts on one's internal/external states) (19, 20). Mindfulness can be experienced alone or with others, through both formal and integrated practice (21). Therefore, mindfulness lends itself well to a multi-session group intervention format during which participants can develop foundational mindfulness skills, which they can further enhance with individual practice between sessions.

Very few studies have been conducted that bring together mindfulness and physician wellbeing. In the broader literature, mindfulness has been shown to have a wide range of potential health benefits, including: reduced anxiety and stress, increased wellbeing, self-regulation, emotional-regulation, motor skills and empathy, along with greater connectivity between brain regions associated with prosocial behaviors (21–30). The small number of initial empirical studies that have been conducted with physicians show a promising potential for mindfulness to positively benefit physician wellbeing, decrease emotional exhaustion and perceived stress, increase compassion/empathy and enhance patient-centered care (31–38). These studies have shown that MBIs have the potential to impact physicians across burnout as measured by the Maslach Burnout Inventory (e.g., emotional exhaustion, depersonalization, and personal accomplishment) (33, 34, 36–39). Not all studies report statistically significant improvements. For example, a study which applied a Mindfulness-Based Stress Reduction intervention with medical, surgical and primary care residents at Radboud University in the Netherlands Verweij et al. (40) found no significant difference in emotional exhaustion between the active and control groups. However, significantly greater improvements were reported by the intervention group than the control group in relation to personal accomplishment, self-compassion and perspective taking (40). The majority of these preliminary studies with physicians have been quantitative, leaving a gap in the understanding of the lived experience and practical application of mindfulness by physicians in the context of their daily lives.

This study will apply a qualitative research framework to support the study's central aim to understand the acceptability, feasibility, and pragmatic application of mindfulness in the context of physicians' daily lives. Qualitative methods are particularly well-suited for studying and understanding human behavior in the context of the social world (41, 42). A distinguishing feature of qualitative research is its use of a research question, rather than hypotheses (42, 43). This is particularly relevant to our study, as human behavior and interactions are often more complex than what can be preemptively or objectively defined or controlled (44).

METHODS AND ANALYSIS

Study Design

This is a prospective qualitative study of physician wellbeing that will be conducted during and following the completion of a 5-week Applied Mindfulness training program. Through the rigorous application of high-academic research standards for qualitative healthcare research, this study aims to contribute new knowledge to prevent physician burnout by bringing together the following three pillars: (1) Physician wellbeing; (2) mindfulness; and (3) qualitative research.

Research Question

The research question for this study, along with two guiding sub questions to help orient the process of analysis, are as follows:

Research Question: How do physicians experience, make sense of, and engage with a 5 week Applied Mindfulness program and what is the impact of the program on their personal wellbeing in the context of their daily lives?

Guiding sub-questions/further areas of inquiry: How, where and in what context(s), do participants apply mindfulness? How does mindfulness impact participants' perceived *relationship* to themselves, colleagues, patients and the context in which they work?

Population

Inclusion and Exclusion Criteria

The study will recruit physicians in active medical practice within the Greater Toronto Area (GTA), Canada. Medical students and other health care personnel (HCPs) will be excluded. Studies on MBIs conducted with physicians, medical students and HCPs show that, while there are some similarities across their

experiences, there are also several areas of significant differences (e.g., how mindfulness impacts studying for exams, and different sets of power dynamics) (45–49). Therefore, based on this study's research question the sample will be limited to physicians, fellows and residents all of whom will have completed undergraduate medical training at the time of enrollment (see **Table 1** for inclusion/exclusion criteria).

Sampling

The minimum sample size for this study (three groups of eight participants) is based on the theory of information power, which establishes that sample size for a qualitative study can be based on the amount of information a sample holds in relation to the aims of the study, rather than being based on a formula or perceived redundancy (50). According to Malterud et al. (50), five factors have an impact on information power. These include: (1) study aim; (2) sample specificity; (3) use of established theory; (4) quality of dialogue; and (5) analysis strategy. The greater the information power of a single sample, the smaller the sample size needs to be. Based on the inclusion/exclusion criteria (outlined above) and purposive sampling approach (described below) the samples in this study are considered to have high information power. This is due to the focused and narrow aim, participants that share the highly specific characteristic of being active physicians, the use of established qualitative theory and precise approach to the dialogue between researcher and participant (50).

Purposive Sampling Approach

A purposive sampling approach will be applied to enhance the sample specificity and information power. Purposive sampling allows the researcher to increase the sample specificity by selecting participants who hold specific characteristics (e.g., experience and knowledge) that are particularly relevant to the study aims, as guided by the research question (50). Participants in this study will be purposefully selected for the characteristics of (1) longer years in medical practice (providing greater knowledge of the lived experience of being a physician); and (2) fewer years of mindfulness practice (bringing a more novice perspective of mindfulness experience). In order to apply this purposive sampling approach, a question regarding number of years in medical practice and experience with mindfulness will be included in the initial online recruitment and registration survey. Participants will be accepted into the study with priority given to those who report longer years practicing medicine and fewer years of experience with mindfulness. Our sample will be drawn from physicians who practice in the Greater Toronto Area (GTA) which represents one of the most diverse workforces in Canada.

TABLE 1 | Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
• Able to independently consent to study • Physician, fellow or resident practicing medicine within the GTA • Self-reported good standing with the College of Physicians and Surgeons of Ontario or College of Family Physicians of Canada • Fluent in English • Able to attend five 2-h sessions, either at midday or evening, over 5 consecutive weeks • Persons of all faiths and genders	• Planning to participate in another mindfulness training program during the delivery of the AMP-MP • Unable to adhere to study procedures

PROCEDURE

Recruitment and Enrollment

Participants will be recruited through a combination of electronic email, poster and in-person announcements. Electronic mail-outs will be sent through hospital leadership and university channels. Responses will be screened for inclusion/exclusion criteria and the purposive sampling approach will be applied to prioritize the order of enrolment.

Mindfulness Intervention Content

The intervention is called the Applied Mindfulness Program (AMP) for physicians. The mindfulness content to be delivered within this study represents an underexplored area within the field of MBIs. It is based on the teachings of internationally renowned scholar, Zen Master and Noble Peace Prize Nominee Thích Nhất Hạnh (see **Table 2** for overview of the program's weekly themes and content). While his work is internationally recognized as seminal, to date no MBIs have been based explicitly on his teachings. Thích Nhất Hạnh's work was selected as the basis for this research study's mindfulness program because of several key characteristics. These include his work's focus on: (1) the *pragmatic application* of mindfulness into daily life to underpin the cultivation of personal wellbeing; and (2) impacting both individual and systemic change. This study's lead investigator's (EW) long-term background and training with Thích Nhất Hạnh's community provides rich and novel access to this body of knowledge.

To inform the rigorous and authentic use of Thích Nhất Hạnh's work, an iterative reciprocal relationship was established at the outset of this research study with his international Plum Village community. This was done through the establishment of an advisory committee made up of four senior monastic teachers in the tradition of Thích Nhất Hạnh and Plum Village. This committee will provide guidance and feedback across all phases of the study. This approach was informed by precedents from Ingenious Research Methods (51), along with calls in the literature to enhance the quality and standards of MBIs by collaborating with the traditional wisdom communities upon which their content draws (52, 53).

Mindfulness Intervention Delivery and Study Flow

Program sessions will be scheduled to take place on a weekly basis on the same time and day for each group for five consecutive weeks (2 h per session) and will have a minimum of 8 and a maximum of 23 participants in each group. Each program session consists of a mixture of didactic lectures,

TABLE 2 | AMP-MP weekly themes and content.

Session	Theme	Content
1	Orientation and foundations for practice	Admin (including consent forms) *Opening practice* Lecture: intro to mindfulness/foundations of practice (including Four Noble Truths) *Mindful eating* Practice: attention to bell/breath *Discussion* Take home activity: Awareness of breath
2	Identifying and transforming habits	*Opening practice* *Take Home Activity check-in: discuss application between sessions* Lecture: Habit energies *Mindful eating* Practice: Mindful walking activity *Discussion* Take home activity: Mindful walking
3	Nourishing our mind	*Opening practice* *Take Home Activity check-in: discuss application between sessions* Lecture: The four nutriments and store consciousness *Mindful eating* Practice: Body awareness practice *Discussion* Take home activity: Mindful eating
4	Skillful communication	*Opening practice* *Take Home Activity check-in: discuss application between sessions* Lecture: Interbeing (interconnection), Empathy fatigue vs. compassion *Mindful eating* Practice: Loving kindness/Kind intention *Discussion* Take home activity: Application in daily life project/worksheet
5	Integration and application	*Opening practice* *Take Home Activity check-in: discuss application between sessions* Lecture: Wellbeing/happiness as products of practice (Eightfold Path + Program review) *Mindful eating* Practice: tea/coffee meditation/closing ceremony (presentations of take-home application projects from Session 4) *Discussion* Closing circle/intention setting

TABLE 3 | Overview of program structure.

Program length	1 session per week over 5 weeks
Session length	2 h (30 min added to the first session for study administration)
Booster session	1 × 2 h (3 months after program)
Focus group	1 × 1.5 h focus group (16 months after program)
In-session content/delivery	Mixture of learning styles, including didactic lectures, group discussion/sharing, hands-on practices
Additional content/delivery	Take home activities, journaling prompts and audio recordings of the in-session didactic lectures

hands-on experiential Applied Mindfulness practices and group discussions. An overview of program structure can be found in **Table 3** and a visual representation of the study flow can be found in **Figure 1**. Further details on the program design and content will be discussed in detail in a forthcoming paper.

Although the mindfulness intervention was designed to be delivered in-person, it can be adapted to a fully online setting using video-conferencing technology, should public health measures (e.g., related to COVID-19) prevent the delivery of an in-person intervention. Both authors have extensive experience delivering and studying mindfulness interventions delivered online (54–56). Emerging literature also suggests that online delivery of mindfulness-based interventions for medical professionals and trainees represents a promising mode of delivery which would benefit from further study (57, 58).

The mindfulness intervention will be delivered to three distinct groups (**Table 4**). The reason for having three groups is to account for physicians' complex schedules. At the time of recruitment, participants will be invited to self-select into the group that is most compatible with their schedule through the secure online REDCap platform. This will allow all participants to receive the mindfulness training by the end of the study period.

Program Facilitators

The mindfulness training program will be led by two facilitators who are not part of the primary research team and have professional training in mindfulness, along with a committed

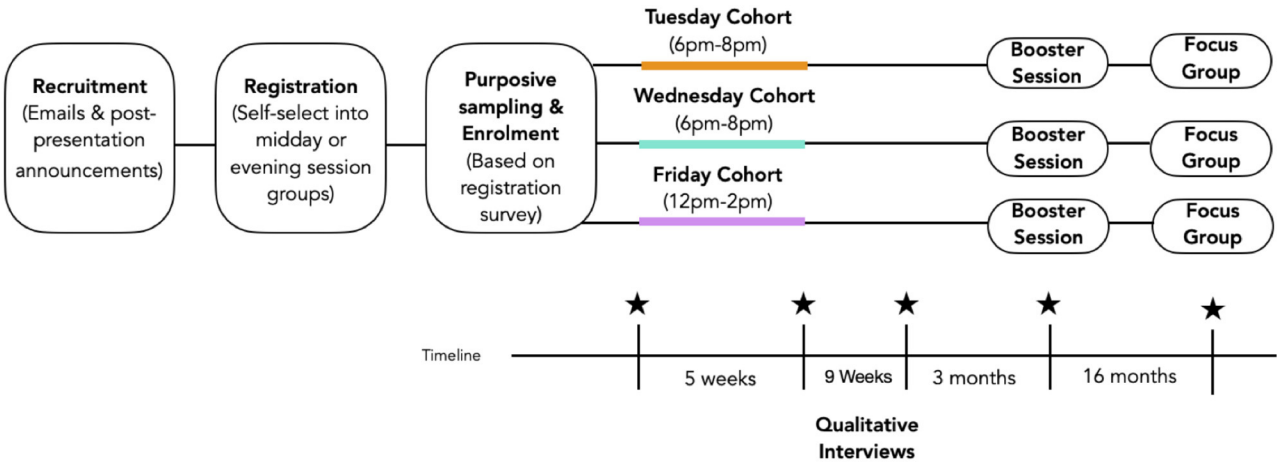


FIGURE 1 | Visual representation of study flow.

TABLE 4 | Study groups.

Day of the week	Time of day
Tuesday	6:00 p.m.–8:00 p.m.
Wednesday	6:00 p.m.–8:00 p.m.
Friday	12:00 p.m.–2:00 p.m.

personal practice rooted in the tradition of Thích Nhất Hạnh and Plum Village. The facilitators will use a program manual as a guide for each session's structure and content. The same facilitators will facilitate all of the program sessions and a manual checklist will be used by a participant observer to track the content presented across the different sessions.

Ethics and Participant Safety

A mindfulness-based program is not generally seen as entailing any significant risks to the physical and psychological safety of participants (59). Some participants might experience temporary discomfort or unpleasant physical, emotional, or mental experiences while exploring the topic of wellbeing either during mindfulness sessions, or during qualitative follow-up interviews. Participants will be informed that they may withdraw from the study or follow-up interviews at any time. Institutional ethics approval has been obtained from The Hospital for Sick Children (HSC) and the University of Toronto. All participants in this study will be required to provide written informed consent. The consent form will include a statement that participation is voluntary and that participants can withdraw from the study at any time. Participants will be sent a copy of the consent form and a one-page coping agreement *via* email prior to the start of the first session so they can review it. At the start of the first program session, 30 min will be set aside for study administration (including answering any additional questions the participants have), reviewing and signing the consent form, filling out the one-page coping agreement and filling in a social demographic survey. Confidentiality and data management have been addressed to fulfill the requirements of the research ethics boards that reviewed this study.

OUTCOME MEASURES

Primary Outcome Measure: Semi-structured Post-intervention Interviews

The primary data for this study will be generated through qualitative semi-structured post-program interviews. All participants will be invited to participate in a post-program interview. The interviews will be conducted with participants within 4 weeks of the final session of the 5-week AMP-MP program. Semi-structured interviews have been chosen as they allow for a clear sequence of themes and questions, while also accounting for the necessity to adapt the order and wording of questions throughout the interview process based on participants' specific responses (60). Interviews will be conducted either in-person, or over a secured video conferencing platform. All interviews will be audio recorded and transcribed.

Development and Iteration of Interview Guide

The study's interview guide was developed with the aim to generate richly detailed data that will get at the "essence or inner core" of participants' experience. High-quality interview guides keep in mind both the bigger picture/arc of the interview (e.g., the overarching sequence of questions) along with the more granular elements (e.g., individual probes) (61). Therefore, the development of this study's interview guide aims to foster (1) a natural conversational flow across the interview and (2) simultaneously delve deeply into specific components of each participants' unique experience.

Secondary Outcome Measure: Participant Observation

Participant observation will be conducted to better understand the lived experience of participants within the context of the

program, rather than only from participants' post-program interviews (62). Detailed field notes will be generated by the participant observer (EW), who will be present during all program sessions for the three study groups. The participant observation field notes will be used to develop documents summarizing the characteristics of each group to further inform data analysis and interpretation.

REFLEXIVITY AND POSITIONALITY

Reflexivity is central to the work of qualitative research. The researcher's position is influenced and shaped by a multiplicity of factors that include the institutional, cultural, historical and interactional contexts (63–66). In the case of this particular study, the lead researcher's long-standing experience as a mindfulness practitioner provides a unique perspective through which to generate and interpret the data. While this lens provides knowledge useful to deploy in relation to the aims of the study, it also has embedded within it assumptions that could impact data analysis (64, 67, 68). Therefore, analytic strategies (e.g., reading for contradictions and reflexivity as an analytic tool) will be applied during analysis and interpretation (69–71).

RESEARCH QUALITY: APPROACHES TO DEVELOPING HIGH-QUALITY RIGOROUS QUALITATIVE RESEARCH

This section discusses the specific processes and strategies that will be applied across the study to develop rigor. Qualitative methodologists have argued the need for qualitative studies to have their own approaches to rigor, as there is a concern that a proceduralist orientation to rigor can over-simplify the complex dynamic nature of qualitative inquiry (72, 73). Therefore, this study has identified and will implement the following approaches and strategies to developing rigor in congruence with the ontology and epistemology of the paradigm being used to guide this study, which is the interpretive paradigm.

Theoretical Perspectives

The application of theory throughout the research process is central to the development of rigor and congruence across a qualitative study. The interpretative paradigm will be mobilized across all phases of this research study. The interpretive paradigm is well suited to this study's research aims as it seeks to *understand* human behavior, rather than *explain* it (42). The Mechanisms of Mindfulness Theory (MMT) (74) was selected as the middle range theory for this research study. A middle range theory acts as a link between a more macro (abstract) theoretical perspective and a more granular perspective about the behavior of individuals in everyday settings (42, 66). MMT expands upon established theories of attention with additional theory that illuminate skillsets particular to the phenomenon of mindfulness. MMT has three main components that aim to describe the underlying mechanisms that are activated through the development of mindfulness. These mechanisms are seen to undergird the benefits described in the literature (e.g., reduced anxiety/stress and increased empathy/wellbeing). The three components include: (1) The IAA model made up of three axioms (Intention, Attention, and Attitude); (2) An overarching (meta) mechanism of Reperceiving (significant shift in perspective); and (3) Four additional mechanisms: (1) Self-Regulation and Self-Management; (2) Values Clarification; (3) Cognitive, Emotional; and (4) Behavioral Flexibility; Exposure (74). These three components are described in more detail within in the **Supplementary Materials** labeled "Mechanisms of Mindfulness Theory Summary".

Approach to Transcription

Three key strategies will be used to produce transcripts that reflect the original nature of the verbal accounts and minimize potential transcription errors. These included: (1) Providing detailed transcription guidelines to the transcriptionist (see **Supplementary Materials**); (2) Reviewing the first transcription against the audio recording and providing further guidelines prior to the rest of transcription; and (3) Reviewing the transcriptions against the original audio recordings before proceeding with textual analysis.

Member Reflections

Member reflection will be applied as part of the data analysis and write up process to enhance the quality of this study through the process of seeking questions, critiques, feedback and affirmation from participants (71). *Member reflection* will be collected by the participant observer during focus group sessions which will be conducted 16-months after the initial study.

Thematic Analysis

Thematic Analysis (TA) will be applied to analyze and interpret the data. The six steps of TA outlined by Braun and Clarke provide a robust framework that allows for a clear and systematic approach (75, 76). The six steps of TA include: (1) Familiarization with the data, (2) Generating initial codes, (3) Searching for themes, (4) Reviewing themes, (5) Defining and naming themes, and (6) Producing the report.

Within each step of TA there are a multiplicity of analytic choices that reflect the interplay of method and theory. A primarily inductive approach will be applied, with the themes remaining strongly linked to the data, or "data-driven", rather than fitting into a preconceived coding format based on a priori assumptions. NVivo software will be used to manage the coding process but will not be seen as a tool for analysis or interpretation.

DISCUSSION

Strengths and Limitations

This study has several noteworthy features that might be seen as limitations in some contexts. The sample will be based on physicians who choose to respond to the recruitment efforts, therefore self-selecting to participate in the mindfulness program. Self-selection can be viewed as a practical approach for delivering MBIs in healthcare settings, as an individual's *intention* to engage is seen as one of the underlying axioms

that activate the mechanisms that undergird the development of mindfulness (74).

While a purposive sampling approach was selected to enhance the specificity of the sample and increase the sample's information power, there is also an element of convenience sampling as the sample will be based on those who respond to the recruitment efforts. The purposive sampling approach (e.g., physicians with greater years of medical practice and fewer years of mindfulness experience) helps focus the study on the population of physicians. Therefore, it will not be known how medical students or other healthcare personnel (HCPs) would experience the Applied Mindfulness program.

The two program facilitators have been selected based on having an ideal set of credentials to deliver the Applied Mindfulness Program. While this will support the successful delivery of the program, it will limit the understanding of whether the program could be effectively taught and scaled into other contexts that may not have access to facilitators with the same level of expertise.

The use of semi-structured interviews as the primary data outcome may be considered by some as a limitation. This data set can be seen as best suited to answer the aims of this study's research question and also address gaps in the current literature regarding the acceptability and pragmatic application of mindfulness in physician's daily lives.

Implications for Policy, Research, and Practice

This study seeks to add pragmatic resources to the field through a prospective qualitative study that brings together the phenomena of physician wellbeing and mindfulness. Very few empirical studies have brought together these phenomena, with almost none using qualitative methods. To our knowledge, at the time of this publication, no research studies have used the teachings of Thich Nhat Hanh as the explicit basis for an MBI. Therefore, our innovative study design aims to answer calls from both the literature and international medical associations to determine the acceptability and feasibility of an Applied Mindfulness intervention for the improvement of physician wellness.

Our study design takes into account how this modality can be delivered in an accessible way for both the participants (e.g., delivering the program onsite, length of program/sessions, allowing participants to select the time/day that suits their schedules etc.) and the institutions that may wish to implement it (e.g., low-cost, approaches to curating a mindful space onsite etc.). As such, our results also aim to provide recommendations on best approaches for implementing this type of training and research within hospital and healthcare settings.

Burnout amongst physicians has been recognized across the literature as highly prevalent, and increasingly so in the context of major public health crises such as the COVID-19 pandemic. Therefore, if results from this study show our Applied Mindfulness intervention to be an acceptable and feasible modality, it could support trainings in Applied Mindfulness being incorporated into hospital settings as an effective means to improve individual physicians' wellbeing. In addition to this, findings in this study will address the question of whether training physicians in Applied Mindfulness can simultaneously benefit their patients and the wider healthcare system.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Hospital for Sick Children (HSC) and the University of Toronto. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EW was the primary contributor to the conception, design of the study, and wrote the first draft of the manuscript. NC contributed to the conception, design of the study, and provided critical revisions and checked the manuscript for important intellectual content. All authors approved of the final version of the manuscript as submitted.

FUNDING

This study was funded by a Supervisor's Research Grant through The Hospital for Sick Children and the Institute of Medical Sciences, University of Toronto (EW). NC is supported by a Junior 1 Career Development Award from the Fonds de Recherche du Québec—Santé.

ACKNOWLEDGMENTS

The authors wish to acknowledge, with deep gratitude, the insights and support provided by Blake Poland, Sara Ahola Khut, Brenda Toner, and Paula Gardiner (Academic Advisory Committee from the University of Toronto), Brother Phap Huu, Brother Phap Dung, Brother Phap Linh, and Sister Hien Nhgiem (Monastic Advisory Committee from Plum Village), along with the ongoing support of Dr. Agnes Wong.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.807792/full#supplementary-material

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frontiers in Public Health

ORIGINAL RESEARCH
published: 24 February 2022
doi: 10.3389/fpubh.2022.801453

Using Structural Equation Modeling to Examine Pathways Between Environmental Characteristics and Perceived Restorativeness on Public Rooftop Gardens in China

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OPEN ACCESS

Edited by:
Giorgio Di Lorenzo,
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Reviewed by:
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: 25 October 2021
Accepted: 20 January 2022
Published: 24 February 2022

Citation:
Chen Z, Gan KK, Zhou T, Du Q and Zeng M (2022) Using Structural Equation Modeling to Examine Pathways Between Environmental Characteristics and Perceived Restorativeness on Public Rooftop Gardens in China. Front. Public Health 10:801453. doi: 10.3389/fpubh.2022.801453

As a kind of informal green space more closely related to the built environment, public rooftop gardens (PRGs) are novel green open space and important salutogenic resource for urban residents. It is one of the most easily accessible method for urban residents to be in contact with outdoor or natural elements from the context of high-altitude living. Given its potential health benefits to city dwellers, existing empirical studies are heavily focused on immediate recovery through visually accessing PRGs (through windows), neglecting the possibility of using PRGs physically as a place of interaction. This paper hypothesizes usage patterns will mediate the associations between the environmental characteristics of PRG and users' restoration. This is done through inputting data from 12 typical samples of PRG in Chengdu, China into structural equation model (SEM). Combining the concept of Perceived Sensory Dimensions (PSD) and Perceived Restorativeness Scales (PRS) with the usage patterns of the above samples, this study aims to examine the correlation of environmental characteristics, usage pattern and restoration, in which identify their relative importance in the context of PRGs. Through serials of numerical tests on the model, the study shows that out of the 20 theoretical pathways constructed by the environmental characteristics (x)–usage patterns (m)–restorative effect (y), only 14 forms a significant correlation. In addition, out of all PSDs, social, serene, refuge, space and nature dimensions are induced into restorative effects through four patterns of use: retreat, nature touch, interpersonal interaction and family-bonding activities. The findings also show that social and family-bonding are the most influential independent and mediating variables respectively in achieving restorative effects in the PRG. This study reveals important findings about how usage patterns mediate the association between the PSD and PRS of users. And it also has generated practical implications on how we can design public rooftop gardens from the perspective of restoration, which could potentially be the key to the future survival and development of PRGs in urban environments.

Keywords: public rooftop garden, restorative environment, perceived sensory dimensions, mediating mechanism, structural equation modeling

INTRODUCTION

Over the past two decades, the gradual increase in urban density has becoming a common denominator in the world's urban development. Although cities account for only about 3% of land area globally, they are home to more than half of the world's population. According to the World Health Organization (WHO) 2014 prediction, more than 70% of the world's population will live in cities in the next 30 years. Hence, urban areas that are heavily populated will be facing serious environmental degradation, which reduces all the ecosystem services that is part of the natural environment. Consequently, the diminished of these large number of biophysical and cultural services that contribute to health and well-being are going to have considerable impact on the mental and psychological health of the general populations (1–4). As a public salutogenic resource, urban green space has been brought under the spotlight. Scholars assume that it is a typical supportive environment that can achieve both physical and psychological restoration, through emotional improvement, behavioral encouragement, social interaction, and aesthetic experience (5–13).

However, most previous studies were based on a crude comparison of natural and built environments, as well as their respective health benefits. In order to effectively guide the planning and design of urban green spaces to achieve such results, scholars have transformed abstract statistical models into theoretical correlation models of "urban green space characteristics—specific health outcome" (11, 14–20). This aims to provide a basis for empirical research on the design of green spaces from a health perspective. Therefore, numerous tools to evaluate the micro characteristics and restorative effects of the environment have been proposed and implemented (21–25). These have contributed to a more comprehensive picture of the green space and the consequent psychological benefits. The more typical and widely used is the Perceived Sensory Dimensions (PSDs) proposed by Grahn P (26) and the Perceived Restorativeness Scale (PRS) proposed by Hartig T (27). Grahn P summarized PSD as the eight different sensory experiences people get from interacting with the natural environment, including serene, nature, rich in species, space, prospect, refuge, social, and culture. On the other hand, Hartig T described PRS being the capacity of an environment to induce restorative effect through the facilitation of the feeling of fascination, being away, extent, and compatibility. The two ratings have been proven to have a distinctive relationship with different green space types. For instance, under the setting of small urban public green spaces, distinct associations are demonstrated between serene, social, nature and the PRS of people with average and high–stressed. Nature, serene, and refuge are strongly related to those in care settings. Serene, rich in species, refuge, and nature are found to be psychologically restorative in urban forests. Nature, refuge, and prospect are significantly associated with teenagers' perceived restoration in urban green spaces. This also indicates that the degree of association between PSD and PRS depends heavily on the type of green space (14, 15, 28–31) (**Table 1**).

Yet, it is also identified that human participation is also required for users to achieve restoration among the theoretical models constructed by many scholars. Usage patterns are introduced in studies to further investigate the correlation between urban green space and recovery, such as "moving away from stressors", "restoring capacity", and "building capacity" (6, 19, 32–37). Specifically, as an embodiment of restorative effects, the notion of "use" mediates the process of acquiring positive restorative benefits from the environmental, be it from adjusting one's physiological or psychological condition (7, 16–18, 38–42). Furthermore, a large number of reviews also summarizes certain usage patterns where people may derive corresponding benefits from the environment, to some extent, supports the research in seeking positive link between PSD and PRS (19, 36, 43–47). For example, a lawn space can be used for both aesthetic viewing (visual stimulation) and physical activity (physiological promotion) to achieve a reduction in the expenditure of cognitive resources and a decrease in negative emotions. Therefore, as an intermediate process and bridge between the physical environment and psychological feelings, usage patterns are an important mediating variable in exploring the pathway on how PSD connected PRS.

TABLE 1 | A review of studies in relation to the relationship of PSD and PRS.

References	Region	Types of green space	Study type	Study aim
Peschardt and Stigsdotter (14)	Denmark	Small public urban green spaces	Cross-sectional research	The analyses were conducted to see whether the PSDs were present or not and to determine how strong or weak they were.
Memari et al. (31)	Iran	Care setting	Controlled experiments	Identifying the relationship between environmental characteristics of restorative natural environments by determining PSDs and restorative potential.
Stigsdottera et al. (29)	Denmark	Forest	Controlled experiments	Identifying which nature qualities and spatial aspects in the Health Forest promote psychological restoration.
Chen et al. (30)	China	Forest,Park,Public Square	Cross-sectional research	Exploring how the local people perceive PSDs in relation to restoration in Chinese urban green space settings.
Akpinar (28)	Turkey	Recreational areas, Neighborhood parks, Urban park, Greenway	Cross-sectional research	Investigate the associations between the PSDs of urban green space and teenagers' perceived restorativeness, stress, and mental health.
Malekinezhad et al. (15)	Malaysia	Campus green space	Cross-sectional research	Identifying if the association between PSD and perceived restorativeness from a user's perspective is positive.

The aforementioned empirical studies tend to focus primarily on green spaces indicated in urban land use and zoning standards, such as parks, urban forests and greenways (38, 39, 48–51). However, high-density urban development has resulted in a significant reduction in the per capita green space, leading to a request for alternative places for nature contact at non-surface level. As informal green spaces that are more closely linked to the built environment, the Public Rooftop Gardens (PRGs) have been neglected in these studies. PRG is a green open space with a certain degree of man-made facilities and natural vegetation that allows urban residents to carry out various types of activities. They are seen as an effective complement and alternative to green open spaces on the ground, especially in densely populated areas, to compensate for the lack of consideration in the provision of open space for the community (52–55). As part of the research on human- place interaction, some researchers have focused on health outcomes through establishing the relationship between the aesthetic value of planting and users' preferences for roof greening (56–61). For example, White and Gatersleben evaluated various forms of roof planting based on self-perceived restoration benefits, aesthetic value, and environmental preference. On that basis, Lee, Loder, Jungles and Nagase used plant form, height, foliage color and biodiversity as the main variables to obtain a significant relationship between users' aesthetic preferences (plant types) and their psychological comfort in rooftop space. Other researchers have experimentally controlled the restorative benefits given to observers with or without green elements in rooftop space (62–64), such as Lee, who demonstrated that green roofs provide observers with attention restoration, relief from mental fatigue and enhanced work performance through "coherence" and "fascination" in micro breaks during days.

While the two research directions confirm the restorative value of PRG from different perspectives, there are two issues where starting point of these studies overlooked. Firstly, the description of PRGs' environmental characteristics is reduced to plant aesthetics, ignoring their complex condition as green spaces. Secondly, the studies based on PRG as a view–a visually accessible window view and neglect its potential to be physically accessible and to take on more activities as open spaces. As mentioned above, the lack of research on these two fundamentals that are important influential factors to the mechanistic model, restricted the further understanding of PRG inducing restorative effect. In China, there are a large number of PRGs that can be used and experienced by all urban residents. These are informal spaces that create and renew gray areas within existing buildings, bringing open space from the public realm into the built environment (65–67). However, due to load, thermal, and usage conditions, the economic demands of stakeholders and the attribute of informal space, there is a lack of uniform standards guiding the planning and construction of PRGs (68–73), suggesting the perceived gap of comprehensive environmental conditions, i.e., PRGs have the potential to provide more public recreational activities that may lead to restorative benefits.

Thus, this manuscript aims to examine how usage patterns (UP) mediate the association of environmental characteristics (PSD) to restoration (PRS), identify the relative importance of different characteristics (PSD), usage patterns and their certain pathways linked to restoration (PRS), as well as to understand impact mechanisms of this new form of greenery using PRGs as the environmental subject. The specific objectives are to address the following questions: Q1: Is there a correlation between PSDs and PRS of PRGs? Q2: Is there a correlation between UPs and PRS of PRGs? Q3:Do UPs mediate the association between PSDs and PRS of PRGs. Q4: The certain pathways transformed from PSDs to PRS.

METHODOLOGY AND MATERIAL

Study Context

Chengdu is located in the transition zone from the western Sichuan Plateau to the Sichuan Basin. It has an average temperature of 15.6∼16.9°C, fewer sunny days compared to cloudy days throughout the year, and has an average annual sunshine hour of 1,003 h. The annual average precipitation is 850.9 mm, the annual average rate of evaporation is 841.1 to 1,066.1 mm, and the annual average relative humidity is 81%. All of above stated are especially suitable for the development of roof greening. Apart from climate suitability, high demolition costs and strict law enforcement on higher greening rates within a shortened timeframe foster the need to investigate the role of PRGs within the city of Chengdu. Needless to say the branding of Chengdu as a "park city" in China. These large PRGs become open green spaces for urban residents working and living in the built environment. Hence these are typical areas of study for environmental characteristics and restoration (**Figure 1**).

Site Definition and Selection Criteria

PRG is also recognized as eco-roof, living roof (74), vegetated roof (69) or cool roof (75). It is defined as green space according to The National Environmental Protection Agency in the broader sense, which implies green space as "land partially or completely covered with herbs, trees, shrubs, or other vegetation" (76, 77). Hence, in this paper PRG is understood as green spaces that provide the opportunities to experience nature and increase physical activity, notwithstanding its role and capability in the regulation of urban heat island effect (78), reducing the overall energy consumption of buildings (79), rainwater detention (79), air purification (72), and increased biodiversity (78). Compared with the other urban green spaces, there was no corresponding data and information on PRGs. This is mainly because they currently do not belong to any land use typology of the city's urban planning guidelines in China. Hence, based on the pre-research and with reference to the application of PSD in traditional urban green space, there needs to be screening criteria for sample selection, in order to ensure that PSD is reasonable for this type of application. Which are shown as follows:

Roofs without enough vegetation are excluded (Green rate less than 20%).
Vacant or storage roofs are excluded.
Roofs that are not open to public are excluded.
Roofs that act like a thoroughfare (such as a podium or elevated bridge structure across two high-rise towers) are excluded.

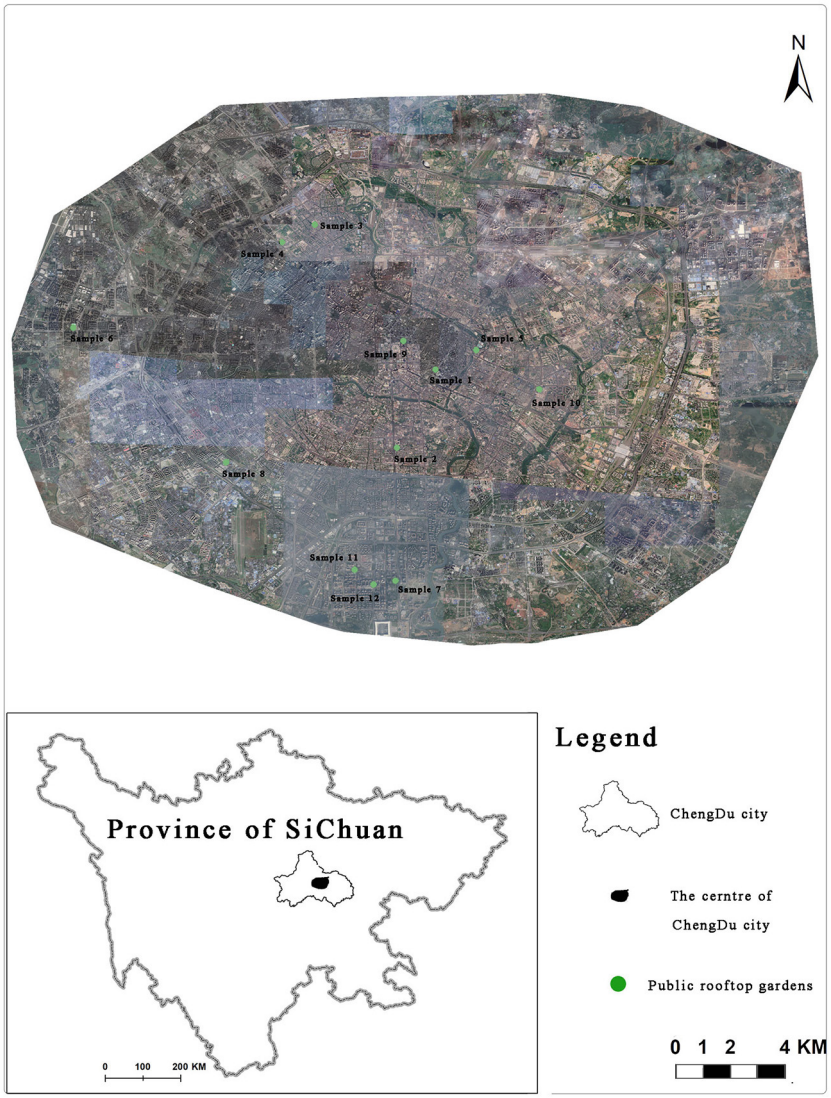


FIGURE 1 | The spatial distribution of each public rooftop garden in center of ChengDu city.

Outdoor gardens that serve individual businesses (such as coffee shops or restaurants) are excluded.

Monotonic spaces that are unable to provide a variety of activities or host only a single activity (such as football fields and basketball courts) are excluded.

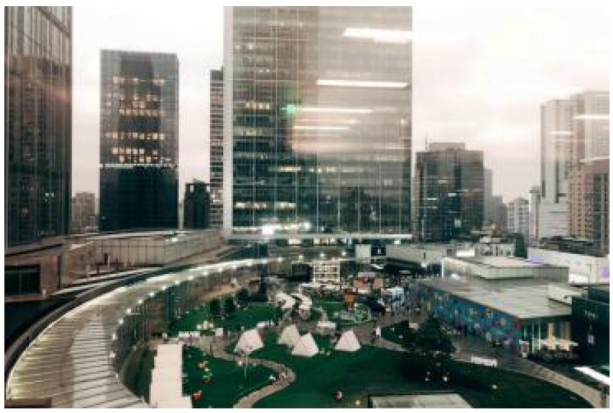
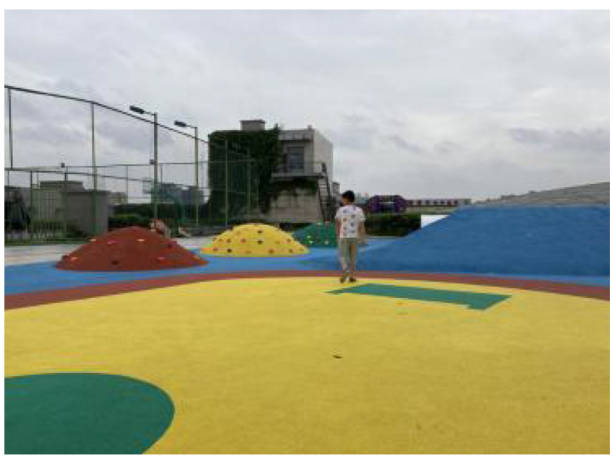
Twenty nine samples were found according to the above criteria. Then, based on information such as the area, shape, vegetation and facilities, 12 out of 29 samples were selected as the typical research samples and numbered them S1∼S12. Therefore, it is safe to say the 12 PRGs selected through the screening process are: (1) green open space that meets the needs of urban residents for public access, experience and interaction, (2) green open place to hold various activities, and (3) green open space intended to serve the majority of urban residents and has a relative mix of natural vegetation and man-made facilities (**Table 2**).

Data Collection

The evaluation of environmental characteristics, usage pattern and restorative effect of PRGs in Chengdu were measured by means of an onsite questionnaire survey. We revised and tested ratings based on the actual condition of sites during the pre-research, then conducted the face to face interviews in the formal questionnaire distribution.

In the Pre-research started on 5 August 2020, every item of the PSDs was rated against actual settings of 12 PRGs on-site by three professional landscape architects. Due to the fact that most items associated with PSDs outlined in previous studies were based off traditional urban green environment, such as small urban green spaces, forests, parks, or care settings, it meant that some of the specific characteristics which described each PSD could not be translated directly into PRGs due to contextual differences. We therefore

TABLE 2 | The samples of Public rooftop gardens in Chengdu (Source: All photos taken by first author unless otherwise mentioned).

Site Number	Photos of sites	General description of sites
Sample 1: Area:9,985.6 m^2		An area full of exhibitions, performances and sculptures. A wide range of recreational activities for adult and local cultural elements for people to enjoy. Landscape component: Lawns, trees. Equipment: Benches, garbage bins, exhibition facilities.
Sample 2: 8,341.5 m^2		An area with cafes and a playground. Plenty of tables, chairs for socializing. while It also has many cultural symbols and water features to attract visitors. Landscape component: Lawns, trees, flower beds, fountains. Equipment: Drinking tables, sculptures, benches, garbage bins.
Sample 3: 12,980.0 m^2		Area consisting of playgrounds, sport fields and social Spaces. A variety of Children's facilities and few trees. Landscape component: Lawns, shrubs, flower beds, trees, water pool. Equipment: Children facilities, Skateboard field, ball field, tables, shelters.

(Continued)

TABLE 2 | Continued

Site Number	Photos of sites	General description of sites
Sample 4: 9,519.0 m^2		A well maintained area with an Indoor basketball court, flowerbeds, trees and many lights. Many spaces for exhibition or artist performances. Landscape component: Flower beds, shrubs, trees. Equipment: basketball field, benches, tables, fitness field.
Sample 5: 3,126.5 m^2		Area with several types of plants and animals, there are several tables and chairs for socializing and indoor or outdoor animal feeding or interaction space. Landscape component: Flower beds, shrubs, trees. Equipment: Drinking tables, benches, animal-feed area, horticulture area, shelters.
Sample 6: 3,323.1 m^2		Area with many trees, bushes and hedges, there are varieties of recreational facilities for different groups and special space for Parental gardening activities with children. Landscape component: Lawn, flower beds, shrubs, trees. Equipment: Children facilities, benches, horticulture area, animal-feed field, garbage bins, shelters.

(Continued)

TABLE 2 | Continued

Site Number	Photos of sites	General description of sites
Sample 7: 4,606.6 m^2		Area with horticultural or gardening space for family, there are also educational space for sports or outdoor environmental knowledge learning. Landscape component: Flower beds, shrubs, trees. Equipment: Benches, tables, animal-feed area, horticulture area, garbage bins, shelters.
Sample 8: 18,555.0 m^2		Area surrounded by many trees bushes and free growing lawns. Different types of plant combinations creates impressive space for users to enjoy. People can have social interaction or have space to be alone. Landscape component: Lawn, flower beds, shrubs, trees, water elements. Equipment: Benches, garbage bins, tables, fitness field, children facilities, shelters.
Sample 9: 6,370.40 m^2		A well maintained area with trees, hedges, growing lawns and flowerbeds. Large trees create semi-enclosed atmosphere. Many benches provide residents with break space, where people can enjoy greenery view. Landscape component: Lawn, trees, shrubs, flower beds. Equipment: benches, garbage bins, tables, fitness field, children facilities.

(Continued)

TABLE 2 | Continued

Site Number	Photos of sites	General description of sites
Sample 10: 8,379.0 m^2		An area dominated by short-stay facilities and hedges. There are several benches where people can sit and look at the up-to-date art performances. Landscape component: Trees, shrubs, flower beds. Equipment: benches, garbage bins, shelter.
Sample 11: 3,454.1 m^2		Area surrounded by many trees bushes and lawns. A social environment with tables and benches for people to drink or chat. Landscape component: Lawn, trees, shrubs, flower beds, water elements. Equipment: benches, garbage bins, shelter, drinking tables, shelters.
Sample 12: 3,975.7 m^2		Area with some lawns, bushes and tables. Many workers feels Silent, have lunch break or seek inspiration here. Landscape component: Lawn, trees, shrubs, flower beds. Equipment: benches, shelters, drinking tables, garbage bins.

screen out the items considered not relevant when evaluating PRGs. Meanwhile, real-time status of the users is also being recorded to provide an indication and summary of their usage patterns, i.e., animal feeding, parent-child interaction, meditation and rest, sports and physical exercise, or looking for inspiration.

As a follow up, formal questionnaire distribution started on 31 September 2020, and the frequency of visits to the 12 sites was controlled to an average of six visits per month, which were conducted until the end of the month on 31 June 2021. During this period, 48 visits were conducted by 1–2 members per site sample (at different times of the month, in the morning, around noon, in the evening and on weekends, for 1–2 h each time to reach as many different users as possible). Each survey was distributed at 12 sites at the same time to ensure that external environmental influences such as weather were consistent. Respondents were randomly selected amongst the visitors of the selected PRGs. Questions were asked before distribution to ascertain whether the respondents who agreed to be interviewed were local residents (or lived in the area more than 1 year) to ensure that the content of the questionnaire was a comprehensive reflection of the most realistic current use of the site each time. Those willing to participate were then asked to fill out a questionnaire during their stay in the area, based on their overall perception of the site and their willingness to carry out the corresponding activities within 6 months (**Supplementary Table S1**).

The questionnaire consisted of five sections. The first part was a survey on motivation, frequency, background, and relevant demographic characteristics (gender, age, education and income level, presence of preschool children, insider or visitor). The second part was an evaluation of the eight perceived dimensions in PRGs. The third part was a questionnaire based on the activities (usage patterns) of the respondents in the specific areas of the site, and the fourth part was a questionnaire on the perceived restorativeness of visiting the site (The fifth part is not relevant in this paper). Correspondingly, a 7-degrees Likert scale was used for the evaluation. Higher scores indicate a greater willingness or agreement of specific item of the questionnaires. The scores of negative questions were being revised for consistency.

During the site investigation, 17,183 users of the sites were recorded, and 1,376 questionnaires (211 paper and 1,165 electronic questionnaires) were distributed. Out of all distributed questionnaires, 899 questionnaires were recovered with a questionnaire recovery rate of 63%. Of these recovered questionnaires 876 were valid, meaning that 97% of the recovered questionnaires were usable. The recovered questionnaires provided an indication to the demographic of all the PRGs users: External visitors (73.3%), females (53%), people with preschool children in family (54.8%), young and middle-aged people (18–39 of age, 58.5%), people with an average lower income (<4,999, 59.2%), and people with a lower education (under vocational education, 70.2%) constitute the main use groups of the site. However, it is utmost important to note that no significant differences were found between the responses of people with different background subjects.

Data Screening and Analysis

Structural Equation Model (SEM) was chosen to construct the final theoretical model in this paper because it (1) introduces latent variables that can be included in the evaluation of multiple specific items in a complex, multi-linked statistic, facilitating the presentation of the causal structure of the variables from a holistic perspective;(2) SEM is similar to multiple regression and path analysis in that they are solved using a system of coupled equations, but unlike the two, it allows for measurement error between variables; (3) SEM can eliminate confounding factors while taking into account the relationship between multiple variables.

The modeling steps were shown in turn: comprehensive data validation tools were used upfront, followed by series of linear regression analysis to screen out uncorrelated variables in order to simplify the construction of structural equation model. Finally, the relevant variables were input into AMOS to establish SEM, and the path coefficients were used to determine whether the theoretical conjecture was valid and the respective contribution.

Specifically, original data was first statistically analyzed to ensure whether it was available for subsequent statistical analysis. Mean and standard deviation were used to describe the data for continuous variables, while frequency and percentage were used to define categorical variables. Then, Harman's one-way ANOVA was used as the test for common method bias to eliminate artificial covariation of the evaluation ratings that can seriously confound results and potentially mislead conclusions.

After that, exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and Cronbach's alpha were used in this study to verify if the data supported the grouping of dimensions of different ratings. Furthermore, corresponding mathematical structures were tested using CR (composite reliability) and AVE (average variance extracted), respectively.

Then a series of multiple linear regression analysis was then used to determine the possible association among the independent variables (PSD ratings), mediating variables (UP ratings) and dependent variables (PRS ratings). Specifically, the models estimate which independent and mediating variables have significant effects on dependent variables, and this is to simplify post-modeling by filtering out irrelevant variables.

All of the above are prerequisite test for the development of a valid mathematical model. Finally, an optimized structural equation model of latent variables was developed to verify the mediating role of each mediating variable between the independent variable and the dependent variable through AMOS. The test level (Significant level) was 0.05, i.e., $P < 0.05$ indicated that the difference was statistically significant. The model reveals what degree of environmental characteristics are associated with users' restorative effects and the mediating role of usage patterns through path coefficients. It also illustrates the different pathways between certain environmental characteristics and restorative effects.

RESULTS

Results from these analyses are described and presented in the following sections: Confirmatory analysis and Main analysis. These sections follow the steps of Data screening and analysis corresponding to the research questions highlighted in the previous chapter. Confirmatory analysis aims to verify whether the data supported the grouping of dimensions of different ratings for the subsequent analysis, followed by Main analysis to respond the research question.

Confirmatory Analysis

Prior to answering the research questions, it was firstly verified whether the variables supported the grouping of dimensions described as PSD as well as PRS, while the dimensionality of the data related to UP was examined (**Tables 3–5**).

Specifically, the results showed that the cumulative variance contribution of the PSD rating was 69.669% > 60%, i.e., when eight common factors (refuge, social, serene, space, nature, rich in species and culture) were extracted. While the cumulative variance contribution of the UP rating was 76.160% > 60%, i.e., When six common factors (retreat, exercise, interpersonal, family-bonding, nature touching, sightseeing) were extracted. Finally, the cumulative variance contribution of the PRS rating was 69.901% > 60%, i.e., When four common factors (fascination, compatibility, coherence and being away) were extracted. That is, the three can better cover the subject of the study through a principal component analysis strategy.

Main Analysis

Q1: The Correlation Between PSDs and PRS?

The effect of the PSD rating (as the X-value of the equation) on the PRS rating (Y-value) was explored by multiple linear regression analysis, incorporating variables such as nature, space, culture, social, refuge, serene, prospect, rich in species and perceived restorativeness as the dependent variable. The regression results show that culture, prospect and rich in species did not have significant effects on the restoration ($P > 0.05$). Nature, space, social, refuge and serene have significant effects on the restoration ($P< 0.001$), and the β values were 0.158, 0151, 0.221, 0.154, 0.186, and 0.022, respectively, so it was concluded that these dimensions had significant positive effects on Y (**Table 6**).

Q2: The Correlation Between UPs and PRS?

The effect of the UP rating (as the M-value of the equation) on the PRS rating (Y-value) was explored by multiple linear regression analysis, incorporating variables such as exercise, retreat, interpersonal, family-bonding, nature touching, sightseeing and perceived restorativeness as the dependent variable. The regression results show that exercise and sightseeing did not have significant effects on the restoration ($P > 0.05$). Retreat, interpersonal, family-bonding, nature touching have significant effects on the restoration ($P < 0.001$), and the β values were 0.210, 0.216, 0.214 and 0.174, respectively, so it was concluded that these dimensions had significant positive effects on Y (**Table 7**).

Q3:The Mediating Effect of UPs

Based on the results of the aforementioned regression analysis, a preliminary structural equation model of UP ratings between the PSD and the PRS ratings was also constructed after removing the irrelevant variables, incorporating nature, space, social, refuge and serene as independent variables. Incorporating retreat, interpersonal experience, family-bonding activities and nature touching as mediating variables. Incorporating restoration as the dependent variable. The model plots and analysis results are presented below.

The results of the structural equation model analysis are presented in the table. The analysis results show that: the effect of nature on family-bonding activities is not significant ($P = 0.096 > 0.05$), social has a non-significant effect on retreat ($P = 0.945 > 0.05$), it also has a non-significant effect on nature touching ($P = 0.674 > 0.05$), and refuge had a non-significant effect on nature touching ($P = 0.505 > 0.05$), serene had a non-significant effect on interpersonal experience ($P = 0.157 > 0.05$), serene had a non-significant effect on Interpersonal experience ($P = 470.05 > 0.05$). This means that 14 of the 20 pathways are significantly correlated, which prove the mediating role of usage pattern between PSD and PRS (**Table 8**).

Q4: The Pathway of PSDs Linked to PRS of PRG

After optimization of the structural equation model by eliminating several insignificant paths between X—M—Y variables, fit indices of the optimized model all met the fit criteria, and it was considered to be a good model structure that was supported by the data. The results of the optimization of the non-significant paths in the structural equation model, as previously mentioned, are presented below (**Figure 2**).

The results of the optimized structural equation model show that for the effect of environmental characteristics on restorative effects, nature, space, social, refuge and serene all show a significant positive effect on restoration ($p < 0.05$), with standardized path coefficients of 0.113, 0.077, 0.222, 0.134 and 0.175, respectively. The effect of the mediating variable M on the dependent variable Y was as follows: retreat, interpersonal experience, family-bonding activities and nature touching all have a significant positive effect on restoration (all $p < 0.001$), with standardized path coefficients of 0.148, 0.136, 0.184, and 0.141, respectively.

To verify the different pathways between environmental characteristics and restorative effects, each path coefficients of independent variable X on mediating variable M will be covered in detail (**Table 7**). For example, the dimension of nature achieved restoration through retreat, interpersonal experience and nature touching (all $p < 0.01$), with standardized path coefficients of 0.176, 0.114 and 0.251, respectively. The dimension of space achieved restoration through family-bonding activities, interpersonal experience, retreat, and nature touching (all $p < 0.001$), with standardized path coefficients of 0.192, 0.211, 0.223, 0.185, respectively. The social dimension achieved restoration through interpersonal experience and family-bonding activities ($p < 0.001$), with standardized path coefficients of 0.193 and 0.159, respectively. The dimension of refuge achieved restoration through family-bonding activities, interpersonal experience and retreat. ($p < 0.001$), with standardized path coefficients of 0.132, 0.159 and 0.249, respectively. The dimension of serene achieved restoration through retreat and nature touching ($p< 0.001$). The standardized path coefficients were 0.223 and 0.214, respectively.

DISCUSSION

The Relationship Between PSD, UP and PRS on PRG

One of the main research questions was to examine how through different use, certain environmental characteristic could provide restorative benefits. Our results confirmed the hypothesis that

TABLE 3 | Corrected correlations between PSDs items and PSDs.

Item	Component								Communalities
	Space	Social	Culture	prospect	refuge	Serene	Nature	Rich in species	
Space (latent variables)									
Spacious	0.792								0.705
Areas not crossed by paths	0.791								0.670
Lots of trees	0.777								0.645
Places sheltered from the wind	0.776								0.677
Places where people can gather	0.790								0.687
Cronbach's alpha = 0.878									
Social (latent variables)									
Entertainment		0.801							0.683
Exhibitions		0.778							0.654
Paths with hard surfaces		0.807							0.709
General good lighting		0.795							0.686
Plenty of people		0.729							0.615
Cronbach's alpha = 0.872									
Culture (latent variables)									
Fountains			0.815						0.710
Statues			0.799						0.698
Foreign plants			0.820						0.710
Flowers			0.853						0.782
Cronbach's alpha = 0.871									
Prospect (latent variables)									
Plane, well-cut grass				0.842					0.732
Prospect				0.836					0.718
Cut lawns				0.849					0.750
Small ball grounds				0.758					0.615
Cronbach's alpha=0.852									
refuge(Latent variables)									
Many bushes					0.753				0.614
Tables and benches					0.789				0.667
Play equipment					0.763				0.649
Watching people being active					0.784				0.675
Cronbach's alpha = 0.820									
Serene (latent variables)									
Silent and calm						0.751			0.610
Clean and well maintained						0.735			0.601
Not crowded						0.783			0.657
Feel safe						0.765			0.650
Cronbach's alpha = 0.797									
Nature (latent variables)									
Nature quality							0.854		0.794
Free growing lawns							0.839		0.773
Wild and untouched							0.859		0.810
Cronbach's alpha = 0.869									
Rich in species (latent variables)									
Natural animals. plant and animal populations								0.871	0.825
Many native plants to study								0.880	0.828
Cronbach's alpha = 0.797									
Eigenvalue	3.388	3.359	2.894	2.816	2.625	2.524	2.347	1.645	
% of variance	10.930	10.834	9.335	9.083	8.467	8.142	7.571	5.306	
Cumulative %	10.930	21.764	31.099	40.182	48.650	56.792	64.363	69.669	

TABLE 4 | Corrected correlations between UPs items and UPs.

Item	Component						Communalities
	Retreat	Interpersonal	Family-bonding	Exercise	Sightseeing	Nature touching	
Retreat(Latent variables)							
Strolling	0.855						0.763
Reading	0.831						0.748
Meditation	0.840						0.765
Inspiration	0.862						0.794
Lunch break	0.846						0.765
Cronbach's alpha = 0.924							
Interpersonal (latent variables)							
Gathering for a meal		0.881					0.795
Playing cards and chess		0.843					0.726
Chat with Friends		0.867					0.768
Dating		0.866					0.761
Square dancing		0.869					0.774
Cronbach's alpha = 0.923							
Family-bonding (latent variables)							
Feed animals			0.848				0.771
Play with children-facility			0.843				0.756
Environmental learning			0.838				0.750
Horticultural work			0.859				0.782
Cronbach's alpha=0.897							
Exercise(Latent variables)							
Running				0.872			0.782
Ball games				0.897			0.822
Equipment fitness				0.855			0.758
Cronbach's alpha = 0.862							
Sightseeing (latent variables)							
Participation in site activities					0.850		0.768
Photo-op landmark scenery					0.855		0.775
Appreciation of artificial landscape					0.849		0.761
Cronbach's alpha = 0.849							
Nature touching (latent variables)							
Breathing fresh air						0.835	0.748
Appreciation of the greenery						0.796	0.679
Enjoy the outdoor weather						0.808	0.705
Cronbach's alpha = 0.791							
Eigenvalue	3.846	3.836	3.058	2.356	2.303	2.117	
% of variance	16.724	16.677	13.296	10.245	10.013	9.206	
Cumulative %	16.724	33.400	46.696	56.941	66.954	76.160	

out of the 20 theoretical pathways constructed by the PSD (x)—UP (m)—PRS (y), only 14 formed a significant correlation. This suggests that environmental characteristics facilitate some specific usage patterns in a way that allows the user to achieve recovery (**Table 9**).

In response to the first research question, it was found that there is a positive relationship between PSDs and PRS. Social and serene are repeatedly the most important PSDs connected to PRS. This result correlates with the conclusion outlined in the research on small public urban green spaces (SPUGS) (14). This is considerably different when we look at PSD and the respective PRS in different settings. For example, refuge, rich in species are the important PSDs associated with urban forest (29); nature and serene within care settings (31); as well as refuge and prospect under park setting (28). The findings of this paper may be attributed to the following reasons: in comparison to the European, Chinese residents tend to socialize in an outdoor environment for stress relief rather than in the hustle and bustle of urban life (30, 80). PRGs can hence potentially compensate for basic needs of socializing in natural environments on busy workdays within urban areas. Similarly, compared with SPUGS, PRGs are elevated that they are far away from the source of

TABLE 5 | Corrected correlations between PRS items and PRS.

Item	Component				Communalities
	Compatibility	Fascination	Coherence	Being away	
Compatibility (latent variables)					
I can do things I like here	0.736				0.672
I have a sense that I belong here.	0.707				0.633
I have a sense of oneness with this setting.	0.722				0.648
Being here suits my personality.	0.783				0.752
I could find ways to enjoy myself in a place like this	0.784				0.728
Cronbach's alpha = 0.876					
Fascination (latent variables)					
The setting has fascinating qualities		0.754			0.668
My attention is drawn to many interesting things		0.649			0.610
I would like to get to know this place better		0.682			0.673
There is much to explore and discover here		0.669			0.579
I would like to spend more time looking at the surroundings		0.748			0.648
Cronbach's alpha = 0.853					
Coherence (latent variables)					
There is too much going on.			0.680		0.593
It is a confusing place.			0.753		0.689
There is a great deal of distraction			0.801		0.776
It is chaotic here.			0.829		0.784
Cronbach's alpha = 0.866					
Being away (latent variables)					
It is an escape experience				0.846	0.871
It gives me a good break from day-to-day routine				0.817	0.860
Cronbach's alpha = 0.840					
Eigenvalue	3.325	3.105	3.048	1.707	
% of variance	20.782	19.404	19.048	10.666	
Cumulative %	20.782	40.187	59.234	69.901	

TABLE 6 | The regression model of PSDs on PRS.

Perceived sensory dimensions	B	Std. Error	Beta	t	P	Tolerance	VIF
(Constant)	2.852	0.090		31.570	0.000		
Nature	0.074	0.015	0.158	5.016	**0.000**	0.808	1.238
Space	0.079	0.017	0.151	4.604	**0.000**	0.739	1.353
Culture	−0.014	0.016	−0.027	−0.865	0.387	0.803	1.246
Social	0.110	0.016	0.221	6.683	**0.000**	0.732	1.366
Refuge	0.077	0.016	0.154	4.806	**0.000**	0.779	1.283
Serene	0.091	0.016	0.176	5.532	**0.000**	0.788	1.270
prospect	−0.005	0.016	−0.009	−0.298	0.766	0.886	1.129
Rich in Species	0.010	0.014	0.022	0.732	0.465	0.865	1.156

The highlighted bold factors represent significantly correlated variables.

TABLE 7 | The regression model of UPs on PRS.

Usage patterns	B	Std. Error	Beta	t	P	Tolerance	VIF
(Constant)	3.037	0.077		39.315	0.000		
Exercise	0.003	0.015	0.005	0.168	0.867	0.929	1.076
Retreat	0.083	0.013	0.210	6.361	0.000	0.751	1.332
Interpersonal	0.088	0.012	0.216	7.210	0.000	0.920	1.087
Family-bonding	0.087	0.013	0.214	6.749	0.000	0.816	1.226
Nature touching	0.087	0.016	0.174	5.560	0.000	0.840	1.190
Sightseeing	0.006	0.014	0.013	0.434	0.664	0.859	1.165

The highlighted bold factors represent significantly correlated variables.

vehicular noise on the ground, which could be seen as a scarce green space for people to obtain tranquility or peace in the built environment (62). Therefore, PRGs are easily perceived as places for temporary escape from the pressure of life and work. It is worth mentioning that the above two dimensions seem to contradict when placed within an environment. However, it may be due to the relatively large scale of PRGs, PRGs design strategies that improve delineation as well as management through a well-established operation and maintenance regime, which ensure the integration and coexistence of these two (59, 65, 70, 73).

TABLE 8 | Preliminary results of structural equation modeling analysis.

Pathway			Standard	Unstandard	SE	t	P
Retreat	←	**Nature**	0.178	0.191	0.039	4.930	***
Interpersonal	←	**Nature**	0.126	0.141	0.040	3.515	***
Family-bonding	←	Nature	0.061	0.065	0.039	1.663	0.096
Nature touching	←	**Nature**	0.248	0.215	0.034	6.249	***
Retreat	←	**Space**	0.189	0.230	0.044	5.211	***
Interpersonal	←	**Space**	0.220	0.281	0.046	6.057	***
Family-bonding	←	**Space**	0.205	0.248	0.045	5.531	***
Nature touching	←	**Space**	0.174	0.171	0.039	4.440	***
Retreat	←	Social	0.002	0.003	0.044	0.069	0.945
Interpersonal	←	**Social**	0.189	0.245	0.047	5.188	***
Family-bonding	←	**Social**	0.152	0.187	0.046	4.111	***
Nature touching	←	Social	0.016	0.016	0.039	0.421	0.674
Retreat	←	**Refuge**	0.132	0.150	0.042	3.550	***
Interpersonal	←	**Refuge**	0.169	0.201	0.044	4.534	***
Family-bonding	←	**Refuge**	0.237	0.267	0.044	6.126	***
Nature touching	←	Refuge	0.027	0.024	0.037	0.666	0.505
Retreat	←	**Serene**	0.225	0.280	0.048	5.834	***
Interpersonal	←	Serene	−0.053	−0.069	0.049	−1.416	0.157
Family-bonding	←	Serene	0.027	0.034	0.047	0.719	0.472
Nature touching	←	**Serene**	0.210	0.211	0.042	5.046	***
Restoration	←	Serene	0.175	0.073	0.017	4.326	***
Restoration	←	Refuge	0.133	0.051	0.015	3.402	***
Restoration	←	Social	0.221	0.092	0.016	5.801	***
Restoration	←	Space	0.078	0.032	0.016	2.003	0.045
Restoration	←	Nature	0.112	0.040	0.014	2.933	0.003
Restoration	←	Nature touching	0.140	0.058	0.017	3.385	***
Restoration	←	Family-bonding	0.181	0.061	0.013	4.687	***
Restoration	←	Interpersonal	0.138	0.044	0.012	3.660	***
Restoration	←	Retreat	0.147	0.050	0.013	3.877	***

*The symbol *** means $p < 0.001$. The highlighted bold factors represent significantly correlated pathways of variables.*

Regarding to second research question, there is a correlation between UPs and PRS according to the result. Retreat and family-bonding activities are repeatedly most important mediating variables linked PSDs and PRS of PRG. It coincides with some scholars underpinnings on restorative experience of PRG (52, 54, 55, 62, 81). For instances, to take the children out, to find peace and quietness. Unexpectedly, out of all UPs, nature touching had relatively low impact on the restorative effect. As a contrary to green spaces on ground whereby the most restorative experience would normally be nature contact (32, 82–89), this study confirms that the current restorative function of PRG was possibly closer to being a participatory farm or place for short-term break, than being a natural space, from the perspective of users.

On the final research question, social, refuge, serene, space and nature were inducted into restorative effects through four patterns of use: retreat, nature touch, interpersonal interaction and family-bonding activities. Our findings validate the importance of mediating mechanisms in restorative environments, which supported previous study conclusions (32–35). Specifically, this study revealed that environmental characteristics of nature such as "wild and untouched" and "growing lawns" contribute more to the creation of a space where visitors feel the inherent power of the environment without human intervention, and their association with restorative effects can be induced by encouraging meditation or the appreciation of greenery. Environmental characteristics of space, such as "spacious" and "places where people can gather", contribute significantly to creating a spatial atmosphere where visitors can feel a sense of diversity and variation in the environment, and these will induce restorative effects by encouraging meditation, gathering, playing with children or enjoying outdoors. The environmental characteristics of social such as "paths with hard surfaces", "entertainment" and "good general lighting" contribute more to the creation of a place where people can meet and interact with others, and these can induce restorative effects through the facilitation of gatherings, reunions, playing with children. Environmental characteristics of refuge such as "many bushes" and "watching people actively", which contribute to the creation of environments offering a sense of shelter and protection, these can be used to induce restorative effects by promoting relaxation, dating and gardening. Environmental factors of serene such as "feeling safe" and "not crowded" contribute more to a peaceful atmosphere without disturbance and can result in a positive restorative effect by promoting the use of relaxation, inspiration and the appreciation of greenery.

These findings suggest changes in environmental characteristics can trigger the willingness of people to carry out certain activities and thus obtain a restorative effect. Hence, it broadens the boundaries of restorative environmental design considerations. For example, even though the social dimension generated the largest contribution to the restorative effect, the space dimension had the most comprehensive correlation pathways in the process of achieving restorative effect. This means that while the user reaps the greatest amount of benefit from the social dimension, the space dimension offers a greater variety of ways to benefit.

Implications for Landscape Designers and Planners

The current lack of uniform standards guiding the planning and construction industry restricted future survival and development of PRGs in urban environments. The PSDs can comprehensively summarize each environmental characteristic in detail, and thus, they can be used both as a tool for analysis and as design guidelines for designers and planners.

This study has generated practical implications on how we can design public rooftop gardens targeted specifically around potential usage patterns and health benefits. For example, the PRGs should be designed with space or facilities for entertainment and exhibitions, paths with hard surfaces and general good lighting also need to be provided. These characteristics can induce restorative effects through the facilitation of gatherings, reunions, playing with children.

This study also suggested that providing a well maintained and not crowded space is necessary for human-place interaction.

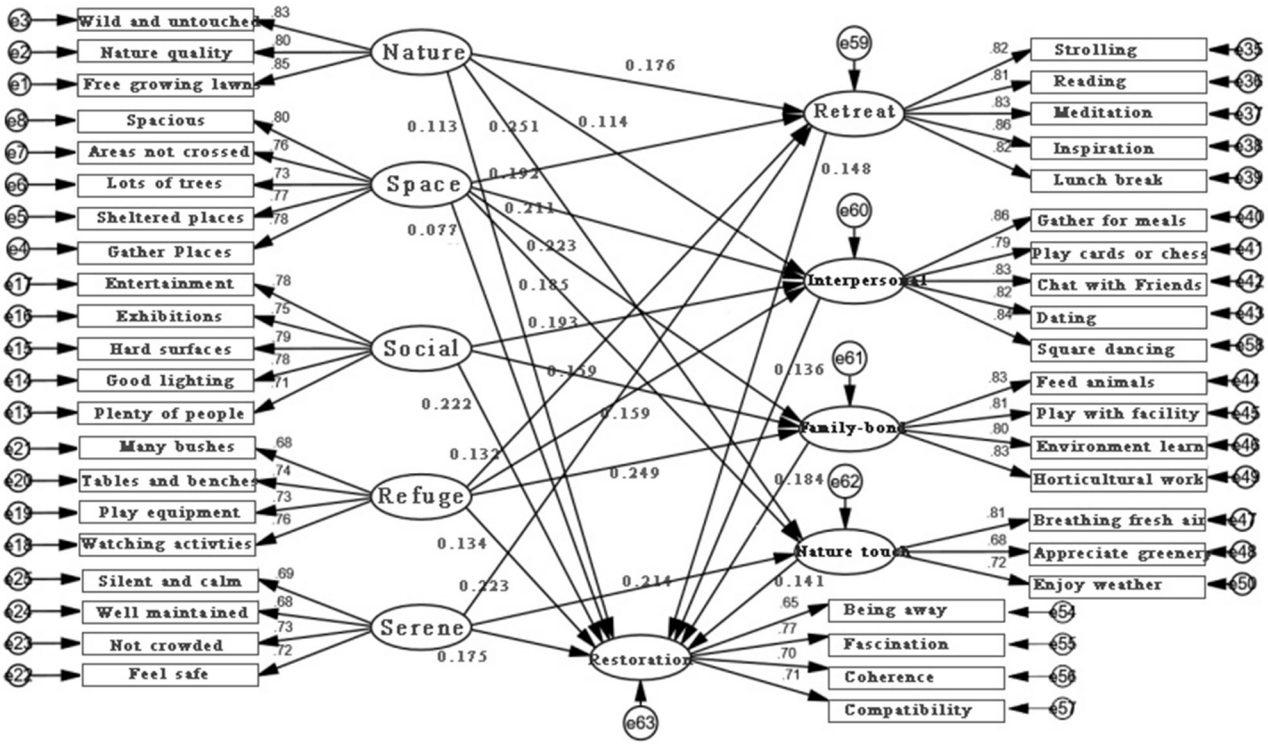


FIGURE 2 | Final result of structural equation modeling analysis.

TABLE 9 | Pathways corresponding to each PSD linked PRS.

Perceived sensory dimensions	Usage pattern
Nature	Retreat
	Interpersonal experience
	Nature touching
Space	Family-bonding activities
	Interpersonal experience
	Retreat
	nature touching
Social	Interpersonal experience
	Family-bonding activities
Refuge	Family-bonding activities
	Interpersonal experience
	Retreat
Serene	Retreat
	Nature touching

Serene atmosphere that makes people feel silent and calm, or feel safe is also important. These characteristics would be associated with restoration through promoting the use of relaxation, inspiration and the appreciation of greenery.

Nevertheless, the findings of this paper should be considered as a valid complement to the previous roofing studies that focused only on the aesthetic characteristics of plants, or as a design guideline for the PRG construction process, rather than a limitation in an absolute sense.

Strengths and Limitations

This study has generated knowledge on the actual status of PRGs through collecting and describing the individual perception or behavior, and it is also the first attempt to concretize the characteristics of PRGs by combining the PSD as well the PRS in the context of China. In addition, this paper verified the pathway between the two mentioned above.

However, there are some limitations in this paper that need to be tackled in future research. First, the study samples applied in this paper are all over 2,000 m^2. The ignorance of smaller-scale potential samples may affect the overall representativeness of PRGs. Then, the respondents were limited to adults aged 18 and above, ignoring the users of younger age, especially teenagers.

CONCLUSION

This study revealed important findings about how usage patterns mediate the association between the PSD and PRS of users. It concluded that the five perceived sensory dimensions of social, refuge, serene, space and nature were induced into restorative effects through four patterns of use: retreat, nature touch, interpersonal interaction and family-bonding activities. It also found that family-bonding activities were the most

influential mediator in achieving positive restorative effects in the PRG, with the remaining activities ranked as follows: retreat > nature touching > interpersonal interaction. A comparison of the path coefficients of the dimensions revealed that "fascination" brings about slightly more restoration than the rest, suggesting that more attention should be given to the setting of scenes related to it. The study also confirmed that five out of the eight environmental characteristics of PRGs had restorative effects, with the degree of influence being social > serene > refuge > nature > space. The findings increased knowledge on the pathways linked to PSDs and PRS amongst users of PRGs. However, in view of the diverse functions of these sites (PRGs), future researchers should investigate whether the PSDs/PRS pathways established will significantly differ under different PRGs. Given this study also shows that access to restorative benefits depends not solely on the characteristics of the environment but also on the specific ways in which they use it, this will also lead to the question if typologies of PRGs will induce specific usage patterns, that in turn strengthening furthers the pathway. In addition to this, individual needs or external conditions will also have a distinctive effect on usage patterns, such as age, gender, income level (7, 90–93)or thermal condition (94–99). Hence, additional moderating variables could be potentially introduced into this model to further improve the theoretical framework and conceptual model of the correlation pathway in PRGs in future research.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

ZC and TZ: conceptualization. ZC and QD: methodology. ZC: investigation, visualization, and writing—original draft preparation. KKG and TZ: review. TZ and MZ: supervision. All authors have read and agreed to the published version of the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.801453/full#supplementary-material

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frontiers in Public Health

ORIGINAL RESEARCH
published: 25 February 2022
doi: 10.3389/fpubh.2022.777178

Volunteer Service and Well-Being of Older People in China

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Purpose: The social support theory suggested that involving older people in social activities could increase their level of social participation and interaction, which in turn improved their well-being. However, there has been a heated controversy about whether participating in volunteer services could enhance the well-being of older people, especially for the Chinese sample.

Method: Based on the data from the China Health and Retirement Longitudinal Study (CHARLS) in 2013, this paper used an ordered probit model to examine the impact of older people's participation in volunteer services on their well-being, as well as the differences in the impact across groups and the specific transmission mechanism.

Result: The empirical study found that Chinese older people's participation in volunteerism significantly enhanced their well-being, which remained robust after eliminating the possible effects of self-selection. Further heterogeneity analysis revealed that for female, non-party members and older adults with good economic status, participation in volunteerism has a higher increase in well-being. The mediating effect test indicated that older people's participation in volunteerism affected well-being mainly through enhancing positive emotions.

Conclusion: It is necessary to promote the participation of older people in volunteer services and to clarify the role of government support and advocacy. Proper guidance is given to change the role of older people as care recipients to that of service providers and caregivers, and to continuously enrich the programmes and content of volunteer service to safeguard the well-being of older people.

Keywords: older people, volunteer service, well-being, propensity score match, positive emotion

OPEN ACCESS

Edited by:
Harshavardhan Sampath, Sikkim Manipal University, India

Reviewed by:
Helmut Frohnhofen, Heinrich Heine University of Düsseldorf, Germany
Lynne Cohen, Edith Cowan University, Australia

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

Received: *15 September 2021*
Accepted: *14 January 2022*
Published: *25 February 2022*

Citation:
Yang H-l, Zhang S, Zhang W-c, Shen Z, Wang J-h, Cheng S-m, Tao Y-w, Zhang S-q, Yang L-x, Yao Y-d, Xie L, Tang L-l, Wu Y-y and Li Z-y (2022) Volunteer Service and Well-Being of Older People in China. Front. Public Health 10:777178. doi: 10.3389/fpubh.2022.777178

INTRODUCTION

At present, the population aging process of China is accelerating, and the number of the elderly population is increasing. Data from the seventh National Census in 2020 showed that China's elderly population aged 60 and above has reached 264 million, accounting for about 18.70% of the total population. By 2050, the elderly population is expected to reach 8.7 billion, accounting for 34.9% of the total population (1). In this demographic context, the mental health of older people

has been drawing widespread attention from the whole society. The *China Health and Retirement Report* stated that about 33.1% of the Chinese population over the age of 60 was at high risk of depression (2). Based on a detailed analysis of data from the 2014 China Longitudinal Aging Social Survey (CLASS), ∼24.78% of Chinese older people experience varying degrees of loneliness (3). Social participation theory suggests that social participation can help older people re-establish social networks, find social roles, recognize themselves in their roles, and enhance their sense of well-being. Supportive social networks can enable people to engage and stay involved in volunteering by providing instrumental and emotional support (4). It is widely accepted that participation in volunteering is associated with higher life satisfaction (5, 6), happiness (5) and positive emotion (6, 7) are related. At the same time, volunteer service may also promote the formation of supportive social relationships. There is broad consensus that supportive social relationships are beneficial to mental health and well-being (8, 9), by promoting positive emotions and acting as a stress buffer (10, 11).

According to the *Charity Blue Book: China Charity Development Report* in 2020, the number of registered volunteers in China reach 169 million, the total number of volunteer groups reach 1,163,600, and the accumulated volunteer service time reach 2,268 million hours. Specifically, among those who participate in volunteer services, the percentage of CPC (Communist Party of China) members is 13.81%. In addition, residents with higher level of education are more likely to volunteer, with the highest percentage of active volunteers with college education and above. However, there are still some shortcomings in China's current volunteer activities. Less than 10% of older volunteers over the age of 60 (12), and the main type of older people's volunteer service is informal volunteering, which refers to unpaid assistance to relatives, friends or neighbors who do not live together, and the participation of older people is obviously insufficient. In addition, there are differences in the participation rates of various types of volunteer service in China in terms of identity, generation, region, urban and rural areas, and the demand for volunteer service is much higher than the current actual participation rate. Therefore, how to further promote the development of volunteerism in China and encourage more people to participate has become a key concern for policy makers as well as many scholars.

Happiness is an important indicator of the quality of life of older people. In the modern sense, starting with the *Factors associated with self-reported happiness* of Wilson published in 1967, it refers to a series of emotions of delight and pleasure that humans subjectively produce based on their own satisfaction and security. This paper does not make a strict distinction between the concepts of happiness, subjective well-being, and life satisfaction. Therefore, based on the backgrounds above, this paper puts forward the topic to be discussed, that is, whether the participation of the Chinese older people in volunteer services will help to improve their well-being in order to deal with the happiness crisis? Besides, if there is a positive connection between the two, is there a difference in this connection among different groups? Then what is its mechanism?

Scholars all over the world have carried out different degrees of discussion on the impact of volunteer service on older people's well-being. This paper combs the impact results, impact extents and impact mechanism.

For the impact result, most scholars have found that volunteer service helps to improve the well-being of older people. Based on the survey data of life change in the United States, Willigen (13) used OLS model found that the more older people participated in volunteer services, the higher their happiness, while this impact was greater for older people than for younger groups. Meanwhile, Haski-Leventhal (14), Andiara et al. (15), Sarid et al. (16) and Ho (17) also used the survey data of Europe, Singapore, Israel and Pingtung County in Taiwan to verify the positive impact of volunteer service on the well-being. However, some scholars have found that there may be no connection between the two. For example, Menec (18) operationalised well-being as happiness and life satisfaction based on Manitoba aging survey data, and it was found that there was no significant relationship between volunteer service and happiness or life satisfaction. In a study of older people in Israel, Shmotkin et al. (19) also found that while volunteering had a significant effect on self-rated health and social relations, it did not have a significant effect on current life evaluation.

In terms of the degree of impact, there are differences in the promotion of well-being by older people participating in volunteer services. Firstly, different participation frequencies have different degrees of influence. Morrow-Howell et al. (20) found that there was a non-linear relationship between the frequency of volunteer service participation and well-being, which meant that there was an optimal frequency of participation. Windsor et al. (6) pointed out that there was an inverted U-shaped relationship between volunteer service and well-being. Older people with high levels of involvement had higher level of negative emotions than those who were not involved and those who were moderately involved in volunteering. However, Christina et al. (21) noted that older people with low and moderate levels of involvement had lower psychological well-being than those without volunteering, while only high levels of involvement significantly increased the psychological well-being of them. Secondly, Changes in the status of participation in volunteer services can also lead to changes in impact effects. Li et al. (22) used the data of the Taiwan older people's health and life survey, dividing the volunteer service status into five states, and it was found that "continuous participation" and "from inactive to active participation" have a significant positive impact on life satisfaction and depression, while "discrete participation" and "from active to inactive participation" only have a significant positive impact on life satisfaction. Thirdly, the degree of influence will vary depending on the characteristics of the individuals involved in the volunteer services. Connolly and O' Shea (23) found that the impact of volunteer service was greater for older, less educated, and retired groups. Besides, based on 2005 CGSS data, Miao and Zhang (24) used a treatment effects model and found that there was a social compensation effect when older people in disadvantaged positions participated in volunteering. In other words, disadvantaged older people were better able to enhance

their well-being through volunteering. Additionally, Jiang et al. (25) found that different social networks had different impact effects. For older people with fewer friends, the impact of volunteer service was more obvious.

As to the influence mechanism, scholars put forward different views based on different theoretical frameworks. By operationalising subjective well-being into life satisfaction, positive emotions and negative emotions, Greenfield and Marks (7) found that older people's participation in volunteering had a significant effect on life satisfaction as well as positive emotions, while the effect on negative emotions was not significant. In this regard, they believed that the impact of volunteer service on well-being was mainly achieved by improving life satisfaction and positive emotions. Similarly, Kahana et al. (26) reached the same conclusion. In addition, based on the Wisconsin follow-up survey data, Piliavin and Siegl (27) pointed out that older people's participation in volunteer services affected their mental health through social integration and the sense of being valued. The former meant that older people with less social relations were more likely to improve their mental health through volunteer service, while the latter meant that older people can realize their importance through volunteer service, which affected their mental health. From a social support perspective, Pilkington et al. (4) hypothesized that the impact of older people's volunteering on well-being was mainly through the type and quality of social support, and their findings suggested that social support from friends and family and positive social exchange played a mediating role.

Through the above literature review, it is found that participating in volunteer services may improve well-being of older people by improving their positive emotions, self-identity, and social support, while the frequency of individual involvement, changes in service status and differences in individual characteristics will in turn lead to differences in the degree of impact. These research conclusions are mainly based on the actual situation of developed countries. As a developing country, China's social development and the living situation of older people may have particularity, so the impact of volunteer service on well-being of them may be different. At the same time, considering the low proportion of older people participating in volunteer services, the single content of activities and the mandatory and obligatory characteristics of voluntary service, it is also worth exploring whether the above mechanisms of volunteer service on the well-being of older people are suitable for China. The existing research results provide a variety of possibilities. What is the relationship and mechanism between volunteer service and well-being of older people in China? We explored this in depth.

METHOD

Data

The data of this paper was from the 2013 China Health and Retirement Longitudinal Study (CHARLS), which was a large-scale interdisciplinary survey project hosted by the National Development Research Institute of Peking University. It aimed to collect a set of high-quality microdata representing the families and individuals of middle-aged and elderly people aged 45 and over in China. Referring to the *Law of the People's Republic of China on the Protection of the Rights and Interests of the Elderly*, this paper selected samples aged 60 and above and retained 4,403 samples after screening variable and cleaning data.

Variable

Dependent Variable

The dependent variable was well-being, which was people's evaluation of their own life, including emotional and cognitive aspects (28). Ma (29) pointed out that life satisfaction was a stable measure of people's long-term well-being based on a comprehensive evaluation of the multidimensional aspects of life and only the indicator of life satisfaction was available in the 2013 questionnaire, so this paper used life satisfaction to represent subjective well-being. Based on the question of "Overall, are you satisfied with your life?," well-being was divided into five levels.

Independent Variable

The independent variable was volunteer service which was defined as public service provided by volunteers, voluntary service organizations, and other organizations to society or others voluntarily and without compensation in the *Voluntary Service Ordinance*. Considering that volunteering in China was characterized by unpaid service and helping people (30), this paper regarded "providing free help to relatives, friends or neighbors who do not live with you" as informal volunteering, and "volunteering or charitable activities" as formal volunteering. Respondents who participated in at least one of them were defined as participating in volunteering.

Control Variable

Considering that other factors had an impact on well-being, this paper selected the respondents' individual, family, and socio-economic characteristics as control variables referring to the research of Wang (31). The details were shown in **Table 1**.

Mediating Variable

Liu (32) stated that social interaction affected older people's life satisfaction through depression. Meanwhile, Greenfield and Marks (7) found that older people's involvement in volunteering could enhance well-being through positive emotions. In order to investigate the mechanism, the responses to "I'm worried about some small things," "I feel depressed," "I feel scared," "I feel lonely," and "I feel unable to continue with my life' were assigned a value of 0–3 in turn, and summed to obtain the level of negative emotion. Similarly, positive emotion level was obtained through 'I am hopeful about the future" and "I am happy."

Model

Ordered Probit Model

As the dependent variable was an ordered variable, this paper used an ordered probit model for estimation, which was set up as followed:

$$happeniness_i = F\left(c * volunteer_i + \gamma X_i + \varepsilon_i\right) \quad (1)$$

TABLE 1 | Variable definition.

Variable	Variable definition
Happiness (*happiness)*	Not satisfied at all = 1, not very satisfied = 2, relatively satisfied = 3, very satisfied = 4, extremely satisfied = 5
Volunteer service (*volunteer)*	Participating in voluntary service = 1, not participating in voluntary service = 0
Gender (*gender)*	Male = 1, female = 0
Age (*age)*	2013-year of birth
ADL (*adl)*	Activities of Daily Living, whether there were difficulties in dressing, eating, bathing, getting in and out of bed, going to the toilet, and controlling bowel movements. Continuous variable. The higher the value, the greater the difficulty.
IADL (*iadl)*	Instrumental Activity of Daily Living, whether there were difficulties in doing housework, cooking, shopping, making phone calls, taking medicine, and managing money. Continuous variable. The larger the value, the greater the difficulty.
Chronic disease (*cdisease)*	Number of chronic diseases
Partner (*partner)*	With partner =1, no partner =0
Live with children (*livechild)*	Yes = 1, no = 0
Number of family members (*hhsize)*	Number of family members
Children's financial support (*lnfinsup)*	The sum of money and material provided by children in the past year, and taking the logarithm.
political look (*party)*	Chinese Communist Party member = 1, others = 0
Years of education (*edu)*	Illiterate = 0, unfinished primary school or private school = 3, primary school graduation = 6, junior middle school graduation = 9, high school or technical secondary school graduation = 12, college graduation = 15, undergraduate graduation = 16, master graduation = 19
Pension insurance (*pension)*	Having pension insurance = 1, not having pension insurance = 0
City (*urban)*	Urban = 1, rural = 0
Working status (*work)*	With work =1, no work = 0
Economic status (*lnasset)*	The sum of personal financial assets (cash, deposits of financial institutions, bonds, stocks, and funds), and taking the logarithm.
Positive emotion (*positive)*	The higher the value, the more positive.
Negative emotion (*negative)*	The higher the value, the more negative.

The name of variable in the model were indicated in parentheses.

$volunteer_i$ indicated participation in volunteer service; X_i was a series of control variables; ε_i was the random error term. In addition, referring to Chen et al. (33) who regarded discrete variable as ordinal variable and then adopted OLS regression model, this paper also added OLS regression results to compare with the results of ordered probit model.

Propensity Score Matching

The participation of older people in voluntary service was a self-selection behavior (24, 34). For example, happier people are more likely to participate in voluntary service. If it was not handled effectively, the impact of participation in voluntary services on well-being in the regression results may not have internal validity. PSM could well-eliminate the endogenous threat caused by self-selection. The participants' average treatment effect (ATT) was obtained through the following model:

$$\begin{aligned} ATT &= E[happeniness_{1i}|D_i = 1, p(X_i)] \\ &- E[happeniness_{0i}|D_i = 0, p(X_i)] \end{aligned} \quad (2)$$

Here, $happeniness_{1i}$ was the well-being of treatment group; $happeniness_{0i}$ was the well-being of control group. $D_i = 1$ indicated participation in volunteer services, while$D_i = 0$ indicated that older people did not participate in volunteer services.

Mediating Effect Test

In order to explore whether participation in voluntary services affected well-being by improving positive emotions and inhibiting negative emotions, this paper added formulas (3) and (4) referring to Wen and Ye (35):

$$happeniness_i = F\left(c * volunteer_i + \gamma X_i + \varepsilon_i\right) \quad (1)$$

$$M_i = a * volunteer_i + \gamma X_i + \varepsilon_i \quad (3)$$

$$happeniness_i = F\left(c' * volunteer_i + b * M_i + \gamma X_i + \varepsilon_i\right) \quad (4)$$

Here, c represented the total effect of participation in voluntary services on well-being. a was the effect of voluntary services on intermediary variable M_i. b was the effect of intermediary variable on well-being. c' represented the direct effect of voluntary service on well-being under the control of intermediary variable. At this time, the intermediary effect was equal to the indirect effect, expressed as a coefficient product ab.

RESULTS

Statistical Description of Variables

Table 2 showed the main statistics of variables. As shown in **Table 2**, the mean value of well-being level was 3.151, which was generally at a relatively satisfactory level. Among them, the well-being level of older people who participated in volunteering was 3.262, higher than those who did not, and this difference was statistically significant at the 1% level. In terms of volunteer service participation, about 10.2% of the sample participated in volunteer services, indicating that the current level of volunteering participation for Chinese older people was low.

Basic Regression Results

Table 3 showed the regression results, in which models (1) and (2) were the ordered probit regression results, and models (3) and (4) were the OLS regression results. According to the results of both models, we could know that the participation of older people in voluntary service has a positive impact on their well-being. That is, older people who participated in volunteer services had an increased sense of well-being compared to those who did not, which was significant at the 1% level. This was in line with the research of other scholars (4, 13).

TABLE 2 | Descriptive statistics of variables.

Variable	Total (N = 4,403)				Participating in volunteer service (N = 450)		Not participating in volunteer service (N = 3,953)	
	Mean	Std.Dev	Min	Max	Mean	Std.Dev	Mean	Std.Dev
Happiness	3.151	0.744	1	5	3.262***	0.754	3.138	0.742
Volunteer	0.102	0.303	0	1	–	–	–	–
Gender	0.464	0.499	0	1	0.480	0.500	0.462	0.499
Age	67.958	6.346	60	95	66.231***	5.324	68.155	6.423
Cdisease	1.529	1.399	0	8	1.578	1.442	1.523	1.394
Adl	0.712	1.688	0	17	0.602	1.308	0.724	1.726
Iadl	1.724	3.178	0	18	1.087***	2.104	1.796	3.271
Partner	0.819	0.385	0	1	0.822	0.383	0.818	0.386
Hhsize	4.648	1.733	1	15	4.722	1.806	4.64	1.724
Livechild	0.471	0.499	0	1	0.500	0.501	0.468	0.499
Lnfinsup	6.596	2.953	0	12.567	6.709	2.814	6.584	2.968
Party	0.126	0.332	0	1	0.149	0.356	0.124	0.329
Edu	4.094	3.830	0	19	4.936***	4.076	3.998	3.790
Pension	0.903	0.295	0	1	0.904	0.294	0.903	0.295
Work	0.531	0.499	0	1	0.627***	0.484	0.520	0.500
Lnasset	5.985	3.119	0	13.999	6.508***	3.213	5.926	3.102
Urban	0.377	0.485	0	1	0.400	0.490	0.375	0.484
Negative	2.814	3.332	0	15	2.807	3.133	2.815	3.354
Positive	2.779	2.08	0	6	3.211***	2.052	2.730	2.078

****, ** and *, respectively, indicate the significance of the t-test results of the difference between the volunteer service group and the non-volunteer service group at the statistical level of 1, 5, and 10%.*

In terms of control variables, age (36), social pension insurance, financial situation, and town life had a significant effect on subjective well-being. Spouse status, living with children and children's economic support also could significantly promoted their well-being (37). Limited ability to perform daily activities and chronic illnesses could reduce the well-being. It was surprising that there was a significant negative relationship between education level and subjective well-being (33).

Robustness Test

In order to eliminate the selection bias caused by self-selection, propensity score matching method was used for robustness test in this paper. A balance test was conducted and the results were shown in **Table 4**. The deviation rate of all variables after matching was reduced to <2.5%, and the difference between the treatment and the control group was not significant, which also showed that the matching effect was good.

This paper used K-nearest neighbor matching, radius matching and kernel matching methods to match the treatment group with the control group, and then calculated the treatment effect. The results in **Table 5** showed that participation in volunteer services by older people was an effective way to improve well-being. By comparing the pre-matching and post-matching results, it could be found that all post-matching results were improved, suggesting that the effect of older people's participation in volunteering on well-being was underestimated when the effect of self-selection waas not taken into account.

Heterogeneity Analysis

In order to further discuss the differences in the impact of older people's participation in volunteer services on their well-being, this paper used PSM method to test gender, political look and economic status, respectively. The results were shown in **Table 6**.

From the perspective of gender, participation in volunteer services significantly increased the well-being of both male and female older people. In particular, participation in volunteer service contributed more to the well-being of female older people than male. However, the result was contrary to the finding of some scholars (38). For individuals' political look, volunteer services did not significantly enhance the well-being of older people who were party members, while non-party members' well-being could be significantly improved. In terms of economic status, taking the median as the boundary, this paper classified older people whose economic status was higher than or equal to the median as good economic status, while the left was sorted as general economic status. The results showed that participation in volunteer services by well-off older people had a more significant effect on the well-being than those of the general economic status.

Intermediary Mechanism Analysis

To further discuss whether older people's participation in volunteer service affected well-being by enhancing positive

TABLE 3 | Basic regression results.

	Ordered Probit		OLS	
	(1)	(2)	(3)	(4)
Volunteer	0.179***	0.207***	0.124***	0.139***
	(0.055)	(0.056)	(0.037)	(0.037)
Gender		−0.012		−0.003
		(0.037)		(0.025)
Age		0.019***		0.013***
		(0.003)		(0.002)
Cdisease		−0.044***		−0.029***
		(0.012)		(0.008)
Adl		−0.043***		−0.030***
		(0.012)		(0.008)
Iadl		−0.018***		−0.013***
		(0.007)		(0.005)
Partner		0.120**		0.075**
		(0.051)		(0.034)
Hhsize		−0.000		0.001
		(0.012)		(0.008)
Livechild		0.077**		0.049**
		(0.038)		(0.025)
Lnfinsup		0.025***		0.016***
		(0.006)		(0.004)
Party		0.048		0.031
		(0.054)		(0.035)
Edu		−0.021***		−0.014***
		(0.005)		(0.003)
Pension		0.121**		0.085**
		(0.057)		(0.038)
Work		−0.033		−0.024
		(0.039)		(0.026)
Lnasset		0.019***		0.013***
		(0.006)		(0.004)
Urban		0.113***		0.071***
		(0.039)		(0.025)
Cons			3.138***	2.054***
			(0.012)	(0.156)
N	4,403	4,403	4,403	4,403
R^2			0.003	0.042

*These in brackets are standard errors; ***, ** and * indicate the significance at the statistical level of 1, 5, and 10%, respectively.*

emotions and suppressing negative emotions, the mediating effect test was conducted and the results were shown in **Table 7**.

From the results of models (5) and (6), it could be seen that older people's participation in volunteering could enhance their positive emotions, which in turn contributed to their well-being. The coefficient on the core explanatory variable became smaller and its significance decreased but remained significant at the 10% level, thus it could be argued that positive emotions played a partially mediating role. Based on models (7) and (8), we could know that there was a significant association between negative emotions and well-being when controlling for participation in volunteer services. However, the association between volunteer service and negative emotions was not significant, implying that volunteer service may not affect well-being through negative emotion changes. To ensure the accuracy of the result, this paper used the Bootstrap method to test the indirect effect. The results showed that the indirect effect coefficient was −0.004 ($p = 0.688 > 0.1$), which was not significant. It can thus be concluded that older people's participation in volunteering did not lead to changes in well-being by affecting negative emotions. Kahana et al. (26) suggested that this may be due to the fact that negative emotions were more associated with negative life events and circumstances and less associated with social engagement.

DISCUSSION

Participation of Older People in Volunteer Services Can Improve Their Well-Being

Activity theory suggests that the higher the level of social participation, the higher the life satisfaction. The logic behind this is that life satisfaction stems from the clear self-understanding, which in turn stems from a new role, and a new role stems from social participation. Therefore, through participation in formal or informal volunteering, older people gradually develop a new role and a clearer understanding of themselves, which in turn increases their sense of well-being.

Many scholars have found that older people's participation in volunteer service has a positive impact on well-being (14–17). Willigen (13) pointed out from a life course perspective that the roles played by individuals had different meanings at different stages of life. For young people, the volunteer role may be an extension of an existing role, such as being a good parent, employee, etc. For older people, however, volunteering is a substitute choice, for example, by volunteer service instead of watching television at home. Therefore, the volunteer role has a greater significance for older people. Pilkington et al. (4) indicated that individuals who participated in volunteer services received more social support from family and friends, which in turn enhanced well-being. Through volunteering, older people can establish and develop new social connections and build and strengthen their social support system. In addition, existing social connections also provide emotional and instrumental social support to enable them to continue volunteering and further enhance their well-being.

Participation in Volunteer Services Contributes More to the Well-Being of Older Female Than Older Male

This is contrary to the findings of Cao and Wang (38). One possible explanation is that after retirement, female shift from an instrumental role in the workplace to a purely emotional role, with a family focus and a shift in the focus of interpersonal interactions from colleagues to relatives, resulting in a compressed space of activities limited to the family internal domain, therefore, it is more prone to negative emotions (39). Participation of older female in volunteering is beneficial to their adaptation to the role change and expansion of social interaction channels.

TABLE 4 | Balance test.

Variable	Mean value				Deviation reduction rate (%)	*T*-test	
	Sample	Processing group	Control group	Deviation rate (%)		*T*-score	P>|T|
Gender	Before matching	0.480	0.462	3.6	98.8	0.72	0.473
	After matching	0.480	0.480	0.0		0.01	0.995
Age	Before matching	66.231	68.155	−32.6	97.1	−6.12	0.000
	After matching	66.231	66.176	0.9		0.15	0.877
Cdisease	Before matching	1.578	1.523	3.9	5.2	0.79	0.432
	After matching	1.578	1.526	3.7		0.54	0.586
Adl	Before matching	0.602	0.724	−8.0	78.7	−1.45	0.147
	After matching	0.602	0.576	1.7		0.29	0.776
Iadl	Before matching	1.087	1.796	−25.8	90.2	−4.50	0.000
	After matching	1.087	1.017	2.5		0.48	0.630
Partner	Before matching	0.822	0.818	1.0	36.6	0.20	0.841
	After matching	0.822	0.825	−0.6		−0.10	0.923
Hhsize	Before matching	4.722	4.640	4.7	69.2	0.95	0.340
	After matching	4.722	4.748	−1.4		−0.21	0.832
Livechild	Before matching	0.500	0.468	4.3	77.0	0.85	0.394
	After matching	0.500	0.506	−1.0		−0.15	0.879
Lnfinsup	Before matching	6.709	6.584	4.3	77.0	0.85	0.394
	After matching	6.709	6.738	−1.0		−0.15	0.879
Party	Before matching	0.149	0.124	7.3	98.2	1.52	0.128
	After matching	0.149	0.148	0.1		0.02	0.985
Edu	Before matching	4.936	3.999	23.8	92.5	4.93	0.000
	After matching	4.936	4.865	1.8		0.27	0.791
Pension	Before matching	0.904	0.903	0.4	−85.2	0.07	0.941
	After matching	0.904	0.906	−0.7		−0.10	0.918
Work	Before matching	0.627	0.520	21.6	93.9	4.29	0.000
	After matching	0.627	0.633	−1.3		−0.20	0.842
Lnasset	Before matching	6.508	5.926	18.4	87.0	3.75	0.000
	After matching	6.508	6.432	2.4		0.37	0.713
Urban	Before matching	0.400	0.375	5.2	60.5	1.05	0.293
	After matching	0.400	0.390	2.1		0.31	0.759

TABLE 5 | Average processing effect of participation in volunteer services on well–being.

Method	Sample	Processing group	Control group	ATT	Standard error
K-nearest neighbor matching	Before matching	3.262	3.138	0.124***	0.037
	After matching	3.262	3.117	0.145***	0.041
Radius matching	Before matching	3.262	3.138	0.124***	0.037
	After matching	3.262	3.127	0.133***	0.038
Kernel matching	Before matching	3.262	3.138	0.124***	0.037
	After matching	3.262	3.127	0.136***	0.038

****, ** and *, respectively, indicate the significance of variables at the statistical level of 1, 5, and 10%; The matched standard error is obtained by bootstrap method, and the self-service sample is 500.*

The Involvement of Non-party Members in Volunteer Services Can Significantly Improve Their Well-Being

For party members, Ding (40) pointed out that the *Constitution of the Communist Party of China* clearly stipulated the obligations of party members, requiring them to serve the people wholeheartedly, be self-sacrificing and make more contributions. This "altruistic spirit" has been implicitly seen by party members as their own part of the job. Xie (41) also suggested that political look was a special kind of cultural capital in China. For many older party members, they still demand themselves by putting others before themselves, serving the people, etc.

TABLE 6 | Heterogeneity test results.

Method	Male			Female		
	N	**ATT**	**Standard error**	***N***	**ATT**	**Standard error**
K-nearest neighbor matching	2,031	0.115*	0.062	2,335	0.141**	0.056
Radius matching	2,028	0.114**	0.055	2,328	0.143***	0.054
Kernel matching	2,031	0.116**	0.055	2,335	0.156***	0.050
Method	**Party member**			**Non-party member**		
	N	**ATT**	**Standard error**	***N***	**ATT**	**Standard error**
K-nearest neighbor matching	516	0.006	0.093	3,838	0.158***	0.043
Radius matching	508	0.028	0.099	3,836	0.148***	0.042
Kernel matching	516	0.031	0.092	3,838	0.152***	0.043
Method	**Good**			**General**		
	N	**ATT**	**Standard error**	***N***	**ATT**	**Standard error**
K-nearest neighbor matching	2,451	0.135**	0.054	1,916	0.115	0.076
Radius matching	2,451	0.134***	0.045	1,912	0.116*	0.067
Kernel matching	2,451	0.128***	0.045	1,916	0.129*	0.068

****, ** and *, respectively, indicate the significance of variables at the statistical level of 1, 5, and 10%; The matched standard error bootstrap shows that there are 500 self-service samples; The sample size here is the sample in the common support interval.*

From this perspective, party members' participation in volunteer services may be seen as a process of fulfilling their duties, rather than as a means of enhancing their well-being. However, for non-party members, there may be relatively few channels for their social participation. Thus, participation in volunteer services, as an important way of social participation, prompts non-party members to form new roles and deepen their self-understanding in the process of volunteer service, effectively enhancing well-being.

The Better the Financial Situation of Older People, the More Significant the Effect of Volunteer Services on Well-Being

Hierarchical theory of needs states that individual needs can be categorized from low to high into five needs: physiological, safety, love and belonging, respect, and self-actualisation. Generally speaking, individuals will only pursue higher level needs when the lower level needs are satisfied. From this perspective, volunteer services can be seen as a channel for self-actualisation that can satisfy higher level needs. Therefore, for individuals with good economic status, after the lower level needs are satisfied, it is obvious that participating in volunteer services as a way to gain social connection and recognition, and to realize self-worth, has a more significant effect on their well-being. Conversely, for individuals of modest means, the more pressing needs are likely to be physiological and safety needs, and the pursuit of higher-level needs is not as high, thus volunteer services participation has a relatively small contribution to their well-being.

TABLE 7 | Test results of mediating effect.

	(5)	**(6)**	**(7)**	**(8)**
	Positive	**Happiness**	**Negative**	**Happiness**
Volunteer	0.411***	0.149*	0.057	0.224***
	(0.103)	(0.056)	(0.156)	(0.056)
Positive		0.189***		
		(0.009)		
Negative				−0.102***
				(0.006)
Control variables	Yes	Yes	Yes	Yes
N	4,403	4,403	4,403	4,403

****, ** and *, respectively, indicate the significance of variables at the statistical level of 1, 5, and 10%.*

Older People's Participation in Volunteer Services Enhances Well-Being by Influencing Positive Emotions

In China, the traditional virtue of helping others is deeply rooted in people's hearts. People are happier when they help others, which means that when you give a rose to someone, you get a reward. Volunteer services as a means of social participation, in the process of helping others, people can gain a sense of being valued and identified, their self-worth is realized and they realize their importance (27), which is conducive to a higher positive emotions and thus a higher sense of well-being. Greenfield and Marks (7) also suggested that the impact of volunteer services on subjective well-being was mainly through increased life

satisfaction and positive emotions, and Kahana et al. (26) reached the same conclusion. Furthermore, in return for providing services and assistance, older people who participate in volunteer services will also gain other social support and connections, strengthening their social networks, which will contribute to maintaining their positive emotions and enhancing well-being.

CONCLUSIONS

Based on 2013 CHARLS data, the empirical findings of this paper show that Chinese older people's participation in volunteer services contributes to their well-being, which is more pronounced in older people who are female, non-party, and in good financial situations. The impact of volunteer service on well-being is mainly achieved through the enhancement of positive emotions. This paper systematically reviews the worldwide literature on the relationship between older people's participation in volunteer services and well-being, enriching the social support theory account of well-being, providing a test of empirical evidence of social support theory in China, and complementing the mechanisms by which participation in volunteer service affects older people's well-being.

In conclusion, firstly, all relevant authorities in all countries should play an advocacy and support role to promote the participation of older people in volunteer services. On the one hand, media campaigns are needed to guide older people to change their traditional role of being cared for and to encourage them to actively use their strengths to participate in volunteering. On the other hand, the government should also provide relevant policies to support the development of community volunteering organizations and provide a platform for older people to participate in volunteering. Secondly, when organizing volunteer services for older people, volunteer projects and content should be enriched so that they can choose volunteer projects to participate in according to their own situation. For example, for the party members, community backbone cultivation programmes can be designed to bring into play their role as role models, which in turn can lead to the participation of other community members. Finally, communities and grassroots organizations can provide suitable volunteering models and channels for older people according to the actual situation. For example, the Time Bank Model, through the introduction of time credits, allows individuals to accumulate time credits of equal length when providing services to others, which can later be exchanged for goods or services. At the same time, they receive social support and this objectively promotes the formation of mutual social networks and support systems, improving the social welfare of older people and safeguarding the welfare of them.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: http://charls.pku.edu.cn/pages/data/2018-charls-wave4/zh-cn.html.

AUTHOR CONTRIBUTIONS

H-lY and W-cZ conceived this research. H-lY, ZS, W-cZ, SZ, and L-lT were responsible for the methodology. S-qZ, SZ, and L-xY conducted software analyses. S-qZ, ZS, Y-wT, and Y-yW conducted necessary validations. W-cZ and J-hW conducted a formal analysis and managed the investigation. Y-dY, ZS, SZ, Y-wT, and W-cZ gathered resources, curated all data, wrote and prepared the original draft, and were responsible for project administration. LX, L-lT, and Z-yL reviewed and edited the manuscript, were responsible for visualization, supervised the project, and acquired funding. All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by the Later funded projects of National Social Science Foundation (Grant number: 21FRKB003).

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frontiers in Public Health

ORIGINAL RESEARCH
published: 04 March 2022
doi: 10.3389/fpubh.2022.825415

The Relationship Between Self-Care Behavior and Concerns About Body Image in Patients Undergoing Hemodialysis in Iran

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OPEN ACCESS

Edited by:
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University of Rome Tor Vergata, Italy

Reviewed by:
Sima Hejazi,
North Khorasan University of Medical Sciences, Iran
Maryam Bakhshandeh Bavarsad,
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Public Health

Received: 30 November 2021
Accepted: 27 January 2022
Published: 04 March 2022

Citation:
Sharif Nia H, Kohestani D, Froelicher ES, Ibrahim FM, Ibrahim MM, Bayat Shahparast F and Goudarzian AH (2022) The Relationship Between Self-Care Behavior and Concerns About Body Image in Patients Undergoing Hemodialysis in Iran. Front. Public Health 10:825415. doi: 10.3389/fpubh.2022.825415

Background and Aim: Hemodialysis treatment saves the life of people with end-stage renal disease (ERDS), but does not prevent the suffering of the disease, anxiety, hopelessness, and so on. Many studies have been performed on self-care behaviors as well as body image in different patients, but so far, no research has been done to investigate the relationship between self-care behavior and body image concerns in hemodialysis patients. Therefore, the aims of this study are to determine the relationship between self-care behavior and body image concern in patients undergoing hemodialysis.

Materials and Methods: A cross-sectional design was used to evaluate Self-care Behavior and Concerns about Body Image in a convenience sample of 280 patients with ERDS. Measures included demographic factors, health characteristics, and validated instruments of the study constructs Body Image Concern Questionnaire (BICI) and Assessment of self-care behaviors with arteriovenous fistula (ASBHD-AVF).

Results: This study showed that self-care behaviors have the ability to predict body image concerns. There was a negative and significant relationship between self-care behavior and body image concern ($B = -0.162$, $\beta = -0.140$, $p = 0.020$). These variables explain 7.5% of predictors.

Conclusion: Although the findings of the present study showed that increasing age and improving the level of self-care behaviors in patients undergoing hemodialysis reduces body image anxiety, but women were the strongest predictor of body image anxiety.

Keywords: self-care behavior, body image concern, hemodialysis, Iran, chronic renal failure

INTRODUCTION

End-stage renal disease (ESRD) is a chronic and debilitating disorder; whereby a patient requires peritoneal dialysis or hemodialysis (several times a week) to survive (1). Conditions that result in ESRD in individuals include type 2 diabetes, hypertension, glomerulonephritis and interstitial nephritis (2). In the United Kingdom, over 115 new patients per million receive dialysis treatment annually. Reports from the United States suggest that the prevalence of ESRD increased by 600% between 1980 and 2009. Also, more than 1 in 7, that is 15% of US adults or 37 million people, are estimated to have CKD (3). According to reports from the Iranian management center for transplantation and special diseases, the prevalence of ESRD among the Iranian population has increased over the last few years (4). Overall, the prevalence of ESRD varies across countries (2).

Hemodialysis treatment saves the lives of people with ESRD, but it does not prevent the pain associated with the disease. The number and seriousness of symptoms increase with age and length of dialysis treatment (5). These people will be confronted with lifestyle limitations to cope with their illness, which can greatly affect people's social functioning, beliefs, sense of control, compatibility, and ultimately their body image (6). Body image is a patient's mental image of their body, which is a complex structure with thoughts, feelings, evaluations and behaviors related to the body, and it has a great impact on the formation of individual identity (7). There are different criteria for evaluating a patient 's self-image, which vary in different societies (8).

In fact, the body with which we live plenarily influences our life experiences. As Plato stated: "Like oysters, which are attached to their shells, we are also attached to our bodies". People tend to keep their body image intact and endeavor not to be affected by changes, injuries or losses in terms of function or body organs. Because any change is considered a threat by, the individual and can lead to anxiety and fear. The most common conditions that lead to changes in body image from the perspective of individuals are receiving medical treatment, amputation, and changes in body functions. Patients with ESRD experiences several clinical conditions at the same time that can lead to a change in body image (9, 10).

Patients undergoing hemodialysis experience both physical and psychological problems such as feelings of fear, anxiety, and hopelessness. Also, patients often suffer from body image disorders. Patients with ESRD often have impaired body image and have difficulty accepting it due to changes in their physical appearance (11). Dissatisfaction with the body is accompanied by social anxiety, shame, depression, decreased self-efficacy, and reduced quality of life (12). Self-efficacy plays an important role in influencing individual behavior. Strong feelings of self-efficacy are associated with better health, greater success, and greater social integration, while feelings of low self-efficacy are associated with depression, stress, and decreased motivation and cognitive abilities (13). Self-efficacy is the main predictor of self-care behaviors (14). It is conscious self-care behaviors that enables people to consciously engage in appropriate self-care behaviors (15).

In addition, dialysis affects the life of the patient and the family, so it is necessary to have an effective strategy in order to reduce dependence, maintain self-esteem, and reduce concerns about body image of individuals. However, studies show that health care providers do not know enough about body image (16). Self-care is a viable strategy for acclimating to life events and stresses, which leads to independence and promotes health by sticking to treatment and performing routine life activities (17). Self-care is characterized as the performance of individual duties to protect life, health, and well-being, that are progressively made (18). Maintaining people's participation in self-care interventions is especially important when a patient has a chronic illness. People with ESRD can adapt to the changes needed to improve their health and take full responsibility for their caregiving activities with active participation (19).

Positive engagement with their family members can lead to better decisions and self-care. Many people need psychological support from health care groups, and it is important to recognize this at the beginning (20). When a patient complains of physical discomfort, it is important to understand that his or her body image has changed, as this will be effective in providing supportive measures (10). Orem is one of the theorists that talks about self-care. According to this theorist, one should take care of oneself and others (21). A study conducted by Cook-Cottone (15) showed that active participation in health care affects body image (15). Other researchers have also shown that self-conscious care is introduced as an antidote to social pressures as well as an enforceable set to foster positive imagery.

If people have a positive body image despite the changes in their bodies appearance, their behaviors will show more self-care, which will ultimately improve the quality of their health (15). Self-care behaviors such as medical care, nutrition, hydration, and exercise are enhanced by strengthening the inner aspects of a patient 's perception of their body. Attention to the body needs is a necessary aspect of self-care behaviors and is likely associated with the positive body image (15). According medical sciences, body image can affect the results of medical interventions, especially for chronic diseases (16). There are many studies on self-care behaviors and body image in different patients (22–25), but no research has been done to investigate the relationship between self-care behavior and body image concerns in hemodialysis patients. Thus, the present study aims to determine the relationship between these two variables in patients undergoing hemodialysis.

MATERIALS AND METHODS

Design and Participants

This study uses a cross sectional study design. It was conducted in 2018. The sample size was estimated using by G*Power 3.1.7 software making the following assumptions: a two-tailed significance level $\alpha = 0.05$, power 80%, and effect size $d = 0.3$ the sample size was estimated to be 280 patients. The study population was comprised of patients with a diagnosis of ESRD and undergoing hemodialysis referred to Shahrvand Dialysis in Sari. A convenience sampling method was used. Inclusion criteria were: ability to read and write, age 18 years and older. Exclusion

criteria were: alcoholism, mental, emotional and verbal problems, decreased level of consciousness, gastrointestinal diseases such as peptic ulcer and gastroesophageal reflux disease, and congestive heart failure.

Instruments

Data collection tools included a demographic registration form and Littleton's Body Image Concern Inventory Questionnaire (BICI) and the Assessment of Self-care Behaviors with Arteriovenous Fistula (ASBHD-AVF).

Body Image Concern Questionnaire

The 19-item Body Image Concern Questionnaire was first designed and validated by Littleton et al. (26). This questionnaire examines a patient 's dissatisfaction, fear and embarrassment regarding appearance, checking and hiding perceived imperfections, and the interference of a patient 's fear of appearance with social performance. The response options were a five-point Likert scale ranging from never = 1 to always = 5 (26). The total score of the questionnaire can varys between 19 and 95, and the highest score indicates more dissatisfaction with the body image or appearance. The reliability of this questionnaire in a sample of university students using Cronbach's alpha method was 0.93, the correlation of total items was between 0.32 and 0.72 and finally the validity coefficient of this questionnaire was 0.83 (26). The BICI has been translated into Persian and validated with satisfactory psychometric properties in an Iranian population (27–29). In the present study, the reliability of the questionnaire by Cronbach's alpha method was 0.94.

Assessment of Self-Care Behaviors With Arteriovenous Fistula

ASBHD-AVF consists of 16 items in two dimensions; that include the management of signs and symptoms (6 items) and the prevention of complications (10 items). The total score is between 16 and 80, and the highest score indicates a higher level of caring behavior (30). Several Persian studies have used ASBHD-AVF and it has reported high validated with satisfactory psychometric properties among Iranian populations with hemodialysis patients (31). The reliability of the questionnaire was calculated using Cronbach's alpha and was equal to 0.87.

Ethical Considerations

Approval from the Ethics Committee at the Mazandaran University of Medical Sciences was obtained (Study ID number IR.MAZUMS.REC.1398.611). Written informed consent was obtained from all patients. The researchers went to the Shaharvand Dialysis and explained the objectives of the study to those who wanted to participate in the study.

Data Analysis

Data were analyzed using SPSS26. The normal distribution of continuous quantitative data was investigated using the Kolmogorov-Smirnov test. Simple linear regression was used to analyze the relationship between self-care variables and body image in hemodialysis patients. Moreover, variables that were significant in simple linear regression were tested simultaneously in multiple linear regression. The significance level of all tests was considered less than $\alpha < 0.05$.

TABLE 1 | Demographic characteristics of the patients in the study ($n = 280$).

	Variable	Frequency (percentage)
Sex	Male	157 (56.1%)
	Female	123 (43.9%)
Marital status	Single/non-partnered	17 (6.1%)
	Married	253 (90.4%)
	Divorced	9 (3.2%)
	Widowed	1 (.4%)
Economic status	Lower income	77 (27.5%)
	Middle income	169 (60.4%)
	Middle-high income	32 (11.4%)
	High income	2 (.7%)
Level of education	Under high school diploma	241 (86.1%)
	Bachelor and master	32 (11.4%)
	Higher than a master's degree	7 (2.5%)
Age		**Mean ± standard deviation (S.D)**
		56.98 ± 13.48

RESULTS

Sample Characteristics

The subject's age was mean = 56.97; SD = 13.48 (age range 21–94 years), respectively (**Table 1**) (Of these, 90.4% were married, 56.1% were men, and 60.4% had moderate economic status and about 86.1% of these patients had a diploma. Total score of self-care behavior (95%: CI: 64.44, 67.21, SD = 11.63, Mean = 65.82) and body image concern (CI 95%: 29.19–32.40, SD = 13.48, Mean = 30.80).

Table 2 shows the results of a simple linear regression between the variables of age, sex, level of education and self-care behavior with concern about body image, age variables ($B = -0.164$, $\beta = -0.163$, $P = 0.007$), gender ($B = 4.169$, $\beta = 0.154$, $p = 0.011$) and self-care behavior ($B = -0.162$, $\beta = -0.140$, $p = 0.020$) are predictable. However, there was no significant relationship between education level variables ($B = 0.597$, $\beta = 0.019$, $p = 758$) economic status ($B = 1.42$, $\beta = 0.066$, $p = 0.247$) and body image concerns. **Table 2** provides the results of a multiple linear regression, it was determined that after entering the age variables ($B = -0.179$, $\beta = -0.179$, $p = 0.003$), gender ($B = 4.072$, $\beta = 0.150$, $p = 0.011$) and self-care behavior ($B = -0.190$, $\beta = -0.164$, $p = 0.006$). Multiple regression model became significant. This regression model explains 7.5% of the predictors of body image concern in hemodialysis patients.

DISCUSSION

In this study, variables such as age, sex and self-care behavior were found to predict body image concerns in patients with

TABLE 2 | Results of body image predictor variables ($n = 280$).

Predictive variables	Simple linear regression				Multiple linear regression			
	B	β	***p*-value**	**CI 95%**	***B***	β	***p*-value**	**CI 95%**
Age (year)	−0.164	−0.163	0.007	−0.282 to 0.042	−0.179	−0.179	0.003	−0.296 to −0.063
Gender (man/woman)	4.169	0.154	0.011	0.978 to 7.36	4.072	0.15	0.011	0.948 to 7.197
Level of education	0.597	0.019	0.758	−3.120 to 4.277	-	-	-	-
Economic status	1.42	0.066	0.247	−1.124 to 3.983	-	-	-	-
Self-care behavior	−0.162	−0.14	0.020	−0.299 to −0.025	−0.19	−0.164	0.006	−0.324 to −0.055

hemodialysis. However, no meaningful relationships were found between variables such as education level and economic status with body image concerns. A study by Chen (10) entitled Body Image and Related Factors among Cervical Cancer Patients in China who have had surgical treatment showed that in women, there are fewer active coping strategies and people with higher education are more likely to have a lower body image (10). Body image consists of perceptions, thoughts, feelings, and behaviors related to the appearance, abilities, and functions of the body (32). Concern of body image is determined by sociocultural ideals and also sociocultural norms as shown in the media, friends, and peers make people internalize certain beliefs and ideas about ideal body shape (33). The triple influence model also states the important effects of sociocultural norms on body image (34).

The results of this study are consistent with the present study in terms of gender and may indicate that women undergoing hemodialysis may be more concerned about body image than men. In addition, the results of the present study are consistent with the results by Sadeghian et al. The results of a study by Sadeghian et al. indicates that hemodialysis patients can experience positive and negative psychological changes. In addition, the ability to take care of self predicts moderate psychological changes. Because it has had a positive and significant relationship with post-traumatic growth and a negative and significant relationship with morale (6).

Self-care behavior refers to the practice of activities that patients initiate and do to keep a healthy life. Self-care behavior is a careful action when it is done effectively. Self-care behavior is the emphasis of managing or solving the problems involved with the external factors under the traditions and cultures (35). Self-care behavior among hemodialysis patients refers to activities that promote survival, functional integration, and well-being (36). As a result, one can say that there can be a relationship between self-care behavior and body image concern, and by promoting self-care, body image anxiety can be reduced in patients undergoing hemodialysis. Wu's et al. (37) study, that investigated the dynamic changes in body image and quality of life in patients with breast cancer, has shown that body image predicts the quality of life of patients with breast cancer. Dynamic changes in body image and quality of life will be useful for combined surgical decisions in patients with breast cancer (37).

This study is consistent with current research and it can be concluded that there may be a relationship between body image changes and self-care. Moreover, the current study is in line with Pakzad et al. (38) study, that aims to investigate the effect of a self-care program based on modeling theory and role modeling on body image development of patients with colorectal cancer. Pakzad's study suggests that the use of a self-care program based on modeling theory and role model can play a key role in developing body image of patients with colon cancer (38). The results of Pakzad's study, along with the current study, suggest that there may be a relationship between self-care behavior and body image. Cook's research, which offers a model to understand the positive role of body image in the treatment of eating disorders, suggests that adaptation and self-care in the mind are considered as potential goals of occupational therapy in fostering a positive body image among people with irregular eating behaviors (15).

Self-care behavior has been related with clinical consequences in chronic kidney disease, and suitable self-care behavior may reduce adverse outcomes (39). Self-care behavior allows patient s to have additional control over their chronic disease and the monitoring of their health (40). Their findings are consistent with the present study, meaning that body image in patients with hemodialysis and self-care behavior are interrelated. The results of studies conducted by Poorgholami et al., is consistent with our study, and shows that information about the self-care program has a positive effect on increasing self-esteem in patients undergoing hemodialysis (41).

Consequently, it can be concluded that improving the level of self-care can reduce the concern about body image in patients with hemodialysis. Previous studies of Iranian patients undergoing hemodialysis have often dealt with the physical and psychological complications associated with dialysis. However, our goal was to study the relationship between self-care behavior and body image problems in hemodialysis patients in Iran. This study contained limitations, including non-random sampling and population in a given area of the country; therefore, it is suggested that further studies be undertaken in other parts of the country with diverse ethnic backgrounds.

CONCLUSION

The findings of the present study identified that the older patients undergoing hemodialysis are less concern about their body image. Also, with increasing levels of self-care behaviors in patients with chronic renal failure who undergo hemodialysis

there was less concern about body image. However, in woman body image was a strong predictor.

RECOMMENDATION

This study suggests that, by increasing the awareness of nurses in recognizing the factors affecting the mental image of patients undergoing hemodialysis, the concerns of patients can be reduced to some extent. This in turn can lead to improved self-care behaviors and thereby reducing multiple referrals of patients to medical centers and ultimately lead to lower costs.

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 IR.MAZUMS.REC.1398.611. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors have participated in conception and design, or analysis and interpretation of the data, drafting the article or revising it critically for important intellectual content, and approval of the final version.

ACKNOWLEDGMENTS

The authors would like to thank the Mazandaran University of Medical Sciences.

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ORIGINAL RESEARCH
published: 18 April 2022
doi: 10.3389/fpsyt.2022.814242

Association Between Wisdom and Psychotic-Like Experiences in the General Population: A Cross-Sectional Study

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OPEN ACCESS

Edited by:
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Reviewed by:
Michel Ferrari, University of Toronto, Canada
Cai-Lan Hou, Guangdong Mental Health Center, China
Jude Uzoma Ohaeri, University of Nigeria, Nsukka, Nigeria

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

Received: *13 November 2021*
Accepted: *11 March 2022*
Published: *18 April 2022*

Citation:
Wu Z, Jiang Z, Wang Z, Ji Y, Wang F, Ross B, Sun X, Liu Z and Long Y (2022) Association Between Wisdom and Psychotic-Like Experiences in the General Population: A Cross-Sectional Study. Front. Psychiatry 13:814242. doi: 10.3389/fpsyt.2022.814242

Introduction: Wisdom has been empirically researched as a complex psychological characteristic that is associated with many mental health outcomes. However, its association with psychotic-like experiences (PLEs) remains unclear. This is the first work to assess wisdom, explore its association with PLEs, and test its moderating effect on the relation between the frequency of PLEs and their associated distress in the general population.

Methods: From January 29th to February 5th, 2021, our online self-administered survey recruited 927 participants (ages 14 to 65) from thirteen Chinese provinces. Convenience sampling was employed. We measured wisdom with the 12-item three-dimensional wisdom scale (3D-WS-12) and PLEs with the 15-item positive subscale of the Community Assessment of Psychic Experiences (CAPE-P15).

Results: Using the cut-off value of 1.47 in the mean frequency score, we divided our participants into high-PLEs group (188, 22.1%) and low-PLEs group (663, 77.9%). Three-dimensional wisdom score was decreased in the high-PLEs group compared to the low-PLEs group (Kruskal-Wallis $t = 59.9$, $p < 0.001$). Wisdom was associated with less frequent PLEs (Spearman's rho = −0.21, $p < 0.01$) and lower distress related to PLEs (Spearman's rho = −0.28) in the high-PLEs group (all above $p < 0.001$), which were replicated in the low-PLEs group. Notably, wisdom significantly attenuated the distress associated with PLEs [coefficient = −0.018, Bootstrap 95% CI (−0.029, −0.008)], but only in the low-PLEs group.

Conclusion: Our results implicated that wisdom could protect individuals from distressful subclinical psychotic symptoms and wiser individuals have better general mental health.

Keywords: wisdom, psychotic-like experiences, mental health, psychosis prevention, epidemiology

INTRODUCTION

Wisdom, a complex and trait-based psychological construct that has been consistently discussed in religious and philosophical texts for centuries, has emerged as a new field of empirical research since the 1970s (1). The essence of wisdom research lies in the definition of wisdom and its empirical measurement. Baltes and Staudinger posited that wisdom was embedded in extensive pragmatic knowledge, concentrating on the cognitive and intellectual aspect (2). Clayton supplemented reflective and affective domains to the components of wisdom (3). Sternberg postulated that wisdom derived from an employment of knowledge regarding to the balance of personal and societal interests (4). Josefsson and colleagues' research on wisdom stressed some aspects related to wellbeing (5). Ardelt developed a three-dimension model to assess wisdom from cognitive (a deep understanding of human existence and relationships), reflective (accurate/unbiased introspection and perspective-taking), and affective (an emotional affinity for others) domains (6). Wang and Chen claimed that wisdom is a comprehensive psychological construct integrating intelligence and morality (7). Although wisdom might be perceived differently in western and eastern cultures, Jeste and Vahia found that the ancient eastern wisdom components are largely in line with modern view of western wisdom, such as emotion regulation and insight (8).

The assessment of wisdom can be based on interviews by experts, such as the Berlin Wisdom Paradigm (9), or self-reported questionnaires, such as the well-recognized 30-item Self-Assessed Wisdom Scale (SAWS) measuring wisdom from five factors: critical life experiences, emotions, reminiscence, openness, and humor; the 39-item Three-Dimensional Wisdom Scale (3D-WS-39) based on the three-dimensional wisdom model (6, 10); and the newly emerged 28-item San Diego Wisdom Scale (SD-WISE) consisting of six domains: social advising, emotional regulation, pro-social behaviors, insight, tolerance for divergent values, and decisiveness (11). It should be noted that self-reported wisdom is highly related to interview-based wisdom and thus suggests an applicability of using self-reported measures in large-scale studies (1). However, these self-administered questionnaires are lengthy and thus limited in use for multifactorial assessments in psychiatric epidemiology. Hence, Thomas et al. developed a 12-item abbreviated Three-Dimensional Wisdom scale (3D-WS-12) that can be administered quickly within the context of epidemiological surveys and show considerable efficiency and validity (12).

A growing body of studies have found that wisdom is associated with multiple health-related outcomes, encompassing better general physical and mental health (13), wellbeing (14), happiness (15), life satisfaction, successful aging, and resilience (11, 16), as well as lower degree of loneliness (17) in the general population. However, the psychiatric assessments involved in these studies mainly covered subclinical anxiety, depressive symptoms, or common positive domains including wellbeing and resilience, while missing the inclusion of psychotic phenomena, a spectrum of less prevalent but even more debilitating subclinical symptoms. Thus, studies covering psychotic phenomena are warranted to get a more comprehensive picture of the association between wisdom and mental health at subclinical level.

Psychotic-like experiences (PLEs), usually known as subclinical delusions or hallucinations, are common in the general population (18–21). In line with the psychosis continuum model, healthy individuals reporting these symptoms are considered to represent a non-clinical psychosis phenotype and thus supposed to be at high risk of schizophrenia-spectrum disorder (20, 22, 23). More recently, under the notion that PLEs usually coexist with affective symptoms including depression and anxiety (24–27), it is also suggested that PLEs are more likely to serve as an indicator of common mental distress, instead of a single risk state for psychosis (28). For both perspectives, psychotic phenomena such as PLEs are recommended to be included as a significant part of assessment in psychiatric epidemiology.

In addition to depressive and anxiety symptoms, previous studies demonstrated that individuals with PLEs, especially delusional experiences, are prone to cognitive bias, for instance, jump to conclusion (JTC), belief inflexibility (BIB) and aberrant salience bias (ASB) (29–31), in line with well-established findings in patients with full-blown psychosis (32–35). Moreover, it was found that patients at ultra-high risk for psychosis showed significant impairments in social cognition that involves the cognitive processes of perceiving, interpreting, and processing social information (36). Further, adults with PLEs presented dysfunction in emotion regulation (ER), which can be regarded as an element of wisdom; and ER is associated with the frequency and distress level of their PLEs (37). However, these studies are not comprehensive since they did not target wisdom as a whole and thus limited in shedding light on the relation between wisdom and subclinical psychotic symptoms. Further studies investigating wisdom as a unitary psychological construct in the population with PLEs are in pressing need because wisdom could protect high-risk individuals for full-onset psychosis.

To the best of our knowledge, this is the first study to investigate the association between wisdom and PLEs and test its moderating role in the relation between frequency of PLEs and their associated distress in the general population. Specifically, adopting the three-dimensional wisdom model, we tested the following hypotheses: (1) wisdom level is decreased in the population with high-level PLEs compared with those having less PLEs; (2) wisdom is negatively associated with the frequency of PLEs and their associated distress; and (3) wisdom attenuates the relation between frequency of PLEs and their associated distress. We expected to see that although wisdom might decrease with the existence of PLEs, wiser individuals may have less frequent and lower distress related to PLEs. Hence, wisdom might be a good intervention target for lowering the social burden of psychosis in the future.

MATERIALS AND METHODS

Participants

This study was designed as an online cross-sectional survey. We adopted a self-reported questionnaire link at the largest

online survey platform in China called "Questionnaire Star[1]". Our online-based data collection was performed between January 29th and February 5th, 2021. A set of self-rating assessments were distributed to students, corporate staff and retired population from 13 different provinces in China (Hunan, Shanghai, Shanxi, Heilongjiang, Jiangsu, Henan, Guangdong, Shandong, Yunnan, Chongqing, Shaanxi, Anhui, and Jiangxi provinces) using convenience sampling method (38). Specifically, we employed thirteen volunteers, who were college students from above-mentioned provinces, to disseminate the questionnaire link and each volunteer reached at least 100 individuals through WeChat (the largest social media application in China) message. Each participant was electronically informed about the purpose of our study and asked to complete an electronic consent inform, and consent from guardians was also requested for those below 18 years old. With their consent, participants completed all the questionnaires before uploading their answers. Each participant who completed our survey was reimbursed five RMB for their time. On average, it took 10 min for each participant to finish these questionnaires.

Our participants were recruited using the following criteria. Inclusion criteria of the study included: (i) able to understand and complete these questionnaires using electronic devices, (ii) consented to participate in this study, and (iii) without history of psychiatric diagnosis. The study was approved by the Ethics Committees of the Second Xiangya Hospital of Central South University.

Assessments

Wisdom

The abbreviated Three-Dimensional Wisdom Scale (3D-WS-12) was refined from the original three-dimensional wisdom scale (3D-WS-39) (6, 12). It contains 12 items covering affective, reflective, and cognitive dimensions of wisdom, and each domain contains 4 items. Answers to each item include range from 1 = strongly agree or definitely true of myself to 5 = strongly disagree or not true of myself. This wisdom screening tool has been translated into Chinese and shown to be valid to assess wisdom in Chinese population (39). Cronbach's alpha for the total score of 3D-WS-12 in our sample was 0.79, which were 0.71, 0.75, 0.72 for cognitive, reflective, and affective subscales, respectively.

Psychotic-Like Experiences (PLEs)

The 15-item positive subscale of the Community Assessment of Psychic Experiences (CAPE-P15) contains two dimensions: frequency and associated distress of PLEs. Each subscale measures the frequency or associated distress of PLEs from three positive psychotic domains: persecutory ideation (PI, 5 items), bizarre experiences (BE, 7 items), and perceptual abnormalities (PA, 3 items) (40). The psychometric properties of the Chinese version of CAPE-P15 were validated (41). Participants completed the questionnaire based on their past 3 months' experiences. Answers in the frequency subscale include: 1-never, 2-sometimes, 3-often, and 4-nearly always. Answers in the distress subscale include: 1-not distressed, 2-a bit distressed, 3-quite distressed, and 4-very distressed. The total frequency score was divided by the number of valid answers to reach an average frequency score for each participant. An average frequency score of 1.47 was adopted as the cut-off value for participants with high-level PLEs (high-PLEs group) versus participants with low-PLEs (41, 42). In our sample, Cronbach's alpha for the total frequency score was 0.88, which was 0.87 for the total distress score.

Demographic Information, Previous Psychiatric Diagnosis and Substance Use

We obtained the following demographic information from participants: age, sex, education years, and personal history of psychiatric illness. We screened participants' personal history of psychiatric diagnoses with the question: "Have you ever been diagnosed with any mental disorder?".

Data Analysis

Before statistical analysis, we excluded participants with any previous psychiatric diagnosis to focus on studying subclinical symptoms. We also eliminated subjects whose age apparently did not match their education years and those who spent very little time (less than 3 min in total) on the survey, to filter out those potentially flawed samples.

Our analysis included three major steps. First, we examined the normality and skewness of all measurements using the Shapiro–Wilk test. Since these variables did not meet the assumption of normality ($p < 0.05$), we employed non-parametric methods in the following analysis. Then descriptive analysis was used to present the characteristics of our sample. Second, we divided the participants into two groups (the high-PLEs and the low-PLEs group) using the cut-off value of 1.47 in the mean frequency score of CAPE-P15 (41, 42) and compared the group difference in all variables using Chi-squared test or Kruskal-Wallis test. Then, Spearman correlation was employed to investigate the association between wisdom and frequency and associated distress of PLEs in the whole population and in two separate groups. Considering that demographic variables, such as age, might correlate both with wisdom and PLEs, we also tested the interaction between demographic variables and wisdom in the association between wisdom and frequency/distress of PLEs in each group using moderation models. Finally, we conducted moderation analysis to explore the moderating effect of wisdom on the relationship between the frequency of PLEs and associated distress in the whole group or in each of the two groups alone after controlling the demographic variables. PROCESS for Windows was used to build a moderation model (43). Bootstrap inference with 5,000 samples and heteroskedasticity-consistent standard error estimator (HC4) were adopted considering the violation of normal distribution, which was in accordance with our previous study (44). IBM SPSS 24.0 for Windows (45) was used for other statistical analyses.

RESULTS

Sample Characteristics

Our online survey recruited 927 participants from thirteen Chinese provinces in total. We eliminated: 35 subjects for their previous diagnosis of any psychiatric illness, 37 subjects for

[1]www.wjx.cn

TABLE 1 | Sample characteristics.

***N* = 851**	
Demographics	
Females, n (%)	591 (69.4)
Age, years, mean (S.D.)	23.7 (8.5)
Han ethnicity, n (%)	805 (94.6)
Education, years, mean (S.D.)	14.3 (2.8)
Family history, n (%)	20 (2.4)
Assessments, mean (S.D.)	
3D-WS-12	39.4 (5.6)
Cognitive	12.4 (2.5)
Affective	14.0 (2.3)
Reflective	13.0 (2.3)
CAPE-P15, frequency, total	20.1 (4.2)
Persecutory ideation	7.7 (1.9)
Bizarre experiences	9.1 (2.2)
Perceptual abnormalities	3.4 (0.9)
CAPE-P15, distress, total	8.1 (7.2)
Persecutory ideation	4.5 (3.4)
Bizarre experiences	3.1 (3.6)
Perceptual abnormalities	0.5 (1.4)

3D-WS-12 = 12-Item Abbreviated Three-Dimensional Wisdom Scale; CAPE-P15 = 15-Item positive subscale of Community Assessment of Psychic Experiences; S.D. = Standard Deviation.

spending less than 3 min on this survey, and 4 subjects for apparent mismatch between reported age and education years. No participant was discarded for missing value because the online survey can only be submitted with every question completed. After cleaning the data, a total of 851 participants entered the final data analysis, including 7.6% middle school students, 69.5% undergraduate students, 4.8% graduate students, 13.3% employed staff, and 4.8% the retired. Other details of sample characteristics are shown in **Table 1**.

Group Comparison Between Participants With High-Level and Low-Level Psychotic-Like Experiences

Using the cut-off value of 1.47 in the mean frequency score of CAPE-P15 (41, 42), we identified 188 individuals with high-level PLEs (PLEs group, 22.1%) and 663 individuals with low-level PLEs (low-PLEs group, 77.9%). Three-dimensional wisdom total score was lower in the high-PLEs group, along with the cognitive, affective and reflective components (**Table 2**).

Associations Between Wisdom and Psychotic-Like Experiences

At the population level, wisdom was negatively correlated with total frequency and associated distress of PLEs, which was replicated in three subtypes of PLEs: persecutory ideation (PI), bizarre experiences (BE), and perceptual abnormalities (PA). These results were verified in each dimension of wisdom (cognitive, affective, and reflective) (**Table 3**).

In the high-PLEs group, correlations between wisdom and frequency/distress of PLEs were still significant at the total score level, but wisdom was not correlated with the frequency and distress of perceptual abnormalities (PA), nor in any of the three wisdom subscales. It should be noted that reflective wisdom showed a slightly strong negative correlation with the total frequency and distress score of PLEs compared to cognitive and affective wisdom (**Table 4**).

In the low-PLEs group, the total three-dimensional wisdom score was correlated with the total frequency and distress score of PLEs and PI/BE subscales except PA, as seen in

TABLE 2 | Difference between high-PLEs and low-PLEs group in demographics and assessments.

	High-PLEs (*n* = 188)	**Low-PLEs (*n* = 663)**	**Statistics**	***p* value**	**Cohen's d**
Demographics					
Females, n (%)	116 (61.7)	475 (71.6)	6.4	0.012	\
Age, years, mean (S.D.)	21.6 (7.5)	24.2 (8.6)	32.8	<0.001	0.31
Han ethnicity, n (%)	176 (93.6)	629 (94.9)	0.4	0.503	\
Education years, mean (S.D.)	13.0 (2.7)	14.7 (2.7)	7.0	<0.001	0.62
Family history, n (%)	4 (2.7)	16 (2.3)	4.1	0.388	\
Assessments, mean (S.D.)					
3D-WS-12, total	36.5 (5.4)	40.2 (5.4)	59.9	<0.001	0.68
Cognitive	11.7 (2.5)	12.6 (2.5)	18.0	<0.001	0.35
Affective	13.0 (2.4)	14.3 (2.1)	46.8	<0.001	0.59
Reflective	11.8 (2.2)	13.3 (2.2)	59.3	<0.001	0.69
CAPE-P15, frequency, total	26.5 (3.6)	18.6 (2.0)	443.2	<0.001	3.29
Persecutory ideation	10.0 (1.8)	7.0 (1.3)	315.8	<0.001	2.08
Bizarre experiences	12.2 (2.3)	8.2 (1.2)	366.3	<0.001	2.68
Perceptual abnormalities	4.3 (1.4)	3.1 (0.4)	258.2	<0.001	1.59
CAPE-P15, distress, total	18.5 (6.8)	5.2 (3.7)	397.5	<0.001	2.93
Persecutory ideation	8.6 (3.0)	3.3 (2.5)	289.9	<0.001	1.99
Bizarre experiences	8.0 (4.1)	1.7 (1.8)	336.8	<0.001	2.50
Perceptual abnormalities	2.0 (2.3)	0.1 (0.6)	258.6	<0.001	1.51

TABLE 3 | Spearman's correlations between wisdom and other variables in the whole population.

	3D-WS-12 Cognitive	3D-WS-12 Affective	3D-WS-12 Reflective	3D-WS-12Total
Demographics				
Gender (higher = males)	−0.03	−0.04	0.02	−0.02
Age	0.08*	0.09**	0.19***	0.15***
Education	0.09**	0.09**	0.15***	0.14***
Assessments				
CAPE-P15, frequency, total	−0.20***	−0.31***	−0.36***	−0.35***
Persecutory ideation	−0.20***	−0.28***	−0.37***	−0.34***
Bizarre experiences	−0.17***	−0.28***	−0.29**	−0.30***
Perceptual abnormalities	−0.08*	−0.14***	−0.15***	−0.15***
CAPE-P15, distress, total	−0.22***	−0.31***	−0.39***	−0.37***
Persecutory ideation	−0.23***	−0.28***	−0.39***	−0.36***
Bizarre experiences	−0.18***	−0.28***	−0.32***	−0.31**
Perceptual abnormalities	−0.08*	−0.15***	−0.15***	−0.15***

**p < 0.05, **p < 0.01, ***p < 0.001; 3D-WS-12 = 12-Item Abbreviated Three-Dimensional Wisdom Scale; CAPE-P15 = 15-Item positive subscale of Community Assessment of Psychic Experiences.*

TABLE 4 | Spearman's correlations between wisdom and other variables in the high-PLEs group.

	3D-WS-12 Cognitive	3D-WS-12 Affective	3D-WS-12 Reflective	3D-WS-12Total
Demographics				
Gender (higher = males)	−0.11	−0.03	−0.11	−0.11
Age	0.06	−0.03	0.10	0.05
Education	0.01	−0.08	0.01	0.01
Assessments				
CAPE-P15, frequency, total	−0.11	−0.18*	−0.22**	−0.21**
Persecutory ideation	−0.20**	−0.11	−0.23**	−0.23**
Bizarre experiences	−0.08	−0.19*	−0.22**	−0.22**
Perceptual abnormalities	−0.01	−0.01	−0.01	0.01
CAPE-P15, distress, total	−0.18*	−0.21**	−0.24***	−0.28***
Persecutory ideation	−0.27***	−0.10	−0.26***	−0.28***
Bizarre experiences	−0.10	−0.20**	−0.21**	−0.25**
Perceptual abnormalities	−0.02	−0.07	−0.04	−0.03

**p < 0.05, **p < 0.01, ***p < 0.001; 3D-WS-12 = 12-Item Abbreviated Three-Dimensional Wisdom Scale; CAPE-P15 = 15-Item positive subscale of Community Assessment of Psychic Experiences.*

the high-PLEs group. Other results were similar to findings in the high-PLEs group and the whole population (**Table 5**). Further analysis revealed that no significant interaction between demographic variables (age, gender, education) and total wisdom score was observed in the association between wisdom and frequency/distress of PLEs.

Moderation of Wisdom on the Relation Between Psychotic-Like Experiences Frequency and Their Associated Distress

At the whole population level, after controlling for age, sex, and educational years, we observed no significant moderating effect of wisdom total score on the relation between PLEs frequency and associated distress, nor that of any of the three subscales of wisdom score. This was replicated in the high-PLEs group. However, in the low-PLEs group, total wisdom score significantly attenuated the relation between total PLEs frequency and associated distress [coefficient = −0.018, Bootstrap 95% CI (−0.029, −0.008)]. At the subscales level, this moderation existed in the cognitive [coefficient = −0.033, Bootstrap 95% CI (−0.058, −0.008)] and reflective [coefficient = −0.052, Bootstrap 95% CI (−0.079, −0.024)] wisdom but not in affective wisdom (**Figure 1**). We further tested this moderation on the subscales of CAPE-P15 (PI, BE, and PA), but the moderation of wisdom was only significant at the total frequency and distress level of PLEs.

TABLE 5 | Spearman's correlations between wisdom and other variables in the low-PLEs group.

	3D-WS-12 Cognitive	3D-WS-12 Affective	3D-WS-12 Reflective	3D-WS-12Total
Demographics				
Gender (higher = males)	−0.02	−0.08	0.02	−0.03
Age	0.05	0.06	0.16***	0.11**
Education	0.07	0.06	0.13**	0.11**
Assessments				
CAPE-P15, frequency, total	−0.15***	−0.22***	−0.28***	−0.28***
Persecutory ideation	−0.14***	−0.18***	−0.29***	−0.25***
Bizarre experiences	−0.11**	−0.18***	−0.17***	−0.18***
Perceptual abnormalities	0.01	−0.02	−0.03	−0.02
CAPE-P15, distress, total	−0.17***	−0.18***	−0.32***	−0.28***
Persecutory ideation	−0.17***	−0.18***	−0.32***	−0.27***
Bizarre experiences	−0.13***	−0.17***	−0.21***	−0.20***
Perceptual abnormalities	0.01	−0.02	−0.03	−0.02

***p < 0.01, ***p < 0.001; 3D-WS-12 = 12-Item Abbreviated Three-Dimensional Wisdom Scale; CAPE-P15 = 15-Item positive subscale of Community Assessment of Psychic Experiences.*

DISCUSSION

To the best of our knowledge, this is the first work to investigate the association between wisdom and subclinical psychotic symptoms, and has three major findings. First, the three-dimensional wisdom level was decreased in participants with high-level PLEs compared to those with less PLEs. Second, wisdom was negatively associated with frequency and associated distress of PLEs. Third, wisdom attenuated the relation between the frequency of PLEs and their associated distress, but only when the frequency was relatively low.

To date, three-dimensional wisdom has not been measured in the subclinical psychotic population, but a previous study suggested that schizophrenia patients had lower wisdom scores (including cognitive, affective, and reflective wisdom) than the control group (46); our findings of decreased wisdom in the subclinical psychotic population highly resonate with these findings. Studies investigating the wisdom level as a whole in the subclinical psychotic population are still lacking. However, some aspects of wisdom were covered in previous studies. A large body of research concluded that many forms of cognitive biases

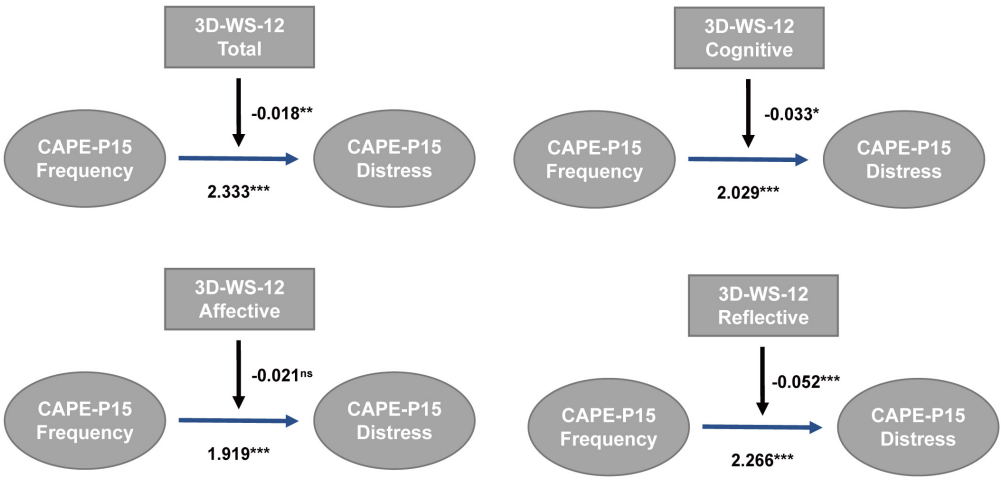


FIGURE 1 | Moderation of wisdom in the relation between PLEs frequency and associated distress in low-PLEs group (N = 663, PROCESS Model 1, ns, not significant, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$).

were observed in individuals with PLEs, such as jumping to conclusions (JTC), aberrant salience (ASB), attention to threat (ATB), externalizing bias (ETB), and belief inflexibility (BIB) (30, 47–50). Notably, it is also well-established that patients with psychosis presented cognitive dysfunction that could precede the onset of full-blown disease with debilitating positive symptoms and cognitive distortion even contribute to the maintenance of psychotic symptoms (51). This suggests that the clinical and subclinical psychotic population might share similar alterations in cognitive function but with varying degrees. Cognitive wisdom, however, refers to an individual's ability to understand life, to comprehend the significance and deeper meaning of phenomena and events, especially with regard to intrapersonal and interpersonal matters, such as the knowledge of the positive and negative aspects of human nature (6). Decreased cognitive wisdom in the population with high-level PLEs is likely to explain the existence of cognitive biases or distortions, which can possibly translate to cognitive symptoms of psychotic patients.

Notably, our results highlight the critical role of reflective wisdom in terms of association with common mental health domains covered in this study. Reflective wisdom is considered to be a prerequisite for developing cognitive wisdom. Perception of reality without any major distortions is mandatory to reach a deeper understanding of life. Wise individuals would engage in reflective thinking by looking at phenomena and events from different perspectives to develop self-awareness and self-insight (3, 6). Previous studies found that individuals with PLEs are prone to poor reflective reasoning and biased self-reflection (52, 53). In clinical settings, a large portion of patients with full-blown psychosis suffer from impaired insight and thus are difficult to reach a rational understanding of their conditions (54, 55). Our work provided further evidence that individuals with more PLEs showed undermined reflective capability, which can be explained by decreased reflective wisdom.

Affective wisdom represents positive emotions and behavior toward others, such as sympathy and compassion. Dysfunction in empathy can be observed in individuals at high risk for psychosis (56). At clinical settings, patients at risk for psychosis showed significant impairment in social cognition, specifically including difficulties in emotion recognition and social skills (36). Further, dysfunction in emotion regulation was associated with the frequency and distress of PLEs (37). In line with these findings, our results provided evidence that individuals with PLEs were in lack of affective wisdom, which is critical in forming social bonds with others.

Furthermore, individuals with higher wisdom tended to have less frequent PLEs and lower degrees of associated distress in the PLEs group. Notably, these findings also apply to the low-PLEs group, suggesting a general protective effect of wisdom for mental health. In these associations, reflective wisdom seemed to play a more significant role among the three wisdom dimensions, which was also observed in a wisdom study on schizophrenia patients (46) and can possibly be explained by the prerequisite role of reflective wisdom for generating cognitive and affective wisdom (6). For the three domains of PLEs, compared to persecutory ideation and bizarre experiences, it should be noted that wisdom showed little ameliorating effect on perceptual abnormalities, which implies that subclinical hallucinations and delusions might share a different nature.

Notably, the moderation results revealed that wiser individuals tended to have lower distress even with the same frequency of PLEs. However, this moderation was only significant among the participants who reported lower levels of PLEs (the low-PLEs group). It could be interpreted that wisdom can attenuate the distress associated with PLEs when the frequency is relatively low. When the frequency reaches a specific threshold, this moderation would no longer work due to the general deterioration of the individual's condition and the possible loss of insight. Further, this moderation seemed more stronger for reflective wisdom, in accordance with its critical role in three-dimensional wisdom as aforementioned. Our findings were also supported by previous works. Cognitive biases moderated the relation between negative

affective states and PLEs in non-clinical adults (57). Individuals having difficulties in emotion regulation showed more frequent PLEs and distress (37).

Our findings may have important implications for clinical practices. Wisdom is considered to be amenable to intervention (58) and thus can be trained and cultivated, just like resilience (59). Under this notion, tailored intervention targeting three dimensions of wisdom can potentially ameliorate the frequency and associated distress of PLEs in this non-clinical population, and meanwhile contribute to a better general mental health outcome. For instance, it could be hypothesized that enhancement of cognitive wisdom could prevent cognitive biases, reflective wisdom could improve the self-reflection, and affective wisdom may boost one's empathy and compassion and finally improve social cognition and function. Works examining these promising hypotheses are highly recommended to lower the debilitating burden of full-onset psychosis to the individual family and to society as a whole.

Finally, our results should be interpreted with several limitations. First, the cross-sectional design limited the conclusion of causal relationship, and further cohort studies following the outcomes of individuals with different levels of wisdom is recommended. Second, the convenience sampling method may incur bias and have less generalizability. For instance, we recruited more females possibly because women are more likely to seek mental health services and participate in psychiatric studies (60, 61). Thus, works using probability sampling (62) to target more representative population are warranted. Third, the sample size of participants with high-level PLEs are relatively modest, future replication in larger population is also needed. Lastly, wisdom may be taken in a different manner since a previous work failed to replicate the three-dimension structure of 3D-WS-12 (63), thus, the interpretation of our results should be cautious, and further validation of three-dimensional wisdom structure is warranted to get a better understanding of its utility in Chinese culture.

Together, our work investigated the association between wisdom and PLEs for the first time, finding that wisdom ameliorated the frequency/distress of PLEs, and attenuated the distress associated with PLEs. Our findings have good implications for clinical practice since wisdom serves as a protective role for PLEs and could be a promising target in preventing the transition from high-risk state to full-blown psychosis.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of The Second Xiangya Hospital of Central South University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

ZL, YL, and ZWu designed the study. ZJ, FW, ZWa, and YJ collected the data and double-checked the data input. ZWu and XS finished the statistical analysis and drafted the manuscript. ZL, YL, ZJ, and BR revised the manuscript. All authors agreed on the final version of the manuscript.

FUNDING

This work was supported by the National Natural Science Foundation of China (Grant Number 82071506 to ZL) and the Natural Science Foundation of Hunan Province, China (2021JJ40851 to YL).

ACKNOWLEDGMENTS

We thank all volunteers and participants for their contribution to this work.

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frontiers | Frontiers in Psychiatry

ORIGINAL RESEARCH
published: 25 April 2022
doi: 10.3389/fpsyt.2022.825460

Effects of Social Participation and Its Diversity, Frequency, and Type on Depression in Middle-Aged and Older Persons: Evidence From China

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OPEN ACCESS

Edited by:
Giorgio Di Lorenzo,
University of Rome Tor Vergata, Italy

Reviewed by:
Wen-Chou Chi,
Chung Shan Medical University, Taiwan
Narimasa Kumagai,
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: 30 November 2021
Accepted: 20 January 2022
Published: 25 April 2022

Citation:
Wang J, Xu J, Nie Y, Pan P, Zhang X, Li Y, Liu H, Liang L, Gao L, Wu Q, Hao Y and Shah S (2022) Effects of Social Participation and Its Diversity, Frequency, and Type on Depression in Middle-Aged and Older Persons: Evidence From China. Front. Psychiatry 13:825460. doi: 10.3389/fpsyt.2022.825460

Background: Depression is one of the greatest public health problems worldwide. The potential benefit of social participation (SP) on mental health has been widely acknowledged. Nevertheless, a few studies have used propensity score matching (PSM) to reduce the influence of data bias and confounding variables. This study explored the effect of social participation on depression among middle-aged and older Chinese persons through a PSM method, considering the frequency, type, and quantity of SP. Effects were compared among different age groups, genders, and places of residence.

Methods: The datasets were obtained from the 2018 wave of the China Health and Retirement Longitudinal Study. A total of 9,404 respondents aged 45 and above were included in the study. PSM and ordinary least squares methods were used to estimate the effect of social participation on depression.

Results: PSM estimation results showed that SP had a significantly positive effect on decreasing depression scores ($p < 0.001$) by 0.875–0.898 compared with persons without SP. All types of SP had a significantly positive effect ($p < 0.001$), and participating in community activities had the largest effect ($\beta = -1.549$ to -1.788, $p < 0.001$). Higher frequency of participation and more types of SP promoted lower depression scores; subgroup analyses revealed that the promotion effect was significantly greater among women, those aged ≥75 years, and those living in urban areas.

Conclusion: PSM indicated that SP could alleviate the depression of middle-aged and older Chinese persons. Targeted measures should be adopted to promote SP and thereby improve mental health and promote healthy and active aging.

Keywords: social participation, depression, propensity score matching, China, elderly

INTRODUCTION

Depression is a common mental disease, which can cause serious harm to physical and mental health if long-term relief from symptoms is not achieved. The widespread impact of depression is not only reflected in the extremely high health lost (1) and numerous complications, such as type 2 diabetes (2) and cardiovascular diseases (3), but also in its promotion of suicide. Depression has evolved into a serious social problem and has accordingly attracted wide research and clinical attention.

According to the latest estimates, more than 300 million people currently experience depression (4), and the prevalence increased by 18.4% between 2005 and 2015. Among different age groups, prevalence peaks in middle and old age (5). With the development of an aging population, depression among middle-aged and older people would become relatively more prevalent. China, as the largest developing country, is also experiencing a trend of rapid population aging. It is estimated that between 2012 and 2050, China's elderly population will increase from 194 million to 483 million, and the aging level will increase from 14.3 to 34.1%; at that time, China would be one of the countries with the fastest population aging rate (6). A study indicated that there were 56.36 million people living with depression in China in 2017, accounting for 21.3% of cases worldwide (7). The prevalence rate of depression increases with age and becomes more serious in persons over 60 years. Thus, for China, it is important to adopt measures to promote mental health among high-risk groups, such as middle-aged and older people, to avoid the adverse outcomes of depression. This would also provide the benefit of globally improving mental health.

Currently, conventional interventions against depression, such as cognitive behavioral therapy and medication, are considered effective approaches. However, it is difficult to meet the needs of low- and middle-income countries for current depression treatments, given resource limitations (8); the cost for depression treatment is notably high. It has been estimated that an annual global cost of US$1.15 trillion is attributable to depression (9). In China, a study calculated that total economic expenditure per capita for depression was 21,650 CNY, with direct economic expenditure of 6,806 CNY and indirect economic expenditure of 14,844 CNY (10). This heavy economic burden on developing countries is not affordable. Thus, it is important to seek other effective and feasible low-cost approaches and pay particular attention to preventive interventions.

Since the concept of SP was introduced to the field of aging research at the beginning of the 20th century (11), increasing attention has been paid to the relationship between SP and depression. Activity theory posits that SP by older persons helps them to maintain self-esteem, obtain psychological satisfaction, and live a long and healthy life. Maintaining intellectual, physical, and certain social activities are necessary in later life, not only to promote physical health but also to foster mental health (12, 13). Prior studies also indicated the relationship between SP and depression among the elderly group. A study found that SP plays a protective role against depressive symptoms (14), and continuous SP may have strong association with fewer depressive symptoms (15). Moreover, a few studies further explored the effect of different types of SP on depression. Formal voluntary activities reduce the risk of depression in older persons, but informal help has no such effect (16). Social activities, group activities, fitness exercise, and intellectual participation can all reduce the risk of depression in older persons, but helping and dedication activities have no significant effect (17). Voluntary participation has positive effects but obligatory participation has harmful influences (18). In addition, some studies suggested that SP could relieve depression among certain older adults (19–21). However, most studies were conducted using ordinary least squares (OLS) regression, and a few of them use propensity score matching, which could reduce bias and improve internal validity of the statistical analysis. In addition, few studies have explored the correlation between depression and SP in China while considering frequency, type, and quantity of SP. This study made the following assumptions: first, SP was associated with a lower depression score. The higher the frequency of SP, the larger the quantity of SP, and the more diverse the types of SP, the lower the depression score.

Our study explored the impact of SP on depression among middle-aged and older Chinese persons using a PSM method and explored the relationships with respect to the frequency, type, and quantity of SP. Effects were further compared among different age groups, genders, and places of residence. The findings could provide evidence for the targeted social participation measures for specific groups of middle-aged and older people.

METHODS

Sample and Data Collection

The datasets were obtained from 2018 wave of the China Health and Retirement Longitudinal Study, a national representative survey adopting a four-stage, stratified, cluster sampling method to collect Chinese residents aged 45 years and above, covering 450 villages and 150 counties in 28 provinces in China, and the detailed sampling methods can be retrieved from the study of Zhao et al. (22). The baseline survey started in 2011 (first wave) and conducted follow-up surveys every 2–3 years, and the 2018 wave is the latest wave data. In the 2018 CHARLS database, 19,816 observations were admitted from the 2018 CHARLS database. After screening and excluding invalid samples, a total of 9,312 respondents were included in the study, **Supplementary Figure S1** shows the process of sample screening.

Variables

Outcome Variable

Depression is the outcome variable in this study, which is estimated by the CES-D10 scale. The respondents were asked the frequency of their feeling or behavior during the last week, and each answer of positively oriented questions was coded from 0 to 3 according to the frequent value; the answers of the negatively oriented questions were reverse-coded. The total score of the scale ranges from 0 to 30, with higher scores indicating more serious depression. Our study used the score of 12 as the cutoff point to describe the prevalence of depression (23). In the previous related studies, CES-D 10 showed a good internal reliability (24).

Explanatory Variable

The explanatory variable in this study is SP, which was estimated by their participation in 11 social activities in the past month. If respondents participated in any of the social activities, they were considered to have SP, otherwise, they were considered not to have SP.

Confounding Variables

The following variables were selected as possible confounding variables according to previous studies (21, 25–27). Confounding variables include three aspects: demographic characteristics, including gender, age, marital status, education, retirement, residency, individual income, medical insurance, number of family member, and living near child/children; lifestyle characteristics, including smoking, physical activity, and alcohol consumption; and health status, including types of NCDs, self-rated health changes. Detail codes, and definitions are shown in **Table 1**.

Statistical Analysis

A chi-square test was used on categorical variables to test the differences in social participation and its diversity and frequency. In addition, an independent sample *t*-test was used for continuous variables to assess social participation differences, an analysis of variance (ANOVA) was performed to evaluate the differences in social participation's diversity and frequency.

PSM was used to estimate the effect of SP on depression. As the data we used were observational, there existed the risk of bias caused by study design, unbalanced distribution or grouping, nonrandom sampling, subjective tendency of the measurer, and so on, as well as confounding variables, all of which can lead to biased estimation (28). PSM can address covariate imbalances between treatment and control groups in observational studies by matching respondents with similar characteristics in the two groups. This can reduce the influence of data bias and confounding variables and facilitate a more reasonable comparison between the exposure and control groups. Observational data are thereby rendered more akin to random trial data, and robust estimation results may be obtained (29–31). Thus, this study used the PSM method to estimate the average treatment effect of SP on depression of the middle-aged and older people.

The PSM method was first proposed by Rosenbaum and Rubin (32), and it has become one of the important empirical methods to deal with nonrandom data. The process of the PSM method is as follows: first, calculating propensity scores by logit regression model to predict the probability of SP, which was matched by confounding variables. We then calculated the average treatment effect for the treated (ATT), and the formula is as follows:

$$ATT = E[(h_{i1}|SP_i = 1)] - E[(h_{i0}|SP_i = 1)]$$

where $E[(h_{i1}|SP_i = 1)]$ represents the depression scores of respondents participating in social activities, and $E[(h_{i0}|SP_i = 1)]$ is the reference outcome.

Next, the matching effect was assessed by testing the absolute standard bias (ASB) between the treatment and control groups after matching. Previous studies showed that the smaller the ASB of confounding variables after matching, the better is the matching effect (32). According to Rosenbaum and Rubin's definition, if ASB is <20, the matching effect can be considered reliable (32). We used three matching methods including K-nearest neighbor matching (1:1), radius matching, and kernel matching to ensured the robustness of our results. In the radius matching, a 0.2 SD caliper was employed, and in the kernel matching, a bandwidth of 0.06 was set with an epan kernel.

In addition, we also applied ordinary least squares (OLS) regression models to estimate the impact of SP on depression, and we used robust standard errors to alleviate the potential effect of heteroscedasticity. All statistical analyses were conducted by STATA version MP17.0 software. A p-value <0.05 was considered as statistically significant.

RESULTS

Characteristics of Respondents

The characteristics of respondents are shown in **Table 2**. These include the characteristics of social participation and its diversity and frequency among the respondents. Most respondents were women (51.91%), partnered (80.00%), rural residents (71.09%), and with a median age of 64 years old. Of the respondents, the education level was illiterate, primary school, middle school, and ≥high school, which accounted for 17.72, 44.50, 23.38, and 14.40%, respectively. The median of the depression score was 8, the value for the SP and no SP groups were 7 and 9, respectively, and the prevalence of depression symptoms among middle-aged and older Chinese people was 42.92%. Whether middle-aged and older people engaged in social participation differed with respect to most characteristics: social participation was associated with younger respondents, those who were not of single marital status, with better economic status, living in an urban area, having at least a high school education, and living far from child/children. The frequency and variety of social participation differed with respect to most of the characteristics.

Social Participation Rate of Respondents With Different Characteristics

Figure 1 shows the social participation rate of respondents with different types (**Figure 1C**), numbers (**Figure 1B**), and frequencies (**Figure 1A**) and social participation rate by different ages, genders, and residencies (**Figure 1D**). The proportion of social participation among middle-aged and older people account for 56.49%, 30.28% of the respondents participated in one activity, and 26.20% participated in at least two activities, 42.04% of the respondents participated in activities more than one time a week. We also obtained that among all types of social participation, the top two types with the highest participation rate are interpersonal activities with 36.08% and entertainment with 29.33%; significant differences were shown among different types, numbers, and frequencies of social participation. The social participants' rate had no significant difference between men and women, while respondents aged <60 years, or those in urban regions, had a higher participation rate than the reference group.

TABLE 1 | Definition/codes of the variables.

Variable	Code/definition
Gender	0 = man; 1 = woman
Age	Continuous variable
Marital status	0 = single; 1 = partnered
Education	1 = Illiterate; 2 = primary school; 3 = middle school; 4 = high school
Residency	0 = rural; 1 = urban
Retirement	0 = no; 1 = yes
Individual financial situation	Individual income annually, continuous variable
Physical activity	Took physical activity at least 10 min every week. 0 = no; 1 = yes
Alcohol consumption	Ever consumed any alcohol last year. 0 = no; 1 = yes
Smoke	Ever chewed tobacco, smoked a pipe, or smoked cigarette last year. 0 = no; 1 = yes
Medical insurance	Type(s) of participating health insurance 1 = Urban employee medical insurance 2 = Urban and rural resident medical insurance (integrated urban resident medical insurance and new rural cooperative medical insurance) 3 = Urban resident medical insurance 4 = New rural cooperative medical insurance 5 = participating in any kind of social insurance and private insurance at the same time 6 = No insurance or other types of insurance
Living near child(ren)	0 = Living in other places or living abroad 1 = Living together or living in the same/neighboring courtyard
Number of family members	The number of family members living together and sharing family income and expenses with respondents, continuous variable
Numbers of NCDs	14-item summaries of any physical noncommunicable diseases, including hypertension, dyslipidemia, diabetes, cancer, chronic lung diseases, liver disease, heart attack, stroke, kidney diseases, stomach or other digestive diseases, memory-related disease, emotional, nervous, or psychiatric problems, arthritis or rheumatism, and asthma 1 = none; 2 = 1 type; 3 = 2 types; 4 = ≥3 types
Self-rated health changes	Health status compared with last wave in 2015. 1 = better; 2 = about the same; 3 = worse
Depression	Applying CES-10 scale to estimate depression, continuous variable
SP	Participating in any activities in 13 items (interacting with friends/mah-jong or cards/sports or social clubs/community-related organizations/voluntary or charity work/using Internet/providing help/cared for a sick or disabled adult/attended an educational or training course/tocks investment/other) 0 = no; 1 = yes
SP frequent(s)	The maximum frequency of SP 1 = none; 2 = not regularly; 3 = ≥1/week
SP variety	Cumulative number of participants in 13 activities 1 = none; 2 = 1 type; 3 ≥2 types

The Probability of Social Participation Among Middle-Aged and Older People

The estimation results of the probability having SP among middle-aged and older people by logit model are depicted in **Supplementary Table S1** (**Supplementary File 1**). Through the logit model, the PSM score was estimated, and the matching of treatment group and control group was completed. The finding showed that pseudo-R2 is 0.0540, indicating that the model fits well, and the association between possible confounding variables and social participation was revealed, for example, those younger ($\beta = -0.021$, $p < 0.001$) and those with better self-rated health changes ($\beta = -0.179$, $p < 0.001$) were more likely to have social participation.

Effect Test on Depression Using Unmatched and Matched Data

After data matching, we conducted a series of tests to check the matching effect. First, we compared the density function of propensity scores of the treated group and control group. **Figure 2** shows that the distribution of the two groups is closer than before matching. Next, the covariates' balancing test was conducted. The results are depicted in **Figure 3**. All the standard bias of the covariates are reduced substantially after matching (**Figure 3A**). The covariates showed no significant difference among the two groups in **Supplementary Tables S2–S4** (**Supplementary File 1**), and all the ASB are <20%, which indicates that the matching has a good quality. We constructed a histogram of the propensity score in the treated and control group (**Figure 3B**), as **Figure 3B** shows no essential difference in the distribution of propensity score of the treatment group and the control group after matching. It was clear that no matter which matching method we used, the propensity score distribution became symmetrical. Most of the observations are in the expected range, thus, satisfying the common support hypothesis.

Propensity Score Matching Estimation of the Effect of Social Participation on Depression Scores

Table 3 reports the estimation results before and after PSM. Overall, the significance and magnitude of the effect of SP on depression scores all decreased. After PSM, the results suggested

TABLE 2 | Basic information of respondents.

	Total (N = 9,312)	SP		p	Variety			P	Frequency			P
		No	Yes		None (N = 4,052)	1 type (N = 2,820)	≥2 types (N = 2,440)		None (N = 4,052)	Not regularly (N = 1,345)	≥1/week (N = 3,915)	
	n (%)	*n* (%)	*n* (%)		*n* (%)	*n* (%)	*n* (%)		*n* (%)	*n* (%)	*n* (%)	
Gender				0.069				<0.001				0.043
Man	4,478 (48.09)	1,992 (44.48)	2,486 (55.52)		1,992 (44.48)	1,253 (27.98)	1,233 (27.53)		1,992 (44.48)	663 (14.81)	1,823 (40.71)	
Woman	4,834 (51.91)	2,060 (42.61)	2,774 (57.39)		2,060 (42.61)	1,567 (32.42)	1,207 (24.97)		2,060 (42.61)	682 (14.11)	2,092 (43.28)	
Age				<0.001				<0.001				<0.001
<60	3,459 (37.15)	1,236 (35.73)	2,223 (64.27)		1,236 (35.73)	1,051 (30.38)	1,172 (33.88)		1,236 (35.73)	552 (15.96)	1,671 (48.31)	
60–74	4,255 (45.69)	1,996 (46.91)	2,259 (53.09)		1,996 (46.91)	1,258 (29.57)	1,001 (23.53)		1,996 (46.91)	614 (14.43)	1,645 (38.66)	
≥75	1,598 (17.16)	820 (51.31)	778 (48.69)		820 (51.31)	511 (31.98)	267 (16.71)		820 (51.31)	179 (11.20)	599 (37.48)	
Median (min, max)	64 (45, 111)	66 (45, 90)	63 (45, 111)	<0.001	66 (45, 98)	64 (45, 98)	60 (45, 111)	<0.001	66 (45, 98)	63 (46, 92)	63 (45, 111)	<0.001
Marital status				0.001				<0.001				0.001
Single	1,862 (20.00)	874 (46.94)	988 (53.06)		874 (46.94)	599 (32.17)	389 (20.89)		874 (46.94)	231 (12.41)	757 (40.66)	
Partnered	7,450 (80.00)	3,178 (42.66)	4,272 (57.34)		3,178 (42.66)	2,221 (29.81)	2,051 (27.53)		3,178 (42.66)	1,114 (14.95)	3,158 (42.39)	
Education				<0.001				<0.001				<0.001
Illiterate	1,650 (17.72)	933 (56.55)	717 (43.45)		933 (56.55)	516 (31.27)	201 (12.18)		933 (56.55)	194 (11.76)	523 (31.70)	
≤Primary school	4,144 (44.50)	1,968 (47.49)	2,176 (52.51)		1,968 (47.49)	1,299 (31.35)	877 (21.16)		1,968 (47.49)	643 (15.52)	1,533 (36.99)	
Middle school	2,177 (23.38)	814 (37.39)	1,363 (62.61)		814 (37.39)	660 (30.32)	703 (32.29)		814 (37.39)	337 (15.48)	1,026 (47.13)	
≥high school	1,341 (14.40)	337 (25.13)	1,004 (74.87)		337 (25.13)	345 (25.73)	659 (49.14)		337 (25.13)	171 (12.75)	833 (62.12)	
Residency				<0.001				<0.001				<0.001
Rural	6,620 (71.09)	3,178 (48.01)	3,442 (51.99)		3,178 (48.01)	2,026 (30.60)	1,416 (21.39)		3,178 (48.01)	988 (14.92)	2,454 (37.07)	
Urban	2,692 (28.91)	874 (32.47)	1,818 (67.53)		874 (32.47)	794 (29.49)	1,024 (38.04)		874 (32.47)	357 (13.26)	1,461 (54.27)	
Retirement				0.120				0.009				<0.001
No	5,976 (64.18)	2,636 (44.11)	3,340 (55.89)		2,636 (44.11)	1,745 (29.20)	1,595 (26.69)		2,636 (44.11)	922 (15.43)	2,418 (40.46)	
Yes	3,336 (35.82)	1,416 (42.45)	1,920 (57.55)		1,416 (42.45)	1,075 (32.22)	845 (25.33)		1,416 (42.45)	423 (12.68)	1,497 (44.87)	
Individual income annually				<0.001				<0.001				<0.001
Median (min, max)	0 (0, 1,280,000)	0 (0, 530,000)	0 (0, 1,280,000)		0 (0, 530,000)	0 (0, 438,000)	0 (0, 530,000)		0 (0, 530,000)	0 (0, 400,000)	0 (0, 530,000)	
Physical activity				<0.001				0.407				<0.001
No	6,373 (68.44)	2,765 (43.39)	3,608 (56.61)		2,765 (43.39)	1,956 (30.69)	1,652 (25.92)		2,765 (43.39)	831 (13.04)	2,777 (43.57)	
Yes	2,939 (31.56)	1,287 (43.79)	1,652 (56.21)		1,287 (43.79)	864 (29.40)	788 (26.81)		1,287 (43.79)	514 (17.49)	1,138 (38.72)	
Alcohol consumption				<0.001				<0.001				<0.001
No	6,129 (65.82)	2,895 (47.23)	3,234 (52.77)		2,895 (47.23)	1,877 (30.62)	1,357 (22.14)		2,895 (47.23)	821 (13.40)	2,413 (39.37)	
Yes	3,183 (34.18)	1,157 (36.35)	2,026 (63.65)		1,157 (36.35)	943 (29.63)	1,083 (34.02)		1,157 (36.35)	524 (16.46)	1,502 (47.19)	

(Continued)

TABLE 2 | Continued

	Total (*N* = 9,312)	SP		*p*	Variety			*P*	Frequency			*P*
		No	Yes		None (*N* = 4,052)	1 type (*N* = 2,820)	≥2 types (*N* = 2,440)		None (*N* = 4,052)	Not regularly (*N* = 1,345)	≥1/week (*N* = 3,915)	
	n (%)	*n* (%)	*n* (%)		*n* (%)	*n* (%)	*n* (%)		*n* (%)	*n* (%)	*n* (%)	
Smoke				<0.001				0.063				0.015
No	6,938 (74.51)	3,029 (43.66)	3,909 (56.34)		3,029 (43.66)	2,132 (30.73)	1,777 (25.61)		3,029 (43.66)	960 (13.84)	2,949 (42.51)	
Yes	2,374 (25.49)	1,023 (43.09)	1,351 (56.91)		1,023 (43.09)	688 (28.98)	663 (27.93)		1,023 (43.09)	385 (16.22)	966 (40.69)	
Medical insurance				<0.001				<0.001				<0.001
UEBMI	1,308 (14.05)	363 (27.75)	945 (72.25)		363 (27.75)	386 (29.51)	559 (42.74)		363 (27.75)	177 (13.53)	768 (58.72)	
URBMI	1,120 (12.03)	504 (45.00)	616 (55.00)		504 (45.00)	366 (32.68)	250 (22.32)		504 (45.00)	159 (14.20)	457 (40.80)	
NCMS	386 (4.15)	152 (39.38)	234 (60.62)		152 (39.38)	129 (33.42)	105 (27.20)		152 (39.38)	45 (11.66)	189 (48.96)	
Integrated insurance	5,710 (61.32)	2,768 (48.48)	2,942 (51.52)		2,768 (48.48)	1,729 (30.28)	1,213 (21.24)		2,768 (48.48)	864 (15.13)	2,078 (36.39)	
Mixture	338 (3.63)	64 (18.93)	274 (81.07)		64 (18.93)	83 (24.56)	191 (56.51)		64 (18.93)	45 (13.31)	229 (67.75)	
Other types and none	450 (4.83)	201 (44.67)	249 (55.33)		201 (44.67)	127 (28.22)	122 (27.11)		201 (44.67)	55 (12.22)	194 (43.11)	
Living near child (ren)				<0.001				<0.001				0.001
No	3,951 (42.43)	1,634 (41.36)	2,317 (58.64)		1,634 (41.36)	1,152 (29.16)	1,165 (29.49)		1,634 (41.36)	589 (14.91)	1,728 (43.74)	
Yes	5,361 (57.57)	2,418 (45.10)	2,943 (54.90)		2,418 (45.10)	1,668 (31.11)	1,275 (23.78)		2,418 (45.10)	756 (14.10)	2,187 (40.79)	
Number of family members				0.313				0.533				0.587
Median (min, max)	0 (0, 9)	0 (0, 8)	0 (0, 9)		0 (0, 8)	0 (0, 9)	0 (0, 7)		0 (0, 8)	0 (0, 6)	0 (0, 9)	
Numbers of NCDs				0.364				0.543				0.634
None	5,117 (54.95)	2,269 (44.34)	2,848 (55.66)		2,269 (44.34)	1,525 (29.80)	1,323 (25.85)		2,269 (44.34)	717 (14.01)	2,131 (41.65)	
1 type	2,612 (28.05)	1,110 (42.50)	1,502 (57.50)		1,110 (42.50)	821 (31.43)	681 (26.07)		1,110 (42.50)	383 (14.66)	1,119 (42.84)	
2 types	974 (10.46)	415 (42.61)	559 (57.39)		415 (42.61)	295 (30.29)	264 (27.10)		415 (42.61)	150 (15.40)	409 (41.99)	
≥3 types	609 (6.54)	258 (42.36)	351 (57.64)		258 (42.36)	179 (29.39)	172 (28.24)		258 (42.36)	95 (15.60)	256 (42.04)	
Self-rated health changes				<0.001				<0.001				<0.001
Better	756 (8.12)	296 (39.15)	460 (60.85)		296 (39.15)	246 (32.54)	214 (28.31)		296 (39.15)	114 (15.08)	346 (45.77)	
About the same	3,890 (41.77)	1,568 (40.31)	2,322 (59.69)		1,568 (40.31)	1,174 (30.18)	1,148 (29.51)		1,568 (40.31)	577 (14.83)	1,745 (44.86)	
Worse	4,666 (50.11)	2,188 (46.89)	2,478 (53.11)		2,188 (46.89)	1,400 (30.00)	1,078 (23.10)		2,188 (46.89)	654 (14.02)	1,824 (39.09)	
Depression				<0.001				<0.001				<0.001
No	5,315 (57.08)	2,149 (40.43)	3,166 (59.57)		2,149 (40.43)	1,604 (30.14)	1,564 (29.43)		2,149 (40.43)	764 (14.37)	2,402 (45.19)	
Yes	3,997 (42.92)	1,903 (47.61)	2,094 (52.39)		1,903 (47.61)	1,218 (30.47)	876 (21.92)		1,903 (47.61)	581 (14.54)	1,513 (37.85)	
Median (min, max)	8 (0, 30)	9 (0, 30)	7 (0, 30)	<0.001	9 (0, 30)	8 (0, 30)	7 (0, 30)	<0.001	9 (0, 30)	8 (0, 30)	7 (0, 30)	<0.001

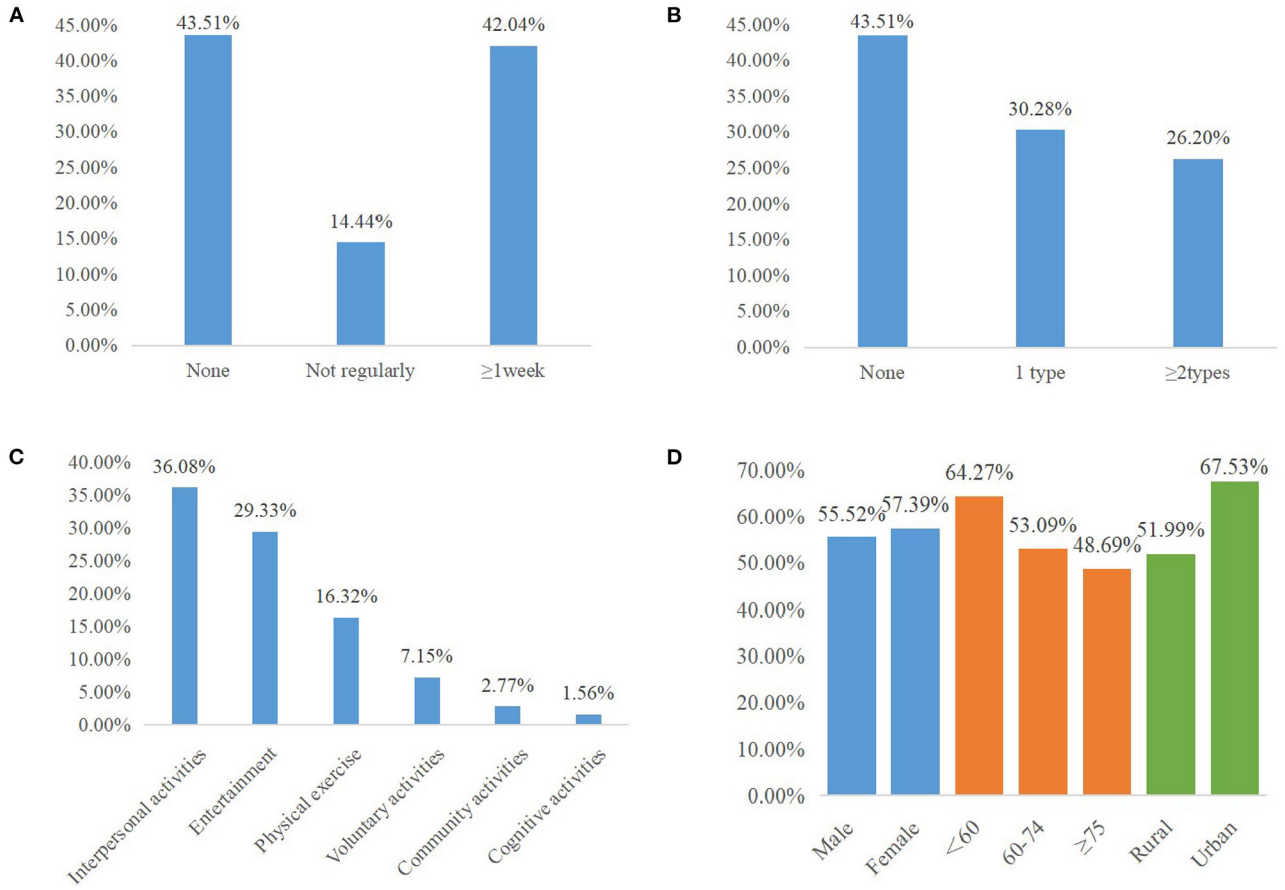


FIGURE 1 | Social participation rate of respondents with different frequencies **(A)**, numbers **(B)**, types **(C)**, and social participation rate by different ages, genders, and residencies **(D)**.

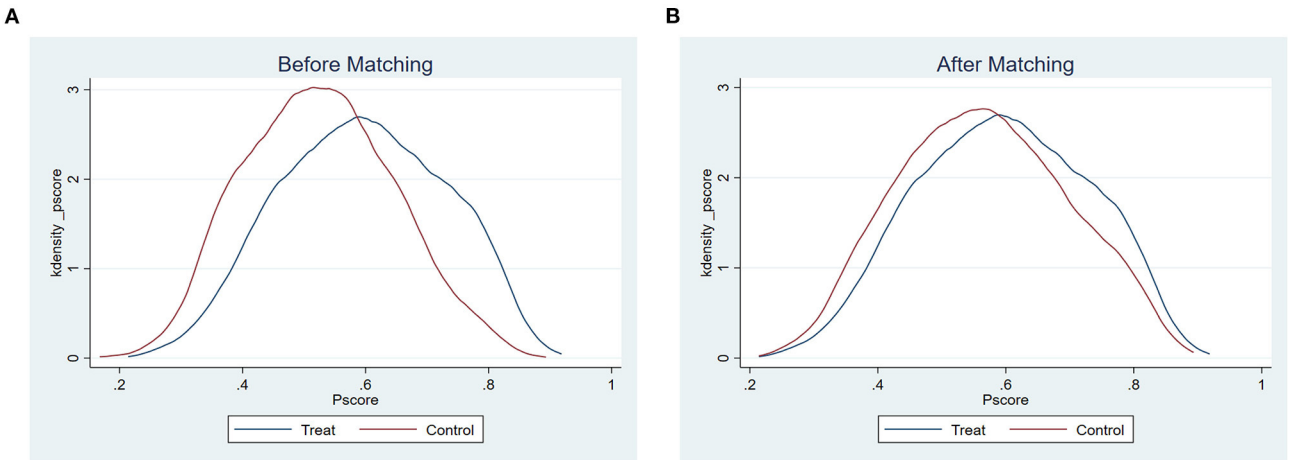


FIGURE 2 | Density function of propensity scores before **(A)** and after **(B)** PSM.

that SP had a positive effect on decreasing depression scores ($p < 0.001$) by 0.875–0.898 points, namely, SP was associated with lower depression scores. Taking the result of the radius matching method as an example, the depression scores of the respondents with SP were 0.881 points (reduction rate was 9.20%) lower, on average, than those of persons without SP. All types of SP had a significantly positive effect on decreasing depression scores ($p < 0.001$); of the different types of SP,

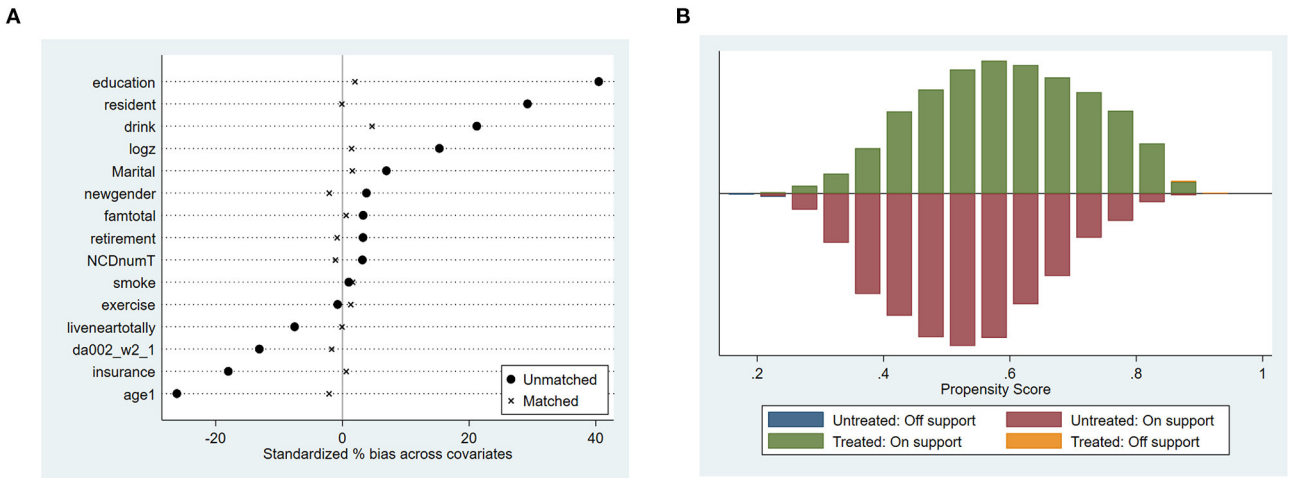


FIGURE 3 | Covariates' balancing test (standard bias of the covariates **(A)** and common support hypothesis histogram **(B)**).

participating in community activities had the largest effect (−1.549 to −1.788). PSM estimation also showed that compared with no SP, taking part in one or two types of social activity had significant negative effects on depression scores, while the more activities participants engaged in, the lower their depression scores. PSM estimation suggested that a higher frequency of participation promoted lower depression scores.

Estimation Results for the Effect of Social Participation on Depression Scores Using Ordinary Least Squares

The results estimated using OLS are shown in **Supplementary Table S5** (**Supplementary File 1**). In model 1, SP had a significant negative effect on depression scores (coefficient = −1.404, $p < 0.001$). Control variables related to demographic characteristic variables were added in Model 2, further lifestyle characteristics were added in Model 3, and health status characteristics were added in Model 4; the coefficient of SP increased to −0.892, −0.868, and −0.774, respectively, while the regression significance level remained at the 1% level. The regression results imply that compared with middle-aged and older adults who did not engage in SP, those who participated in social activities exhibited a depression score that was reduced by 0.63, on average, after adjusting for the control variables.

Heterogeneity Analysis of the Effect of Social Participation on Depression

We further conducted a heterogeneity analysis by age, gender, and residency (**Supplementary Tables S6**–S8 in **Supplementary File 1**). The results showed that SP had a significant negative effect on depression scores among different ages, genders, and residencies: being female woman, aged ≥75, and living in an urban area were all associated with more negative effects on depression scores.

DISCUSSION

This study applied a PSM method to explore the effect of SP on depression scores, including examining the effect with respect to the type, number, and frequency of SP, and further conducted a heterogeneity analysis. In addition, we also applied OLS regression models to estimate the impact of SP on depression. Our main findings indicated that SP was associated with significantly reduced depression scores: participating in community activities, higher frequency of SP, and engaging in more types of SP promoted a lower depression score. In the subgroup analysis, SP had a greater effect among older persons, women, and urban residents. The results using OLS also revealed a negative impact of SP on depression scores.

Prevalence of Depression Symptoms in Middle-Aged and Older Chinese People

Through this large-scale investigation, we found that the prevalence of depression among middle-aged and older Chinese people was 42.92%. Although the CESD-10 scale was widely used in depression investigation, it was just the estimation of depression symptom, not obsoletely equal to the real diagnosis and, thus, highly far from the monitoring data. In domestic studies using the CESD-10 scale to measure depression, a study showed that the prevalence of depression of the middle-aged and older in 2015 was 32.62% (33). Zhou found that depression prevalence was 35.19% in 2018 (34), which can be seen that the trend of prevalence is rising and the recent finding was close to us. An explanation was that physical pain caused by chronic diseases often leads to mental disorder, which may lead to depressive symptoms. Domestic studies showed that middle-aged and older people are not only the main patients with chronic diseases but also the high-risk groups of depression (35).

Nevertheless, the result in our research was also higher than other previous studies that used an estimated scale; the incidence of depression is not only higher than in earlier reports (25,

TABLE 3 | Propensity score matching (PSM) estimation results for the effect of social participation (SP) on depression scores.

Variable	Method	Treated	Controls	ATT	Standard error	*t*
SP						
	Unmatched	8.690	10.095	−1.404**	0.141	−9.950
	K-nearest neighbor matching (1:1)	8.696	9.571	−0.875**	0.209	−4.190
	Radius matching	8.696	9.577	−0.881**	0.162	−5.430
	Kernel matching	8.696	9.594	−0.898**	0.160	−5.610
Types of SP						
Interpersonal activities[a]						
	Unmatched	8.753	10.095	−1.342**	0.160	−8.390
	K-nearest neighbor matching (1:1)	8.753	9.675	−0.922**	0.236	−3.900
	Radius matching	8.753	9.730	−0.977**	0.178	−5.490
	Kernel matching	8.753	9.739	−0.986**	0.176	−5.620
Physical exercise[b]						
	Unmatched	7.799	10.095	−2.296**	0.289	−7.940
	K-nearest neighbor matching (1:1)	7.872	9.608	−1.737**	0.427	−4.070
	Radius matching	7.872	9.275	−1.403**	0.312	−4.500
	Kernel matching	7.872	9.307	−1.435**	0.308	−4.650
Voluntary activities[c]						
	Unmatched	8.652	10.094	−1.443**	0.208	−6.940
	K-nearest neighbor matching (1:1)	8.662	9.264	−0.602*	0.305	−1.970
	Radius matching	8.662	9.408	−0.746**	0.233	−3.20
	Kernel matching	8.662	9.415	−0.752*	0.229	−3.280
Community activities[d]						
	Unmatched	6.888	10.095	−3.207**	0.448	−7.160
	K-nearest neighbor matching (1:1)	6.984	8.533	−1.549*	0.604	−2.570
	Radius matching	6.984	8.706	−1.723**	0.429	−4.010
	Kernel matching	6.984	8.772	−1.788**	0.425	−4.200
Entertainment[e]						
	Unmatched	7.873	10.095	−2.222**	0.165	−13.430
	K-nearest neighbor matching (1:1)	7.881	9.096	−1.215**	0.267	−4.550
	Radius matching	7.881	9.008	−1.127**	0.208	−5.420
	Kernel matching	7.881	9.001	−1.120**	0.205	−5.460
Cognitive activities[f]						
	Unmatched	6.145	10.095	−3.950**	0.591	−6.680
	K-nearest neighbor matching (1:1)	6.183	7.345	−1.162	0.876	−1.330
	Radius matching	6.113	7.635	−1.522*	0.727	−2.090
	Kernel matching	6.183	7.760	−1.577*	0.697	−2.260
Numbers of different types of SP						
1 type	Unmatched	9.254	10.095	−0.840**	0.169	−4.960
	K-nearest neighbor matching (1:1)	9.262	9.854	−0.592*	0.232	−2.550
	Radius matching	9.262	9.922	−0.660**	0.172	−3.830
	Kernel matching	9.262	9.946	−0.684**	0.172	−3.980
≥2 types	Unmatched	8.039	10.095	−2.056**	0.173	−11.880
	K-nearest neighbor matching (1:1)	8.038	9.213	−1.175**	0.286	−4.110
	Radius matching	8.038	9.182	−1.143**	0.218	−5.240
	Kernel matching	8.038	9.194	−1.156**	0.213	−5.440
Frequency of SP						
Not regularly	Unmatched	9.140	10.095	−0.955**	0.220	−4.350
	K-nearest neighbor matching (1:1)	9.145	9.891	−0.746*	0.305	−2.450
	Radius matching	9.145	9.781	−0.636**	0.222	−2.860
	Kernel matching	9.145	9.796	−0.651**	0.221	−2.950
≥1/week	Unmatched	8.536	10.095	−1.559**	0.151	−10.310

(Continued)

TABLE 3 | Continued

Variable	Method	Treated	Controls	ATT	Standard error	*t*
	K-nearest neighbor matching (1:1)	8.543	9.378	−0.836**	0.233	−3.580
	Radius matching	8.543	9.513	−0.971**	0.175	−5.540
	Kernel matching	8.543	9.529	−0.986**	0.173	−5.700

[a] *Interpersonal activities, including interacting with friends.*
[b] *Physical exercise, including sport or social clubs.*
[c] *Voluntary activity, including voluntary or charity work, providing help or caring for a sick or disabled adult.*
[d] *Community activities, including community-related organizations.*
[e] *Entertainment, including mah-jong or cards, using the Internet.*
[f] *Cognitive activities, including stock investment or attending an educational or training course.*
*$p < 0.05$.
**$p < 0.01$.
ATT, average treatment effect for the treated.

36, 37), but also exceeds that of other developed countries (19, 38, 39), and even some developing countries (40–42). The high prevalence is a reminder that depression in Chinese middle-aged and older persons is an urgent concern. China will face greater challenges in terms of the increasing burden of depression; accordingly, attention must be paid to this issue, and feasible preventive measures are urgently needed.

Social Participation Could Benefit Older Middle-Aged and Older Adults' Mental Health

Our study verified that SP promotes mental health. We found that respondents who engaged in SP had lower depression scores, consistent with previous studies (18, 43–45). This could be explained by social participation incentivizing mutual support, providing a sense of belonging, and largely reducing social isolation (46, 47), which, therefore, result in better mental health (48). Due to aging, retirement, and declining health quality, among other factors, middle-aged and older people may experience a considerable psychological burden, social isolation, changed social roles, and the need to adapt to aging; these factors may promote depression. Against a background of population aging trends worldwide, mental health has attracted substantial research attention. The WHO noted out that SP is a key factor in healthy aging (49). Therefore, effective measures should be developed to promote SP. Policy makers should provide support for middle-aged and older people, first, by constructing service facilities suitable for this population, and second, forming related organizations with a community or village committee as a unit and encouraging middle-aged and older people to actively participate in social activities.

Participating in Community Activities, Higher Frequency of Social Participation, and More Types of Social Participation Promoted Lower Depression Scores

We proceed to explore the associations between depression and different types of social engagement. We observed that taking part in community activities was the best way to promote mental health among all types of activities considered. Community activities are carried out by a mutually beneficial organization formed by people with certain common characteristics; we speculate that such organizations are associated with promoting a sense of belonging. However, the participation rate of community activities was only 2.77%. In China, development of leagues for older persons is incomplete and informal; most leagues are self-organized and lack legal status. Consequently, there is no legal basis for the construction and operation of associations for older persons and, hence, a lack of guarantee in terms of policies, organizations, and funds. This results in many contradictions, difficulties, and problems in the construction of associations for older persons (50). In addition, we observed that engaging in more diverse social activities and engaging in SP more than once a week were relatively conducive to mental health, consistent with prior studies (14, 25, 51). Therefore, governments should make effective use of the community as a platform to promote the development of diverse activities, such as by providing financial support. Furthermore, incentive mechanisms could be used to promote the participation of middle-aged and older people in various activities.

Social Participation Had a Greater Effect on Older Persons, Women, and Urban Residents

Through further comparing the effect of subgroups of age, gender, and residency, we determined that SP had a greater effect on women, and urban residents. We also found that the older the age, the greater the impact. People over 75 years of age had the largest effect among the age groups. The percentage of social participants had no significant difference between men and women, while respondents aged <75 years, or those in urban regions, had a higher value than the reference group. The above results emphasize that SP appears to be a more effective measure to prevent depression for women, older persons, and urban residents.

Older women are more likely to lack social interaction than older men; furthermore, influenced by the traditional Chinese concept of "men dominate the outside, women dominate the interior" (52), older men often enter the labor market to earn income and have frequent contact with the outside world, while older women generally engage in housework or take care of children or older relatives at home, compared with men. This

part of communication with the outside world is insufficient for women. Activities in which women participated were the primary source of relief for their depressive symptoms and, thus, had a more considerable effect on them.

As age grows, the mental health status and social adaptability of the elderly generally decreased, and the possibility of social isolation become higher (53). Our study also showed that as age increased, social participation decreased; thus, social participation plays a greater role among the venerable age group. Residents of urban regions received more benefit than did rural residents, as the former had a more convenient environment for participation, due to greater availability of diverse social activities in a city. Targeted measures should consider women, elderly, and rural residents, such as middle-aged and older women, and elderly persons with limited mobility. For example, accessibility of participation should be improved by installing elevators in buildings or introducing social workers to conduct activities in the homes of elderly people with disabilities. For rural elderly persons, the social activities currently available have limited effects on improving health. Activities, such as "guangchangwu" (after-dinner community square dancing) and other community activities that are widespread in cities have beneficial effects on health, are rarely available in rural areas (54). Therefore, it is necessary to improve the provision of various organized activities for elderly persons in rural areas and to guide such persons to participate in these activities on a consistent basis.

Comparison of Effects Between Propensity Score Matching and Ordinary Least Squares Analysis Strategies

A significant negative association between SP and depression scores was found in both PSM and OLS analysis, although the estimated effect was larger in the OLS method than the PSM method, that is, not balancing covariates led to overestimation of the treatment effect.

The primary strength of our study is that the PSM method enabled a reasonable comparison to be made between groups with and without SP, reducing estimation bias. There are also some limitations to our study. First, as a cross-sectional study, causal relationships between SP and depression could not be determined; future studies should use longitudinal designs to address this limitation. Second, PSM cannot solve endogenous problems, such as self-selection and omission of variables, which may affect the accuracy of the results. Third, we obtained the result from scale responses, thus, it reflects a degree of mental status, namely, depressive symptoms. However, it does not equate to depression clinically diagnosed by a physician. Fourth, the sample size of persons who took part in several types of SP, such as voluntary activities, community organizations, or using the Internet, was small; using a larger sample of such persons would provide more reliable results, future studies are needed for such further exploration.

CONCLUSION

This study highlighted the crucial role of SP in preventing depression and promoting the mental health of middle-aged and older Chinese people. Community activities were the most effective of all activities. Participation in more diverse activities and participation with the frequencies of once a week or more is beneficial to mental health. SP had a greater effect on older persons, women, and urban residents. The results suggest that as the population of China ages, the government should provide support for middle-aged and older person's social participation, such as by providing venues, funds, and channels for social participation. Organized and diverse activities should be provided and measures should be taken to encourage middle aged and older persons participated in such social engagement. In particular, attention should be paid to women, rural residents, and older persons, who would benefit from targeted measures provided according to their needs.

DATA AVAILABILITY STATEMENT

The dataset are available from the CHARLS repository, http://charls.pku.edu.cn.

ETHICS STATEMENT

This study was approved by the Ethical Committees of Peking University. During the investigation, all participants provided written informed consent. CHARLS is publicly available and de-identified. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JW and QW designed the study. JW contributed to the data processing and drafted the manuscript. JW, JX, YN, and PP contributed to the result analysis. XZ and SS contributed to the collection of literature and review of the manuscripts. YL, HL, LL, and LG assisted by providing suggestions for this manuscript. QW and YH revised the paper. All authors approved the current version of this manuscript for publication. All authors contributed to the article and approved the submitted version.

FUNDING

This study was funded by the National Social Science Fund of China (Grant No. 19AZD013) and the National Natural Science Foundation of China (Grant No. 71804036).

ACKNOWLEDGMENTS

In this study, the authors are very grateful to QW for her guidance. The authors would also like to thank all the participants. We also appreciate the CHARLS research team and all respondents for their contribution.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.825460/full#supplementary-material

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frontiers | Frontiers in Psychiatry

ORIGINAL RESEARCH
published: 27 April 2022
doi: 10.3389/fpsyt.2022.848911

The Impact of Early Neighborhood Cohesion, and Its Mechanism, on Cognitive Function in Later Life

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Objectives: This study aimed to explore the impact of early neighborhood cohesion, and its mechanism, on cognitive function in later life.

Methods: In total, 10,727 Chinese elderly, aged 60–90, forming two datasets (2014 and 2018) from the China Health and Retirement Longitudinal Study (CHARLS) were used as a sample. Childhood neighborhood cohesion was measured by the extent of how much neighbors were willing to help and how close-knit neighbors were. Mini-Mental State Examination (MMSE) and Center for Epidemiologic Studies Depression Scale (CESD-10) were used to assess the cognitive functions and depression of the elderly. We used a structural equation model to examine the relationship between early neighborhood cohesion and late-life cognitive function and conducted bootstrapping analyses to assess the mechanism.

Results: Cognitive function was positively predicted by childhood neighborhood cohesion ($\beta = 0.06$, $p < 0.001$), and cognitive function of the elderly were also positively predicted through the mediating effects of childhood friendships, which included depression and social activity participation as two chain paths.

Conclusion: The findings suggest that childhood neighborhood cohesion positively predicts cognitive function among elderly people through the mediating roles of childhood friendship, depression, and social activity engagement. Childhood neighborhood cohesion is correlated with better childhood friendships, then to fewer depression symptoms and greater elderly social activity participation, and finally to better cognitive functions in the elderly.

Keywords: cognitive function, early neighborhood cohesion, life course perspective, early friendship, depression, social activities engagement

OPEN ACCESS

Edited by:
Giorgio Di Lorenzo, University of Rome Tor Vergata, Italy

Reviewed by:
Sitong Chen, Victoria University, Australia
Yanjie Zhang, The Chinese University of Hong Kong, China

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

Received: *05 January 2022*
Accepted: *06 April 2022*
Published: *27 April 2022*

Citation:
Zhou T, Zhang X, Fan S, Deng Z and Jiao C (2022) The Impact of Early Neighborhood Cohesion, and Its Mechanism, on Cognitive Function in Later Life. Front. Psychiatry 13:848911. doi: 10.3389/fpsyt.2022.848911

INTRODUCTION

China's population is aging rapidly. Zhai et al. (1) predicted that the proportion of the elderly population aged 60 and above in China will reach 25% in 2030 and 37.92% in 2100. With an aging society, cognitive function among the older Chinese population becomes an important public health concern. Cognitive function refers to a spectrum of higher-order cerebral functions (2). It

declines with age and can be sufficiently severe to threaten the physical and mental health of the elderly. Its decline is characterized as a clinical syndrome of dementia. The number of dementia patients in China is the largest in the world, placing a considerable strain on the public and health care services (3). As a major problem facing the elderly population, dementia may adversely affect the elderly's ability to maintain social connections. Additionally, the elderly who have lost the ability to live independently place a heavy burden on their families and society. Cognitive decline is the most common cause of dementia (4). Therefore, it is necessary to prevent the cognitive decline of the elderly in China.

Researchers have proposed that early life factors related to cognitive aging should be identified in the context of the life course (5). The cognitive health of the elderly is not only affected by their current conditions but also the result of the accumulation of life experiences (6). Previous work has linked childhood experiences with cognitive function in later life. For example, older adults are at a lower risk of cognitive impairment if they had better childhood friendship experiences (7). Additionally, childhood family-life happiness significantly predicts older adult cognitive functioning. However, previous studies focused on the impact of early personal experiences on cognitive abilities in later life, but few studies have considered environmental factors in childhood. What deserves additional consideration is whether and how the childhood neighborhood social environment, such as neighborhood cohesion, impacts the cognitive function of the elderly. In addition, it is worth considering whether and how childhood cohesion affects the cognition function of the elderly.

Neighborhood cohesion is the degree of mutual trust, support, unity, and friendship among neighbors, which reflects the social environment of the neighborhood (8). Socialization theory posits that the early social environment integrates individuals into society, shaping their social characters, values, and behavioral patterns (9). Those who grew up in cohesive neighborhoods may show better social development (10), which impacts cognitive function in later life. On the basis of relevant literature regarding cohesive neighborhoods and cognitive function, we proposed the following hypothesis: Neighborhood cohesion in childhood is positively associated with cognitive function in the elderly.

Children who live in cohesive neighborhoods are likely to develop high-quality friendships. First, in cohesive neighborhoods, children are guided to take a pro-social attitude and conform to the norms of trust, solidarity, and reciprocity, which may contribute to the establishment of harmonious peer relationships (10). Second, according to the social learning theory (11), children can acquire social skills by observing and imitating how cohesive neighbors interact. These social skills can be applied to children's interpersonal relationships, helping them form friendships (12). Finally, parents are willing to let their children play alone in common areas when they perceive their neighborhoods as cohesive (13). Those independently mobile trips provide great opportunities for children to make friends.

A recent study found that childhood friendship is significantly related to better cognitive function and slower cognitive decline in middle and old age (7). The cognitive reserve hypothesis postulates that participation in stimulating activities early in life can help the brain build a reserve to buffer against cognitive decline (14). It has been reported that a higher level of availability of cognitive resources and frequency of participation in cognitively stimulating activities at 12 years of age is associated with less cognitive decline per year, and the pathological symptoms of Alzheimer's disease were mediated by these factors (15). As an important source of cognitive stimulation, early friendship experiences contribute to improving cognitive reserves, especially when educational resources are lacking. Childhood neighborhood cohesion may protect the cognitive function of the elderly by promoting childhood friendship. Therefore, we proposed the following second hypothesis: Childhood friendship mediates between childhood neighborhood cohesion and cognitive function in older adults.

Childhood neighborhood cohesion and friendship may also reduce depressive symptoms in old age, thereby improving cognitive function. Evidence is emerging that childhood friendship can protect elderly people from depression. The higher the quality of childhood friendship, the fewer depressive symptoms in adults (16). The elevated level of loneliness and decreased engagement in peer relationships during childhood are associated with increased depressive symptoms in middle and old age (9). Thus, depressive symptoms in later life are influenced by childhood neighborhood cohesion and friendship.

Other quantitative studies have demonstrated that depressive symptoms in later life confer a greater risk of cognitive decline (17–19). One study has shown that depressive symptoms in old age are negatively correlated with cognitive abilities, such as orientation, language, memory, attention, and calculation skills (19). The elderly people with more depressive symptoms performed worse on the cognitive tests, including delayed word recall, digit symbol substitution, and animal fluency (17). Longitudinal studies have also shown that depressive symptoms in the elderly negatively predict cognitive function (18). The feeling of depression distracts individuals' attention and interferes with cognitive task performances (20). Elevated levels of inflammatory factors in depressed older adults may cause nerve damage and enlarge neuropathological changes related to Alzheimer's disease (18). In conclusion, childhood friendship could independently mediate the relationship between childhood neighborhood cohesion and cognitive function in the elderly, and depressive symptoms could independently mediate the association of childhood friendship with cognitive function in later life. However, how the two mediators can work together in this relationship remains to be explored. According to Hayes (21), when there is more than one mediator in a mediation model, these mediators have chain-mediating roles if they are related to each other. Considering the effect of childhood friendship on depression, this study further proposed the following third hypothesis: Childhood friendship and depression play chain mediating roles between childhood neighborhood cohesion and cognitive function among the elderly.

Childhood neighborhood cohesion and friendship may also affect cognitive function by enhancing social activity engagement among older adults. Children's success in fostering harmonious peer relationships increases friendship-related self-efficacy, which is the belief in the ability to communicate and

interact with friends, resolve conflicts, and manage interpersonal emotions (16). They will be motivated to participate actively in social interactions and form a self-reinforcing cycle. On the contrary, poor peer relationships usually result in low-quality socialization, limiting social participation over a lifetime (22). The neurobiology literature shows that early social isolation has deleterious effects on brain functions related to the social functioning in adulthood, revealing a mechanism underlying sociability deficits (23). Moreover, children who lack friendship in childhood have limited opportunities to practice social skills, which restricts their social interactions as adults (24).

Based on the points mentioned above, childhood neighborhood cohesion affects social activity engagement by influencing childhood friendships. Additionally, social activity engagement is protective of cognitive function in elder adults (25). Participation in at least one social activity and the number of participated social activities in old age is significantly related to better mental status and memory (26). A study using a latent class growth analysis found that older people with active social activity engagement are more likely to have stable cognitive decline trajectories (27). The "Use It or Lose It" hypothesis postulates that social activity engagement provides the elderly with intellectual stimulation, helping them exercise brain function (28). This kind of cognitively stimulating lifestyle enables the elderly to better maintain their cognitive abilities (29). Therefore, we proposed a fourth hypothesis: Childhood friendship and social activity engagement play chain mediating roles between childhood neighborhood cohesion and cognitive function in later life.

In summary, the current study aimed to expand the "life course" model of later-life cognitive function by examining the relationship between childhood neighborhood cohesion and cognitive function in the elderly, as well as the mediating effects of childhood friendship, depression, and social activity engagement (**Figure 1**).

MATERIALS AND METHODS

Data Source

This study analyzed data from the CHARLS,[1] a nationally representative longitudinal survey of individuals over age 45 in China. The survey collects answers to a rich set of questions about aging, including physical and psychological health. Its samples were obtained using a multistage probability-proportional-to-size method in 150 counties across 28 provinces in China (30). In this study, the data on childhood neighborhood cohesion and friendship were taken from the CHARLS life course survey (2014). The data on late-life depression, social activity engagement, and cognitive function were obtained from the latest CHARLS follow-up survey (2018). We matched the individuals in CHARLS 2014 and 2018 using their IDs to link childhood experience with later life. When considering whether the social activity engagement of the most elderly is greatly affected by age, we selected subjects aged 60–90 years old. We used a maximum-likelihood estimation of missing data to maximize the utility of the available data (31). After excluding 17 samples with missing data for all variables, the final study sample included 10,727 respondents.

[1] http://charls.pku.edu.cn/

Measurements

Childhood Neighborhood Cohesion

Childhood neighborhood cohesion was evaluated based on two aspects of the neighborhood in which respondents lived in before 17 years of age, as done previously (32). They were represented by the two following questions: (1) "Were the neighbors willing to help each other out?" (1 = not willing at all, 2 = not very willing, 3 = somewhat willing, and 4 = very willing); (2) "Were the neighbors close-knit?" (1 = not close-knit at all, 2 = not very close-knit, 3 = somewhat close-knit, and 4 = very close-knit).

Childhood Friendship

Childhood friendship was measured by the respondents' experiences before age 17 in accordance with previous studies (7, 16, 33). This was determined using the following three questions: (1) "How often did you feel lonely because you did not have any friends?" (1 = often, 2 = sometimes, 3 = not very often, and 4 = never); (2) "Did you often have a group of friends that you felt comfortable spending time with?" (1 = never, 2 = not very often, 3 = sometimes, and 4 = often); (3) "Did you have a good friend?" (1 = no, 2 = yes).

Depression

Depression was assessed using the 10-item Center for Epidemiologic Studies Depression Scale (CESD-10) short form, which has been shown to have high reliability and validity. It has been widely used among older Chinese adults (34). This scale is based on 10 items having answers that reflect how respondents have felt and behaved during the last week, including "bothered by things", "can't concentrate", "feel depressed", "hard to do anything", "feel hopeful", "feel fearful", "poor sleep", "feel happy", "feel lonely" and "can't go on living". Responses to each item are rated using a 4-point scale (0 = Rarely or none of the time; 1 = Some or a little of the time; 3 = Occasionally or a moderate amount of the time; 4 = Most or all of the time). The final CESD-10 score is the sum of each item, ranging from 0 to 30, with a higher score reflecting a greater level of severity. A CESD-10 score $\geq$ 20 was classified as depression group, $\geq$10 as the depressive symptoms group, and <10 as the no depressive symptoms group (19). The Cronbach's α for CESD-10 was 0.807 in this study.

Social Activity Engagement

Measures of social activity engagement were assessed by whether the respondents had participated in the following six activities in the past month (1 = yes; 0 = no): (i) interacted with friends, (ii) played Mahjong, chess, or cards, or went to a community club; (iii) provided help to family, friends, or neighbors who does not live with the respondent; (iv) went to a sport, social, or other kind of club; (v) took part in a community-related organization; (vi) performed voluntary or charity work; and (vii) cared for a sick or disabled adult who does not live with the respondent.

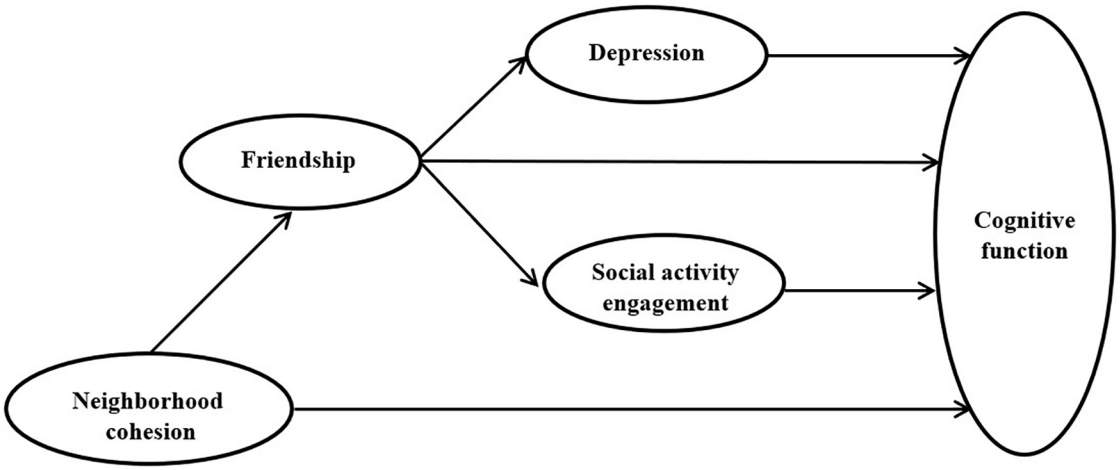


FIGURE 1 | Hypothesized structural equation model (SEM).

Cognitive Function

Respondents' cognitive function were measured using the Chinese version of the Mini Mental State Examination (MMSE), (2). This test uses 30 items to evaluate language (repeating phrase, three-step command, and naming), delayed memory, attention, calculation (calculation and copying intersecting polygons), immediate memory, and orientation (orientation to time and place). The total score ranges from 0 to 30 points, with higher scores indicating better cognitive function. The Cronbach's α for MMSE was 0.686 in this study. The Chinese version of the MMSE shows adequate reliability and validity among patients with depression and in the general population (35).

Covariates

Based on previously published studies (7, 36, 37), the confounding variables in our study included sex (male or female), age (years), marital status (married or unmarried), and reading ability (illiterate and literate). In the regression model, we controlled for these confounding variables.

Statistical Analyses

All statistical analyses were conducted using the SPSS 25.0 (SPSS Inc., Chicago, IL, United States). Results were considered statistically significant if p value was less than 0.05. The descriptive characteristics of the study sample were expressed as the means, standard deviation (SD), or proportion. Next, we used Structural Equation Modeling to explore the relationship and its mechanism between childhood neighborhood cohesion and cognitive function in the elderly using MPlus 7.11 (38). Given that some variables were categorical, such as childhood neighborhood cohesion and friendship, the model was assessed by the weighted least squares means and variance adjusted estimation. We used the following indices to assess the fit of the structural equation models: root means square error of approximation (RMSEA) < 0.08, comparative fit index (CFI) > 0.90, and Tucker-Lewis index (TLI) > 0.90 (39). The chi-square test (χ^2) could have been reported as a fitness index, but it was excluded its use is not optimal for a large sample size. We handled the missing data using the pairwise present approach to maximize the utility of the available data. Finally, the mediation effects were estimated with 50,000 bootstrap samples.

RESULTS

Study sample characteristics are presented in **Table 1**. The mean age of participants were 69 years old, and females accounted for 50.9%, 68.4% of participants were literate, and 78.8% of participants were having companions. Most of the respondents lived in a neighborhood where people were close-knit (very close-knit, 42.0%, and somewhat close-knit, 52.6%) and willing to help each other (very willing, 45.0%, and somewhat willing, 40.1%). The majority of respondents never felt lonely because they did not have friends (77.5%), often had a group of friends (58.9%), and had a good friend (56.1%). About a third of the subjects had interacted with friends in the last month. The average cognitive function score was 21.15 (SD = 5.4), and the mean depression score was 8.42 (SD = 6.39).

The cognitive scores for different categories of each explanatory variable and the statistical significance of the difference are shown in **Table 2**. There were significant differences in cognitive function among different categories of explanatory variables except for some social activities, such as "Interacted with friends" and "Cared for a sick or disabled adult." The analysis of the measuring model indicated that the model had the appropriate factor structure. The factor loading from the latent variables to observed variables was significant, and the fit indices indicated the model fit the data well (RMSEA = 0.04, CFI = 0.96, and TLI = 0.95). As shown in **Table 3**, if other variables were not considered, the regression coefficient of childhood cohesion on cognitive function was significant ($\beta = 0.16$, $p < 0.001$) with good model fit indices (RMSEA = 0.02, CFI = 0.99, and

TABLE 1 | Descriptive characteristics.

Variable	*x* ± *SD*/*n* (%)
Age	69.09 ± 6.87
Female (%)	5460(50.9%)
Have companion (%)	8453(78.8%)
Non-illiterate (%)	7059(68.4%)
Childhood neighborhood cohesion (%)	
Neighbors were willing to help	
Very	2012(45.2%)
Somewhat	1773(39.8%)
Not very	435(9.8%)
Not at all	231(5.2%)
Neighbors were close-nit	
Very	1874(41.7%)
Somewhat	2362(52.6%)
Not very	192(4.3%)
Not at all	63(1.4%)
Childhood friendship (%)	
Lonely due to no friends	
Never	3475(77.5%)
Not very often	379(8.5%)
Sometimes	280(6.2%)
Often	348(7.8%)
Having a group of friends	
Often	2648(58.9%)
Sometimes	553(12.3%)
Not very often	451(10.0%)
Never	846(18.8%)
Having a good friend	2527(56.1%)
Social activity engagement (%)	
Interacted with friends	1626(30.4%)
Played Ma-jong, chess or cards, or went to community club	903(16.9%)
Provided help to family, friends, or neighbors who do not live with you	535(10.0%)
Went to a sport, social, or other kind of club	299(5.6%)
Took part in a community-related organization	119(2.2%)
Done voluntary or charity work	46(0.9%)
Cared for a sick or disabled adult	101(2.0%)
Depression	8.42 ± 6.39
Cognitive function	21.15 ± 5.44

SD, standard deviation. Sample N = 10,727.

TABLE 2 | Test for statistical differences in cognitive function scores.

Variable	Cognitive Function (*M* ± SD)	*P*
Childhood neighborhood cohesion		
Neighbors were willing to help		<0.001
Very	20.83 ± 5.36	
Somewhat	20.87 ± 5.34	
Not very	18.68 ± 5.42	
Not at all	17.50 ± 5.43	
Neighbors were close-nit		<0.001
Very	20.77 ± 5.42	
Somewhat	20.55 ± 5.38	
Not very	18.31 ± 5.54	
Not at all	16.36 ± 5.29	
Childhood friendship		
Lonely due to no friends		<0.001
Never	18.73 ± 5.67	
Not very often	20.09 ± 5.16	
Sometimes	19.40 ± 5.27	
Often	20.83 ± 5.39	
Having a group of friends		<0.001
Often	21.23 ± 5.21	
Sometimes	20.91 ± 5.25	
Not very often	19.43 ± 5.10	
Never	17.90 ± 5.78	
Having a good friend		<0.001
Yes	21.19 ± 5.24	
No	19.94 ± 5.51	
Social activity engagement		
Interacted with friends		0.635
Yes	21.17 ± 5.47	
No	20.31 ± 5.38	
Played Mahjong, chess or cards, or went to community club		<0.001
Yes	22.29 ± 4.60	
No	20.17 ± 5.52	
Provided help to family, friends, or neighbors who do not live with you		0.068
Yes	21.30 ± 5.20	
No	20.48 ± 5.44	
Went to a sport, social, or other kind of club		<0.001
Yes	22.26 ± 4.71	
No	20.47 ± 5.45	
Took part in a community-related organization		0.008
Yes	22.88 ± 4.64	
No	20.52 ± 5.43	
Done voluntary or charity work		0.020
Yes	23.16 ± 4.65	
No	20.54 ± 5.42	
Cared for a sick or disabled adult		0.738
Yes	21.20 ± 5.30	
No	20.56 ± 5.43	
Depression		<0.001
No depression	21.93 ± 4.97	
Depressive symptoms	19.80 ± 5.12	
Depression	18.18 ± 5.25	

SD, standard deviation.

TLI = 0.99). However, after entering childhood friendship, depression, and social activity engagement into the hypothesized Structural Equation Modeling, the path was not significant and had been deleted. The final model had good fit indices (RMSEA = 0.03, CFI = 0.94, and TLI = 0.93). Within the model, childhood neighborhood cohesion was positively associated with childhood friendship ($\beta = 0.46$, $p < 0.001$). Better childhood friendship predicted higher late-life cognitive function ($\beta = 0.14$, $p < 0.001$). Childhood friendship negatively predicted depression ($\beta = -0.24$, $p < 0.001$), which further negatively predicted cognitive function ($\beta = -0.14$, $p < 0.001$). Social activity engagement was also positively predicted by childhood friendship ($\beta = 0.35$, $p < 0.001$), and in turn, predicted higher cognitive function ($\beta = 0.17$, $p < 0.001$). The final model with standardized path coefficients and significance level are shown in **Figure 2**.

TABLE 3 | Path coefficient test

Path	β	95% CI	
		Low	High
Childhood neighborhood cohesion → cognitive function	0.06***	0.03	0.10
Childhood neighborhood cohesion → childhood friendship	0.46***	0.42	0.49
childhood friendship → cognitive function	0.14***	0.09	0.18
childhood friendship → depression	−0.24***	−0.27	−0.2
Depression → cognitive function	−0.14***	−0.17	−0.12
childhood friendship → social activity engagement	0.35***	0.29	0.41
social activity engagement → cognitive function	0.17***	0.13	0.2

CI, confidence interval. Confidence intervals that do not contain 0 are significant.
****$p < 0.001$.*

As shown in **Table 4**, the indirect effect on the childhood neighborhood cohesion → childhood friendship → cognitive function path was 0.06, and the 95% confidence interval (CI) was [0.04, 0.09]. The childhood neighborhood cohesion → childhood friendship → depression → cognitive function path was 0.02, and the 95% CI was [0.01, 0.02]. The childhood neighborhood cohesion → childhood friendship–social activities engagement → cognitive function path was 0.03, and the 95% CI was [0.02, 0.04]. The total mediating effect was 0.11, and the 95% CI was [0.09, 0.13]. Because the 95% confidence intervals of the mediating effects all included zero, the second, third, and fourth hypotheses were proven.

DISCUSSION

This study provided the evidence that childhood neighborhood cohesion had prospective associations with cognitive function in the elderly. We further expanded this relationship by examining it in the framework of life course, and we determined the mediating role of childhood friendship, depression, and social activity engagement through which childhood neighborhood cohesion affects cognitive function.

According to the ecological system theory proposed by Jørgensen (40), the environment affects the development of individuals. The individual's environmental system consists of four systems, include the micro system, the intermediate system, the outer system, and the macro system. The micro-system is the direct environment for individual activities and social interactions, which is constantly changing and developing. As children grow, the range of activities expands into the community, and their behavior is more easily influenced by the community environment (40). Under the research framework of Life Course Theory, the individual's early experiences have a great influence on their behavior, and many studies have shown that the influence of social structure in childhood is more prominent and homogenous than that in adulthood (41), which laid the foundation for our research. In recent years, researchers have begun to pay attention to the influence of the growth environment in the early years on the individual's future life, such as early life stress has an impact on cognitive function in the middle and later stages of an individual. This study focused on the relationship between childhood neighborhood cohesion and cognitive function in the elderly in a community environment.

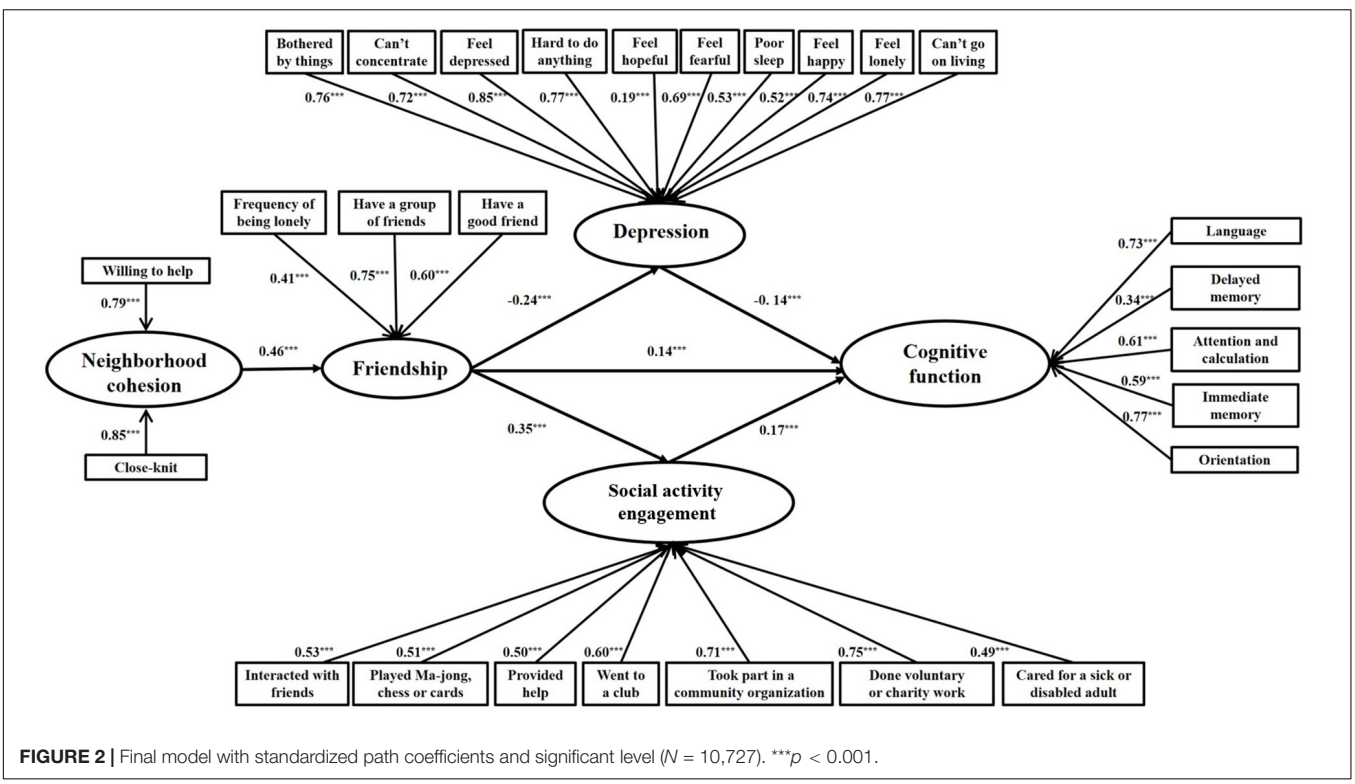


FIGURE 2 | Final model with standardized path coefficients and significant level (N = 10,727). ***$p < 0.001$.

TABLE 4 | The mediation effect of childhood neighborhood cohesion on cognitive function.

Effect	Path	Effect	95% CI	
			Low	High
Direct Effect	Childhood neighborhood cohesion → cognitive function	0.004	−0.04	0.03
Indirect Effect	Childhood neighborhood cohesion → childhood friendship → cognitive function	0.06***	0.04	0.09
	Childhood neighborhood cohesion → childhood friendship → depression→cognitive function	0.02***	0.01	0.02
	Childhood neighborhood cohesion → childhood friendship → social activity engagement→cognitive function	0.03***	0.02	0.04
Total Mediating Effect		0.11***	0.09	0.13

CI, confidence interval. Confidence intervals that do not contain 0 are significant.
****$p < 0.001$.*

Childhood neighborhood cohesion positively predicts childhood friendship and thereby contributes to cognitive health. The cohesive neighborhood may result in strong friendships in early life. The neighborhood is an important part of the social environment from which children form their values. The pro-social values that comprise the cohesion can be passed to children, promoting friendship (10). Furthermore, as supported by social learning theory (11), cohesive neighbors may be good role models for children as they build friendly relationships. Children can imitate their social behavior to develop social skills, such as empathy, sharing, and trust, which are important for friendship (12). Individuals with a higher quality of childhood friendship have better cognitive function in later life. This is consistent with previous studies (15, 36) and in line with the cognitive reserve hypothesis (14). There are multiple pathways between childhood friendship and cognitive function in older adults, and previous studies have explored their relationship from different perspectives. Burr and his colleagues (7) found that childhood friendship has an impact on cognitive function in the elderly through adult social disconnectedness and loneliness. Sharifian discussed the relationships among childhood friendship, activity engagement, and cognitive function in older adults (42). According to the Convoy Theory by Antonucci et al. (43), friendship is related to cognition, feelings, and behaviors through the interactions of individual and social factors. Because depression is a personal factor related to childhood friendship and cognitive function, it is a common mental health problem faced by the elderly in China, and social activity engagement is an important form of social contact. Therefore, in our study, depression and social activity engagement were selected as mediating variables to explore the relationship between childhood friendship and cognitive function. Early social interactions may provide beneficial cognitive stimulation and enhance cognition reserve, which can promote the development of the brain and reduce the pathological changes related to Alzheimer's disease in old age (15). In addition, friendship can enrich the individual's early life activities, helping them maintain an active mind in the future (36).

Some studies have suggested that cognitive function plays a role in depression and that depression and cognitive disorders, like dementia, share some biological mechanisms (44), with depression being a symptom of cognitive impairment (45). However, there is a bidirectional relationship between depression and cognitive function, and most studies have shown that while depression can predict cognitive decline, changes in cognitive function cannot predict depression (45, 46). This study found that childhood neighborhood cohesion and friendship further affect the symptoms of depression in old age, thereby forming a link to cognitive function. Individuals growing up in a cohesive neighborhood are likely to establish good peer relationships. Researchers have shown that a life devoid of friendship may induce stress and lead to dysfunctions in stress-related response systems, such as increases in stress hormones and inflammatory factors. When encountering stressful life events as adults, those who lacked peer relationships in childhood are prone to maladaptation and depressive symptoms (6). These supportive relationships may help them strengthen self-resilience and build skills that help recognize and manage emotions, which can aid in stress management and the prevention of depression. Conversely, the lack of neighborhood cohesion can lead to poor friendship (9, 16). If these responses continue through life, then they may permanently change the stress system over time and cause the failure of the emotional regulation, which confers a greater risk of depression in later years (6). Previous studies have found that depression can increase the levels of inflammatory cytokines and cortisol to levels that damage the neural connections in the brain and impair cognitive function (18).

Our results also indicate that childhood neighborhood cohesion and friendship impact cognitive function through social activity engagement in old age. In a neighborhood with greater cohesion, individuals form better peer relationships, which lay the foundation for social activity participation in later life. This occurs because childhood friendship enhances the individuals' self-efficacy in interpersonal interactions. When individuals believe in their ability to communicate with others and cope with conflicts, they are motivated to make friends and form a supportive circle (24). Individuals with good friendships have numerous opportunities to practice social skills, during which neural circuits related to social interactions are fully developed and function normally until old age (23). Here, social activity engagement was significantly related to cognitive function among older people, which is consistent with the "Use It or Lose It" hypothesis (28) and previous findings (26, 27, 29, 47). Social activities provide cognitive stimulation to exercise the brain and keep the mind active, which contributes to cognitive health.

A key strength of this research is the refinement of the social convoy theory, which is mainly used to study the social

relations of the elderly. The theory proposes that individuals go through life with different sets of supportive relationships separated by circles in terms of closeness (48). Specifically, the close relationships in the inner cycle are stable and will continue to stay through the whole life, whereas the marginal relationships in the outer cycle are likely to change with age. The theory has two research focuses, the dynamic changes in the social relations of the elderly during aging and the emotional closeness in the social network. The emotional "depth" and emotional "breadth" attributes of individual emotional intimacy have important impacts on the distribution of social relationships and satisfaction with social support networks. The influencing factors of the convoy theory include personal and situational characteristics, and their interactions affect the individual's social network, as well as their health and subjective well-being (43, 49, 50). This study found that the neighborhood cohesion of the elderly in childhood affects social participation in old age, which is a continuous and stable process. Social relationships in childhood may change as people age; however, the emotional intimacy of the social network in childhood will affect the social participation of the elderly, and this will continue to affect the elderly, even in their later years. Early high-quality peer interactions may help individuals build social skills and lay the foundation for later social engagement. The current study indicated that although the size and composition of the outer social network will change along with circumstances, the process of individuals integrating into the social environment and expanding social relationships has a certain degree of continuity and stability.

An additional strength of the research is the highlighting of the importance of social life in the framework of the life course. Social environment (neighborhood cohesion), social relationship (friendship), and social activity engagement throughout life were found to exert significant and long-lasting influences on emotional and cognitive health. From the perspective of evolutionary psychology, social life has evolved into a deep-rooted human characteristic, which acts as a crucial means for ensuring survival and reproduction (51). Thus, interventions to encourage an active social life over the life course are beneficial. Many studies have shown that participating in social activities in early life (7) and later life (26, 27, 29) improves cognitive abilities. However, this evidence was limited to the individual level. Considering that effective public health interventions must be carried out in a multi-level and systematic manner (52), the current study fills the research gap by proving the effect of neighborhood cohesion, a situational factor, on cognitive health. Thus, public health initiatives may promote an active social life among residents of all ages by facilitating cohesion, thereby contributing to cognitive health in an increasingly aging society.

This study has certain limitations. First, many other factors affect cognitive function over the life course. Second, the self-reported data on the childhood experience may have recall errors, which may bias results toward the null hypothesis. Third, personality traits, such as extroversion and openness, may affect the relationship between childhood friendship and social activity engagement in old age. Finally, the relationship between social activity engagement and cognitive function may be bidirectional. In addition, a cross-lagged analysis can be used to examine directional influences between social activity engagement and cognitive function over time. Future research will explore the interaction effect of neighborhood cohesion (external factor) and personality (internal factor) on social life. Because green spaces provide venues for human social activities, they may contribute to cognitive health by enhancing neighborhood cohesion, which can be studied in the future.

CONCLUSION

This study found that childhood neighborhood cohesion positively predicts the cognitive function of the elderly through the mediation effect of childhood friendship. This mediating effect includes two paths: "childhood friendship → depression" and "childhood friendship → social activity engagement". Childhood neighborhood cohesion is related to better childhood friendship, then to fewer depression symptoms and more social activity participation over a life span, and finally to better cognitive function in the elderly.

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.

AUTHOR CONTRIBUTIONS

TZ: validation and investigation. XZ: writing—review and editing, and methodology. SF: conceptualization and formal analysis. ZD: software. CJ: supervision. All authors contributed to the article and approved the submitted version.

FUNDING

This study was supported by a National Science Foundation (Grant No. 21BSH018) and the Shenzhen Humanities & Social Sciences Key Research Bases of the Center for Mental Health, Shenzhen university. Key project of humanities and social sciences research in University of Guangdong (Grant No. 2018WZDXM015).

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frontiers | Frontiers in Public Health

SYSTEMATIC REVIEW
published: 03 May 2022
doi: 10.3389/fpubh.2022.800880

Workplace Mental Health Interventions in India: A Rapid Systematic Scoping Review

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The mental health initiatives at the workplace are growing in numbers over the past few years. Public and private sectors continue to explore avenues to navigate and adapt initiatives to promote employee's mental wellbeing. However, such initiatives in the Indian context are not thoroughly studied. We attempted to review existing literature on workplace mental health interventions in the Indian context. The scoping review was conducted following the standard process as recommended by the Joanna Briggs Institute and the Preferred Reporting Items for Systematic Review and Meta-Analysis extension for scoping reviews. We searched in the databases such as PubMed, Google Scholar and Scopus. Scientific literature including gray literature of the past decade was searched to synthesize evidence on types of mental health interventions and their unique features. Of the 1,311 records, 30 records that met the inclusion criteria were included for the final review. The review highlights evidence on stress and mental health problems faced by the working population and various strategies adopted by organizations to address mental health problems. However, very few interventions were accompanied by comprehensive needs assessment, impact evaluation and workplace policy initiatives. Most interventions were curative–provisioning counseling services, limiting the scope of mental health promotion activities. Addressing mental health wellbeing comprehensively and aligning an organization's policies are crucial. Research on employee mental health, its risk factors, and cost-effectiveness analysis of workplace mental health interventions in the Indian context need to be prioritized.

Keywords: workplace mental health, employee wellbeing, India, work place and improvement, wellbeing cost

OPEN ACCESS

Edited by:
Samrat Singh Bhandari, Sikkim Manipal University, India

Reviewed by:
Mohd Faizul Hassan, Universiti Teknologi MARA Puncak Alam, Malaysia
Avinash De Sousa, Lokmanya Tilak Municipal Medical College, India

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

Received: *24 October 2021*
Accepted: *29 March 2022*
Published: *03 May 2022*

Citation:
Pandya A, Khanal N and Upadhyaya M (2022) Workplace Mental Health Interventions in India: A Rapid Systematic Scoping Review. Front. Public Health 10:800880. doi: 10.3389/fpubh.2022.800880

INTRODUCTION

Mental health problems in the working population (15–64 years of age) are growing public health concerns. Recent evidence indicates that non-communicable diseases (NCDs) including mental health problems such as stress, depression, and anxiety among working populations are directly linked to reduced work performance and increased absenteeism (1). Studies also show that investment in such interventions is cost-saving (2).

Mental disorders in the working population are a major cause of disability and unemployment (3, 4). The World Health Organization (WHO) estimates that the burden of mental health problems in India generates as high as 2,443 disability-adjusted life years (DALYs) per 100,000 population followed by the estimated economic loss, between 2012 and 2030, at USD 1.03 trillion (5).

Importantly, most NCDs including mental disorders occur in people below 60 years of age, in other words, among the working-age population (6). The global cost of mental health conditions in 2010 was estimated at US$ 2.5 trillion, with the cost projected to surge to US$ 6.0 trillion by 2030, which is a huge burden on society (7). Thus, a multipronged approach to address NCDs including mental health problems among the working population commands urgent attention.

Workplace Mental Health in Indian Context

According to Census 2011 (8), India has a 474 million working population. Furthermore, the country's Sample Registration System's 2018 report (9) shows that country's demographic dividend continues to grow. The proportion of the working-age population is expected to increase from 61% in 2011 to 65% in 2036, adding 12 million people to the working population each year.

Mental disorders are impacting millions of working populations in India. Although there are no population-based prevalence studies for working populations, there are estimates of mental disorders in India, implying the burden of mental disorders in the working population. For example, the findings of the National Mental Health Survey 2015-16 (10) by the National Institute of Mental Health and Neuro-Sciences (NIMHANS) estimated that nearly 150 million individuals suffer from one or the other mental disorders of varying severity, comprising 10.5% of the population. In 2017, the Global Burden of Disease Study published in 2020 (6) revealed 197 million people experiencing mental illnesses, comprising 14.3% of the total population. Both reports implicitly imply that the majority of the population with mental disorders in the working-age groups, between 15 and 59 years of age.

The survey by The7th Fold 2020 (11) with 509 working people across metros cities and diverse sectors from India revealed that 36% of employees were suffering from one or other types of mental health issues. The situation of mental health has been exacerbated due to the COVID-19 pandemic, making it a more serious concern. Recent PwC's 2021 Employee Financial Wellness Survey (12) reported that 63% of employees were experiencing stress due to financial strain ever since the COVID-19 pandemic began. Another study (13) conducted during the second wave of the pandemic by Deloitte ranked India as the highest among 18 countries in terms of anxiety. These studies suggest that workplace mental health requires immediate attention.

Poor mental health at the workplace can be a contributor to a range of physical illnesses like hypertension, diabetes and cardiovascular conditions, amongst others (14). Recent evidence indicates that employee effectiveness resonates with the mental health of the employees, and it contributes to overall organizational productivity (15). Thus, prioritizing the mental health of employees is essential.

Much of the literature on workplace health and mental health promotion interventions originate from high-income countries with a long history of industrial development. These countries have made workplace health a priority and expanded government as well as private health-insurance regulations, which perhaps contributed to the growing number of workplace health interventions (16–21). Despite the extensive global literature on workplace mental health initiatives and improvement in employee's productivity, the extent of workplace mental health interventions in India remains unknown. Further, evidence on the effectiveness of workplace interventions particularly in India is scarce. Therefore, the present rapid systematic scoping review attempts to review existing evidence on workplace mental health intervention in India and identify unique features.

METHODS

Study Design

This rapid systematic scoping review aims to identify and summarize diverse evidence on workplace mental health promotion programs in India and their unique features. This rapid review followed the standard process as recommended by the Joanna Briggs Institute (22) and adhered to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) extension for scoping reviews (PRISMA-ScR) (23).

Definition of Population, Intervention Comparator and Outcomes (PICO) of the Study

- Population: Employees–primarily working population – (15–64 years of age) in India.
- Intervention: Any interventions introduced by the organization to address mental health problems such as stress, psychological distress or promote mental wellbeing in the Indian organizational set-up.
- Comparators: Not applicable for this scoping review.
- Outcome: Types of mental health interventions, key features of mental health interventions, best practices and effect on mental health status if reported.

Search Strategy

A systematic search of the literature was conducted across four databases: PubMed, Scopus, Google Scholar, and PsycINFO. Keywords such as "employee wellbeing program," "employee wellness," "workplace mental health interventions," and "India" were used and searches were narrowed by using Boolean operators. Two researchers conducted a literature search and the third researcher reviewed the screening, resolved conflicts related to the final selection of records. Searches were limited to articles published until October 20, 2021.

Inclusion and Exclusion Criteria

All records were imported in Microsoft excel and duplicates were removed. Unqualified records were excluded based on the exclusion criteria.

Inclusion criteria of the study:

1. Studies conducted with the working population in India.
2. Any studies (quantitative, qualitative, or mixed-method studies) were included.
3. Studies explaining or describing employee wellbeing programs targeting mental health, key characteristics of different employee wellbeing programs and their effectiveness.

4. Studies published in English.
5. Peer-reviewed articles, gray literature such as project reports, annual reports explaining mental health interventions or employee assistance programs, and journal blogs.

Exclusion criteria of the study:

1. Publications published in other than the English language.
2. Publications such as perspective, editorial, and commentary.
3. Studies conducted in other country contexts and/or conducted with non-Indian participants.

Screening of Records

We piloted 10 records against a priori inclusion and exclusion criteria to minimize selection bias. Each record title was reviewed by two independent screeners (AkP, NK). A third reviewer (MU) reviewed conflicts and resolved disagreements through discussion. Two reviewers also independently screened the full text of potentially eligible articles to check whether the records fulfilled the inclusion criteria.

Data Extraction

We used Microsoft Excel to organize and code data used in the scoping review. Selected records were extracted in the domains such as author's name, year of publication, type of publication, country of the study conducted, type of population, mental health problems, different types of mental health interventions, key findings, and recommendations.

Quality Assessment of Studies

The quality of included quantitative studies was assessed using the Effective Public Health Practice Project quality assessment tool (24). The studies are evaluated in eight parameters such as study design, analysis, withdrawals and dropouts, data collection practices, selection bias, invention integrity, blinding as part of a controlled trial, and confounders. Evaluation of each parameter range between "strong," "moderate," and "weak." Qualitative studies were assessed using the Critical Appraisal Skills Programme quality assessment tool (25). The studies are evaluated based on 10 questions followed by reviewer's overall comments based on responses to 10 questions.

Data Synthesis

Full text of selected records was appraised and thematically organized. Both authors reviewed the data synthesis. Thematic analysis methods (26) were used to identify key themes across studies. Thematic analysis was used as most of the studies were descriptive in nature. A mind map was constructed to sort the type of features of workplace mental health interventions and their unique features. Overarching themes were then reviewed, refined, and named (27). Results were synthesized in five themes namely: classification of mental health interventions, quality assessment of studies, evidence on mental health problems of the working population, workplace mental health interventions, and outcomes of mental health interventions.

RESULTS

The literature search resulted in 1,311 records. After removing duplicates, 1,047 were screened for the title. Of the 137 records screened for full-text review, 30 records met inclusion criteria and were finally included for the review. **Figure 1** provides a summary of the PRISMA flow diagram.

Mental health interventions were further classified as (1) corporate wellness programs, (2) employee assistance programs and (3) health promotion interventions. **Table 1** presents the type of mental health interventions and corresponding numbers of studies.

Quality Assessment of Studies

Out of 30 records, 7 were observational studies, 5 were reviews, 3 qualitative studies and 15 were websites and e-newspaper articles. We found that the overall methodological quality of observational studies was moderate to weak. About 5 papers were rated at moderate whereas, 2 were rated as weak studies. None of the studies were rated to be of strong. The Critical Appraisal Skills Programme quality assessment tool evaluated three qualitative studies to be average.

Anecdotal evidence of the ability to make positive impacts on improving employee's mental health outcomes and overall wellbeing were noted in websites and e-newspapers; however, a lack of methodological rigor was a common problem. Overall, there was a lack of properly controlled studies to attribute the mental health outcomes or employee wellbeing to the interventions only.

Evidence on Stress and Mental Health Problems of the Working Population

Occupational stress or work-related stress is a significant cause of poor physical and mental health, low productivity, and human error. The World Health Organization defines occupational stress as "…the response people may have when presented with work demands and pressures that challenge their ability to cope" (3, 28). Occupational stress emerged as the most common risk factor contributing to increased sickness absence, high staff turnover, sub-optimal performance and a possible increase in accidents due to human err (4, 5).

Factors such as workload, lack of participation and control in the workplace, monotonous tasks, role ambiguity or role conflict, lack of recognition at work, poor interpersonal relationships, poor working conditions, poor communication, and conflicting home and work demands contribute to stress (16–19). Bullying and sexual harassment at the workplace are also critical causal factors of chronic stress (3). It is evident that chronic stress leads to a range of physical illnesses like hypertension, diabetes, cardiovascular conditions as well as mental health problems such as burnout, psychological distress, anxiety or depression, significantly affecting employees ability to contribute meaningfully in their personal and professional lives (16, 18, 19). Worryingly, these health problems especially in the working population is on the rise (28).

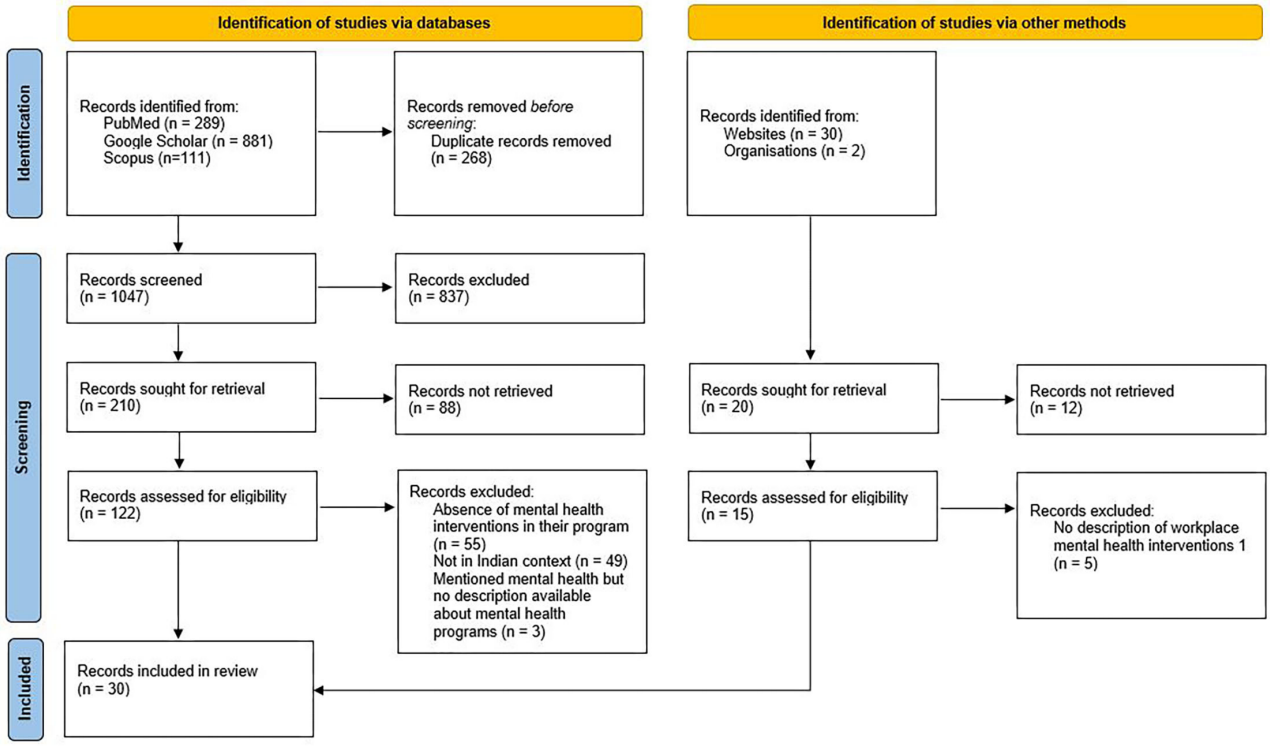


FIGURE 1 | PRISMA flow diagram of the study.

Employees with mental illnesses also face discrimination at the workplace. Brouwers et al. (29) have conducted a cross-sectional study that reported that about 67% of employees who suffered from depression either experienced discrimination at the present workplace or faced discrimination while applying for new jobs. The stigma and discrimination push the working population to suffer silently and avoid seeking professional mental health help (30). A study conducted by ASSOCHAM in 2015 (31) found that 43% of employees in the private sector experienced signs of general anxiety disorder or depression. A survey conducted last year (11, 32) in India revealed that more than a quarter of Indian employees (36%) were experiencing mental health problems, and half of the sample (50%) were worried about an uncertain future due to the COVID-19 pandemic (32). Certainly, the negative impact of the COVID-19 outbreak on mental wellbeing is undeniable.

TABLE 1 | Classification of workplace mental health interventions.

Sr. No.	Type of mental health interventions	Key features	No. of records
1	Corporate wellness program	• Work-life balance strategies (such as wellbeing related leaves, 'no meeting Friday's policy, etc.) • Wellness sessions (yoga/meditation/stress management sessions etc.)	15
2	Employee assistance program	• Counseling services outsourced • Some offer counseling services through Mobile application, 24*7 tele helpline	8
3	Employee wellbeing program	• Physical healthcare services • Mental health services	3
4	Peer Support program	• Mental health advocates • Peer support • Peer-to-peer counseling	4

Workplace Mental Health Interventions in India

Indian multinational companies have been prominent in using the workplace to promote long-term health behavioral change to the measurable benefit of themselves, their employees and local communities. **Supplementary Table 1** highlights notable employee wellbeing programs in India (33–49).

As shown in **Supplementary Table 1**, many companies (n = 15) offer preventive and promotive physical and mental healthcare services, few companies (n = 4) emphasize work-life balance in addition to counseling services. Some companies (n = 5) have strengthened primary mental healthcare through training employees on psychological first-aid and establishing peer-support networks within the company. One company

has upgraded employee health insurance and provisioned reimbursement for mental health consultations and another offering counseling services through an Artificial Intelligence (AI) based chatbot (2). Many companies ($n = 7$) use the digital platform to provide mental healthcare services Many other companies do implement workplace mental health interventions but at a smaller scale. For example, the companies such as ICICI Lombard, Capegemini India, Oyo, Uber India, Google India, Mondelez India, American Express India and Panasonic India offer mental health counseling by outsourcing services under employee assistance programs (33). Many consulting agencies such as BetterLYF (34), MeeHappy (35), Trueworth wellness (36), YourDost (37), WYSA (38), ePsyClinic (38), Trijog (38), Mindhouse (39), Mind Care India (40), Practo (41) and Optum (42) provide mental health services for the national and multi-national companie's staff.

Outcomes of Workplace Mental Health Interventions

Although outcomes of these programs in the Indian context are not yet published, such programs potentially prevent the breakdown of the employees. The global literature highlights that employee wellbeing programs (which include mental health interventions) have prevented employees from mental illnesses (43–49). Moreover, employee wellbeing programs (with a focus on mental health promotion) have been proved to be cost-saving; companies save anywhere between $3 to 15 per for every 1$ spent on workplace mental health programs (50). The regular physical activities and health check-ups were found promising in early diagnosis, treatment and controlling NCDs (43).

Employee wellbeing programs also improve employee engagement significantly (51, 52). Employee recognition and constructive feedback practices too contribute to higher employee engagement levels (51). Most importantly, employee wellbeing programs improve productivity and morale. When employee wellbeing is optimized, employees focus more on their work, and their productivity increases (49). The available evidence highlights that health promotion activities, psychosocial intervention along stress management training have a positive impact on mental wellbeing (53–55).

A recent survey report of human resources leaders (48) from 400 organizations across 15 different industries in India revealed half of the organizations offer health benefits as screenings or health awareness programs to employees, dedicated resources to address the spectrum of wellbeing, including mental wellbeing. However, impact assessment, documentation of workplace mental health interventions was lacking, only 40% of organizations have a documented wellbeing plan (53).

DISCUSSION

Organizations in India have certainly realized the need for protecting employee's mental health and have started offering policies and programs that promotes positive mental health. Most programs are more employee growth oriented and family-friendly. Although, numerous organizations have introduced policies to ensure the physical wellbeing of their employees, very few organizations have explicit policies for mental health promotion and programs addressing employees' mental wellbeing. Those organizations having employee wellbeing programs, ironically, revealed difficulties in engaging their employees in employee wellbeing programs (11, 33, 54–64). Perhaps, mental health stigma precludes employees identify and seeks timely mental health help. Efforts are needed to create mental health literacy at workplaces. Moreover, a proactive approach to mental health at the workplace targeted to create safe and conducive environment is commanded.

While research has established the link between wellbeing (which encompasses positive mental health) and productivity, organizations need to enforce guidelines based on acceptable industrial practices for maintaining an optimal work-life balance.

Any wellbeing initiatives that are designed with the employee's needs in mind can certainly thrive. Thus, assessing employees need and their participation in designing and implementing mental health interventions is crucial. Larger companies may benefit from "decentralizing and allowing regional business units to design and customize the execution of mental health interventions" can potentially increase employee participation rates.

Psychological capital (such as efficacy, hope, optimism, and resilience) (65, 66) can be fostered through mental health promotion interventions such as imparting life skills, stress management, fostering work-life balance, encouraging physical activities and create conducive environment through peer support. Strengthening psychological capital has direct association with positive attitude, productivity and mental wellbeing (66).

Implications for Policy, Practice, and Research

Employee wellbeing programs can potentially impact employee's experience. Many strategies organizations can implement to improve their employee's wellbeing.

Organizations need to introduce policy-level changes to address employee wellbeing. Without clearly articulated workplace policy, employee wellbeing initiatives may not be sustainable and impactful. The development and execution of a workplace mental health policy and employee wellbeing program will benefit the health of employees, increase the productivity of the organization (2, 3).

Employees need may vary depending up on their occupations and job roles. Thus, comprehensive needs assessment is recommended prior designing and implementing workplace mental health program. Some additional strategies for fostering positive mental health are enumerated as below:

- Encourage collaboration in the organization to boost teamwork, competitiveness, and employee morale. By enabling easy collaboration, organizations can leverage employee's diverse skill sets, feel recognized, and decrease their stress levels.
- Formulate grievance redressal mechanism to listen and address employee's concerns. Employees want to be listened to.

- Promote regular and constructive feedback. Regular feedback provides scope for improvement, advancing their skills and make them feel satisfied with their jobs. The feeling of satisfaction and learning attitude is crucial for employee wellbeing.
- Train employees on psychological first-aid and peer counseling. There is a tremendous need to make workplaces more humane. Training employees on psychological first-aid and peer counseling destigmatize mental health and empower them to seek timely support at the primary level. It enables timely referral for treatment when needed. Moreover, this will equip employees to show empathy and compassion for others, ultimately creating an emotional bond between employees and employers, and making workplace a better place to work.
- Introduce periodic general health screening. Ensuring annual health screening can help identify diseases early and treat employee's health issues timely.
- Establish in-house psychological counseling services or formulate linkages with trained mental health service providers. By offering psychological counseling services, organizations can reduce stigma.
- Other strategies such as flexible work options, introducing health initiatives like an organization-wide competition in running or cycling, and promoting mental wellbeing mobile applications can help cope with stress and improve quality of life.
- Promote research. Organizations can establish linkages with academic and research institutions to carry out researches including impact assessment periodically.

Strengths and Limitations of This Study

A rapid systematic scoping review was conducted to map workplace mental health interventions, identify key features of these interventions and gaps in workplace mental health interventions. In order to ensure the relevance of our review, the review scope, review questions, protocol and literature search strategies were defined based on the targeted literature review conducted by both authors. The study provides a descriptive synthesis of current evidence on interventions to prevent mental health for working people. Most details regarding mental health interventions found from gray literature i.e., e-magazines and websites, left us with limited information about the interventions. The authors did write to the company for detailed information; however, only two companies responded to our queries. Further, few studies used cross-sectional surveys, making it difficult to determine the longitudinal impact. Despite these limitations, the present study provides a mapping of workplace mental health interventions in Indian companies and offer insights on key features and presented strategies to address gaps in workplace mental health interventions.

CONCLUSIONS

A healthy population productively contributes to the economy and it is in the benefit of organizations to safeguard public health. Given the substantial contributions of the private sector to the economy, making an investment in formal and structured workplace mental health interventions should be a strategic priority. There is a need to map the impact of workplace mental health programs on productivity and health outcomes. Also, documenting best practices around workplace mental health interventions and positive case stories are worthy exercises. Research on employee mental health, associated risk factors, and cost-effectiveness analysis should be promoted.

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.

AUTHOR CONTRIBUTIONS

AkP conceptualized, prepared the protocol, and revised the manuscript. NK and AkP carried out the literature search and screened records for inclusion in the study. MU synthesized the evidence and drafted the manuscript. All authors have reviewed, edited, and approved the submitted version of the manuscript.

ACKNOWLEDGMENTS

Authors thank Mr. Himanshu Gupta for his support in reviewing the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.800880/full#supplementary-material

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frontiers | Frontiers in Psychiatry

ORIGINAL RESEARCH
published: 19 May 2022
doi: 10.3389/fpsyt.2022.869647

Internalized and Perceived Stigma and Depression in Pulmonary Tuberculosis: Do They Explain the Relationship Between Drug Sensitivity Status and Adherence?

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OPEN ACCESS

Edited by:
Roy Abraham Kallivayalil, Pushpagiri Medical College, India

Reviewed by:
Kaustav Chakraborty, College of Medicine & JNM Hospital, India
Nilesh Chandrakant Gawde, Tata Institute of Social Sciences, India

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

Received: *04 February 2022*
Accepted: *20 April 2022*
Published: *19 May 2022*

Citation:
Pradhan A, Koirala P, Bhandari SS, Dutta S, García-Grau P, Sampath H and Sharma I (2022) Internalized and Perceived Stigma and Depression in Pulmonary Tuberculosis: Do They Explain the Relationship Between Drug Sensitivity Status and Adherence? Front. Psychiatry 13:869647. doi: 10.3389/fpsyt.2022.869647

Background: Adherence to medication for tuberculosis (TB) has been found to be deleteriously affected by psychosocial issues, including internalized and perceived stigma (IPS) and depression, usually resulting in the emergence of multidrug-resistant TB (MDR-TB). The objective of the study was to find the prevalence of depression among patients receiving treatment for pulmonary TB, and how stigma and depression affect the relationship between drug sensitivity status (DSS) and treatment adherence.

Method: It was a cross-sectional observational study conducted between January 2019 and July 2020 in two centers in Sikkim, India. The Patient Health Questionnaire-9 (PHQ-9), Internalized Social Stigma Scale (ISSS), and Tuberculosis Medication Adherence Scale were used to assess depression, IPS, and medication adherence, respectively. A path analysis was performed with DSS, treatment adherence, IPS, and depression. Education in years was included in the model as it was significantly correlated with IPS.

Results: A total of 71 patients who were on drug-sensitive TB (DS-TB) regimen (n = 26) and MDR-TB regimen (n = 45) participated in the study. Notably, 56.3% (n = 40) of the participants were found to have depression. Among the depressed participants, 32.5% were on the DS-TB regimen and 67.5% were on the MDR-TB regimen. The path analysis indicated that IPS and depression were serially mediating the relationship between DSS and treatment adherence (β = −0.06, $p < 0.05$, 95% CI = −3.20, −0.02). Finally, years of education had an exogenous predictor role, not only directly affecting IPS (β = −0.38, $p < 0.001$, 95% CI = −0.99, −0.31) but also affecting treatment adherence through IPS and depression (β = 0.08, p = 0.02, 95% CI = 0.03, 0.47). This indicated that with

more years of education, the IPS decreases, which decreases depression and ultimately leads to better adherence.

Conclusion: We found an important relationship between different psychosocial factors which may affect treatment adherence. Patients who have higher IPS are more likely to develop depression which negatively affect adherence. Patients on the MDR-TB regimen have higher stigma. There is an urgent need to integrate mental health services with TB Control Programs.

Keywords: pulmonary tuberculosis, multidrug-resistant tuberculosis (MDR-TB), internalized stigma, depression, prevalence, Patient Health Questionnaire-9, medication adherence

INTRODUCTION

Tuberculosis (TB) is a communicable disease that is a major source of morbidity and one of the leading causes of mortality around the world. TB was the biggest cause of death from a single infectious agent until the coronavirus (COVID-19) pandemic, ranking ahead of HIV/AIDS (1). In 2020, the World Health Organization (WHO) regions of South-East Asia had the highest number of TB cases (43%), followed by Africa (25%), the Western Pacific region (18%) with lower numbers in the Eastern Mediterranean (8.3%), the America (3.0%), and Europe (2.3%). The National Tuberculosis Program, India, which was launched in 1962, was revitalized and renamed as Revised National TB Control Program (RNTCP) in 1993 after the WHO declared TB as a global emergency. A directly observed treatment-short course (DOTS) was launched in 1997 and by the late part of 2005, the whole country was covered (2). There are more than 850,000 cases of TB in India which are either undetected, untreated, or treated in private setup with poor-quality drugs or incorrect regime that contribute to the rise in the incidence of multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB) (3). A number of factors influence the health-seeking behavior of the affected individuals which includes awareness about the illness, accessibility to healthcare facilities, educational level, stigma (4–7), and comorbid conditions, such as anxiety and depression (8).

One of the primary reasons for difficulty in early detection and lost to follow-up of patients with TB in India is stigma (9). The term stigma is used to describe a severely disparaging attribute. There is a difference between enacted and felt stigma. Enacted stigma relates to instances of discrimination based on social unacceptability or inferiority, whereas perceived stigma is based on a profound sense of inferiority and refers to an oppressive fear of enacted stigma (7). Perceived stigma, such as fear of losing social status, fear of getting isolated in the community, fear of losing job, fear of poor marriage prospect, and fear of becoming a subject of gossip, has identified few of the patient-related factors that could impair active case detection (9, 10). Reluctance to avail the treatment because of stigma or irregular or poor adherence may lead to MDR-TB and XDR-TB (11). However, factors, such as higher education and knowledge about TB, have been found to have a buffering effect on the perception of stigma (6).

Depression has been found to be present among patients with TB and has been related to poor adherence to the prescribed treatment (12). Duko et al. reported that the pooled estimated prevalence of depression of 45.55% among patients with TB; additionally, they found in the subgroup analysis that the pooled prevalence of depression among patients with MDR-TB was higher than in patients without MDR-TB (13). Redwood et al. in their study performed in Vietnam found that people with MDR-TB scored higher in depression and stigma score when compared to people with drug-sensitive TB (DS-TB) (14). Ruiz-Grosso et al. in their meta-analysis found a strong association between depressive symptoms and negative treatment outcome. In addition, they found an association between depressive symptoms and loss of follow-up and increased mortality among patients with TB (15). In a study performed in South Ethiopia, it was found that patients with comorbid HIV-infection, poor social support, perceived stigma, currently having substance use disorder or if female, were more likely to have depression and anxiety. The same study reported a prevalence of depression and anxiety at 43.4 and 41.5%, respectively (16). Depression has been found to mediate the relationship between stigma and medication adherence among patients with TB. The study was performed in China (17). To the best of our knowledge, the complex interplay among drug sensitivity status (DSS; i.e., DS-TB and MDR-TB), perceived stigma, depression, and adherence to TB treatment has never been explored especially in the Indian scenario where cultural beliefs and orthodox societal norms are still prevalent. We also used measures that are specific and validated for patients with TB to assess for stigma and medication adherence. The objective of this survey was to find the prevalence of depression among the patients receiving DOTS. As the cognitive behavioral model of psychological phenomenon suggests that behaviors, thoughts, and emotions mutually influence each other (18), we proposed the following hypothesis:

H1: Internalized and perceived stigma (IPS) will be higher in patients on the MDR-TB regimen when compared to patients on the DS-TB regimen, and it will mediate the relationship between DSS and depression.
H2: Depression will mediate the relationship between IPS and treatment adherence.
H3: The relationship between treatment regimen and treatment adherence will be serially mediated by IPS and depression.
H4: Years of education will predict stigma and have an indirect effect on depression.

MATERIALS AND METHODS

Study Design and Setting

This cross-sectional exploratory survey was conducted in two centers providing the treatment for both newly diagnosed cases and drug-resistant cases, in the East district of Sikkim, a small northeastern part of India bordering Bhutan, Nepal, and Tibet. These two centers are Central Referral Hospital (CRH), Sikkim Manipal Institute of Medical Sciences, and Sir Thutob Namgyal Memorial Hospital (STNMH). The survey was performed during the period of January 2019 to July 2020.

Participants

All the patients who were 18 years of age and older and had completed 3 months of treatment for pulmonary TB were included in the study. As there was a lack of validated scale for measuring related physical symptoms, patients with extrapulmonary TB were not included. Patients who had a prior history of psychiatric illness before the diagnosis of TB and those who were having comorbid conditions, namely, HIV and hepatitis were also excluded from the study. The sample size was based on the number of patients diagnosed with pulmonary TB (excluding extensively drug-resistant pulmonary TB) receiving medication from the DOTS centers. On checking the records, 30 patients were on medication from CRH and 41 patients from STNMH. All 71 patients gave consent for participation.

Measures

Sociodemographic Proforma

A structured proforma was used to record sociodemographic and clinical data. The sociodemographic data included gender, age, marital status, type of family, number of dependent family members, education, occupation status, monthly family income, and distance of DOTS center from current place of residence. Clinical data included months under treatment, type of pulmonary TB (e.g., miliary, cavitary, and multilobar), RNTCP regimen and medical comorbidity, RNTCP regimen (DS-TB regimen or MDR-TB regimen), and medical comorbidity. The quality of data was assured by checking the medical records and radiographic evidence.

Depression

Depression was assessed with the Patient Health Questionnaire-9 (PHQ-9). The scale consists of nine items scored on a 4-point Likert-type scale (from 0 to 3). The total score ranges from 0 to 27. Scores are divided into minimal (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe (20–27). The internal reliability test scored Cronbach's alpha as 0.89 and 0.86 in two different studies (19). PHQ-9 was used as it takes less time and is more preferred in out-patient setting and was suitable for our study. It has been found to be strongly correlated with the Beck Depression Inventory (20). The psychometric properties of PHQ-9 for assessing depression among the Indian population have been found to be comparable with the finding of the Western studies (21).

Internalized and Perceived Stigma

The IPS was measured with a ten-item Internalized Social Stigma Scale (ISSS). ISSS was inspired by the scale developed by Boyd et al. within the context of mental illness (22). This ten-item scale has been found to have a good internal consistency (Cronbach's alpha = 0.7) when tested among patients with TB (23). It measures four subdimensions, namely, alienation (the subjective experience of being less than a full member of the society or having a spoiled identity), perceived discrimination (perceptions of the way of patients with TB that they currently tend to be treated by others), stereotypes endorsement (the degree to which people affected by TB agree with common stereotypes about people with TB), and social withdrawal (the tendency of people affected by TB to isolate themselves from the rest of the society). A higher score indicates higher IPS (23).

Adherence to Tuberculosis Medication

Tuberculosis medication adherence scale (TBMAS) was developed by taking into consideration the difficulties experienced while assessing general medication adherence, such as pharmacy record review or pill counts, which is not feasible in clinical practice. TBMAS incorporates predictors of adherence, such as patient's behavior and patient–provider interaction. TBMAS has 30 items which are scored in a 5-point Likert-type scale. Scores ranging from 30 to 150 with higher scores show better medication adherence. It assesses the following factors: communication with healthcare providers, confidence in curing TB, access to healthcare, social support, lifestyle and habits, personal traits, mood disorders, coping style, and forgetfulness. A higher score indicates better adherence (24). The internal consistency of the scores produced by the TBMAS scale in the Indian participants of the current study showed acceptable values, indicating an acceptable reliability. In addition to Cronbach's alpha, the McDonald's omega statistic (ω) was calculated, as Cronbach's alpha underestimates the true reliability unless the items are tau-equivalent (25). In our study, the reliability of the scores was $\omega = 0.764$, indicating acceptable values, with an average interitem correlation of $r = 0.20$, indicating all dimensions working well together and measuring the same overall construct.

ETHICAL REVIEW

The study was approved by the Institutional Ethical Committee of Sikkim Manipal University (SMIMS/IEC/2018-87) and was conducted according to the Declaration of Helsinki. All patients provided written informed consent prior to the study participation.

STATISTICAL ANALYSES

The aim of this study was first explored using descriptive statistics. To display the prevalence of depression among the participants, a PHQ-9 score greater than 5 was taken as depressed (19); for other analyses, it was taken as a continuous variable.

An exploratory partial correlation analysis was performed to find out the correlation among years of education, DSS (coded as 0 = DS-TB and 1 = MDR-TB), IPS (ISSI score), TBMAS, and PHQ-9 with sociodemographic variables (age and income) controlled. A p-value of <0.05 was considered significant for all the tests. Analysis was performed using SPSS version 20 (IBM SPSS Statistics for Windows, Version 20.0., IBM Corp, Armonk, NY, United States). A path analysis was used to evaluate the fit of the theoretical model to the data. Path analyses allow the assessment of direct and indirect effects of a set of variables on a specific target variable, in this case, treatment adherence. The strength of the effects is represented by path coefficient, i.e., standardized partial regression coefficients with a range from −1 to +1. The fit of the data to the specified model was investigated using the χ2 test (26) and root mean square error of approximation (RMSEA) (27). In addition, the amount of variance in all endogenous variables was calculated through regression analysis. Effect sizes for both direct and indirect effects were calculated through standardized coefficients, due to the different scaling of some of the observed variables. R and Jamovi version 2.2 (Jamovi Project, 2021) were used for both the direct and indirect effects of the predictor variables on patients' treatment adherence and the role of intermediate variables in indirect effects as a mediator. A *post-hoc* calculation for multiple regression analysis was employed using G*Power 3 with a probability value of.05, a medium effect size, and a sample size of $N = 71$. The statistical power for the analysis, considering our N, was 1-β = 0.712, $F_{(4,66)} = 2.51$, $p = 0.05$, $f^2 = 0.15$, with four predictors. For a large effect size, however, the statistical power increased to.98 with four predictors (1-β = 0.982, $F_{(4,66)} = 2.51$, $p = 0.05$, $f^2 = 0.35$), which was considered sufficient to test the hypothesized model.

RESULTS

The mean age of the participants was 28.14 years (SD = 10.46). Among the participants, 56.3% ($n = 40$) were found to have depression. Among the patients who were found to have depression, 32.5% ($n = 13$) were on the DS-TB regimen and 67.5% ($n = 27$) were on the MDR-TB regimen. The mean duration of treatment for patients on the DS-TB regimen and MDR-TB regimen was 3.81 (SD = 1.09) months and 9.20 (SD = 6.58) months, respectively. We found that the duration of treatment did not have any significant relation to PHQ-9 score. The details of the participants' characteristics are given in **Table 1**.

Correlation Analysis

In order to test the magnitude and plausibility of our research question, we looked at correlations between variables (**Table 2**). TB medication adherence was negatively and significantly correlated with depression, IPS related to TB, and DSS. Stigma was negatively correlated with years of education.

Path Analysis

All the four hypotheses (H1, H2, H3, and H4) were tested by path analysis. Overall, the model (**Figure 1**) was statistically significant (Akaike information criterion = 1,442; Bayesian information criterion = 1,471; $\chi^2 = 2.63$; $p = 0.27$), indicating that the data did not differ from the specified model (non-significant chi-square test). Additional fit measures indicated an optimum fit of the data to the model (RMSEA = 0.06 [0.00–0.25], $p = 0.33$); standardized root mean square residual = 0.04). Results from multiple regression analysis showed that the predictors had a statistically significant influence on all the endogenous variables, namely, for TBMAS, it was $R^2 = 0.29$, $df = 2$, $p < 0.001$, for internal stigma, it was $R^2 = 0.25$, $df = 2$,

TABLE 1 | Characteristic of the participants ($N = 71$).

Variable	No. of patients (n)	Percentage (%)
Gender		
Male	35	49.3
Female	36	50.7
Marital status		
Unmarried	40	56.3
Married	31	43.7
Occupation		
Employed	37	52.1
Unemployed	34	47.9
Type of family		
Nuclear	50	70.4
Extended	19	26.8
Joint	2	2.8
Education		
No formal education	4	5.6
Primary school	7	9.9
Secondary school	23	32.4
Senior secondary school	18	25.4
Graduate	17	23.9
Post-graduate	2	2.8
Pulmonary TB Type		
Miliary	3	4.2
Cavitary	26	36.6
Multilobar	42	59.2
DSS		
DS-TB regimen	26	36.6
MDR-TB regimen	45	63.4

DSS, drug sensitivity status; DS-TB, drug sensitive regimen; MDR-TB, multidrug resistant.

TABLE 2 | Correlations and descriptive study of study variables.

	Yrs. of education (1)	DSS (2)	ISSS (3)	PHQ-9 (4)	TBMAS (5)	Mean (SD)
1	–					10.38(4.10) (yrs.)
2	−0.100	–				
3	−0.420**	0.306*	–			28.17(6.94)
4	−0.043	0.277*	0.409**	–		7.15(5.32)
5	0.018	−0.167	−0.266**	−0.580**	–	113.62(12.9)

***Correlation is significant at p < 0.01 (two-sided). *Correlation is significant at p < 0.05 (two-sided). ISSS, internalized social stigma scale; PHQ-9, patient health questionnaire-9; TBMAS, TB medication adherence scale. DSS was dichotomized as 0 = DS-TB, 1 = MDR-TB.*

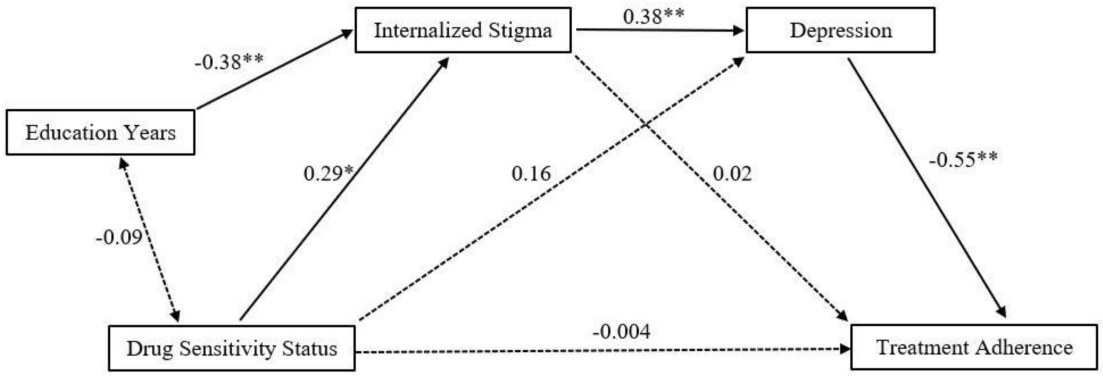


FIGURE 1 | It shows the standardized coefficients for the paths of the model. Dashed arrows represent statistically non-significant paths, and solid arrows represent statistically significant paths.

$p < 0.001$, and for depression, it was $R^2 = 0.20$, $df = 2$, $p < 0.001$.

The results indicated that there was a statistically significant direct effect between IPS and depression, between education years and IPS, between DSS and IPS, and between depression and adherence to treatment (**Table 3**). We did not find any significant direct effect of DSS on depression. Even when IPS was included as a mediator, the indirect effect of DSS on depression remained insignificant (**Figure 1**). Three statistically significant indirect effects were found from DSS to TBMAS through IPS and depression ($\beta = -0.06$, $p = 0.04$). This result indicated that IPS and depression were serially mediating the relationship between DSS and treatment adherence. Whereas IPS was not directly related to TBMAS, there was a statistically significant indirect effect on TBMAS through depression ($\beta = -0.20$, $p < 0.01$). The negative beta indicated that the relationship was inverse and that the higher the IPS, the higher the depression and the lower the treatment adherence. Overall, IPS mediated the relationship of DSS and depression, depression mediated the relationship of IPS and treatment adherence, and both IPS and depression mediated the relationship between treatment regimen and treatment adherence.

Finally, education years had an exogenous predictor role, not only directly affecting stigma ($\beta = -0.38$, $p < 0.001$) but also affecting treatment adherence through stigma and depression ($\beta = 0.08$, $p = 0.02$). This result indicated that with more years of education, the perceived and internal stigma decreases, which decreases depression and ultimately leads to better adherence.

DISCUSSION

In the current study, the prevalence of depression among patients with pulmonary TB receiving DOTS was 56.3%. More patients who were on the MDR-TB regimen reported depression when compared to patients on the DS-TB regimen. Although perceived and internal stigma and depression have been found to affect treatment adherence negatively, less is known about the possible complex interplay between different factors, such as sensitivity to drugs, education level of the affected individual, perceived stigma, depression, and how all these factors impact treatment adherence. The main aim of the study was to find whether DSS has any relationship with adherence to pulmonary TB and whether perceived stigma and depression together play a role in the influence of DSS on treatment adherence. We also wanted to find the role of completed years of education in this complex relationship. We found that stigma and depression sequentially mediated the relationship between DSS and adherence to treatment. We also found that patients with longer years of education had a lesser perceived or internal stigma.

Indian studies on the prevalence of depression among patients with TB reported findings from 16.1 to 80% (28, 29). We found that 56.3% of our patients had depression; such variation can be understood because of variation in the mean age of the participants, education level of population of the geographical region, social and cultural practice, as well as the screening instrument used. In their meta-analysis, Duko et al. reported a pooled prevalence of 45.19% (95% CI: 38.04–52.55), and they reported a high heterogeneity in the studies included in the analysis (16). These data may not be similar, and they do show a higher prevalence of depression among patients with TB when compared to the general population which is much lower, i.e., 5% (30). As one disease may lead to the development of the other, the interplay between TB and depression is complicated. Depression and stress can lead to the production of pro-inflammatory cytokines and also have been found to have an adverse effect on other immunological mechanisms, including the downregulation of cellular and humoral responses (31) which can contribute to the development of TB. In contrast, TB is a chronic inflammatory condition where there is the release in pro-inflammatory cytokines, such a like interleukin-β, tumor necrosis factor-α, and interferon-γ. These cytokines activate indoleamine-2,3-dioxygenase (IDO) which degrades tryptophan, a rate-limiting factor in serotonin synthesis resulting in depressive disorder. An increase in the activity of IDO results in the increasing production of quinolinic acid which is a neurotoxic metabolite of tryptophan and acts as an agonist for *N*-methyl-D-aspartate (NMDA) receptors. An increasing level of NMDA

TABLE 3 | Direct and indirect path coefficients.

Path	Estimate	SE	95% CI		β	*z*	*p*
			Lower	Upper			
Direct effect							
PHQ9–>TBMAS	−1.338	0.273	−1.874	−0.802	−0.549	−4.894	<0.001
InStigma–>TBMAS	0.044	0.213	−0.373	0.461	0.024	0.207	0.836
DSS1–>TBMAS	−0.102	2.869	−5.725	5.521	−0.004	−0.035	0.972
DSS1–>PHQ9	1.804	1.227	−0.600	4.209	0.164	1.471	0.141
InStigma–>PHQ9	0.288	0.086	0.120	0.456	0.376	3.361	<0.001
DSS1–>InStigma	4.217	1.472	1.332	7.102	0.295	2.865	0.004
Edu_Yrs–>InStigma	−0.652	0.174	−0.994	−0.311	−0.385	−3.742	<0.001
Indirect effect							
InStigma ⇒ PHQ9 ⇒ TBMAS	−0.385	0.139	−0.658	−0.113	−0.206	−2.771	0.006
DSS1 ⇒ PHQ9 ⇒ TBMAS	−2.414	1.714	−5.774	0.945	−0.090	−1.409	0.159
DSS1 ⇒ InStigma ⇒ TBMAS	0.186	0.899	−1.576	1.947	0.007	0.206	0.836
DSS1 ⇒ InStigma ⇒ PHQ9 ⇒ TBMAS	−1.625	0.816	−3.225	−0.026	−0.061	−1.992	0.046
Edu_Yrs ⇒ InStigma ⇒ TBMAS	−0.029	0.139	−0.301	0.244	−0.009	−0.207	0.836
Edu_Yrs ⇒ InStigma ⇒ PHQ9 ⇒ TBMAS	0.251	0.113	0.030	0.473	0.079	2.227	0.026

Estimate = Unstandardized structural coefficient, β = Standardized structural coefficient, SE = standard error of the structural coefficients. InStigma, internalized and perceived stigma; PHQ9, patient health questionnaire 9; DSS, drug sensitivity status was dichotomized as 0 = DS-TB, 1 = MDR-TB; TBMAS, TB medication adherence scale; Edu_Yrs, years of education.

agonist again accelerates the development and worsening of depression (32).

Our research has some theoretical significance. The results of the path analysis showed that the DSS, whether on DS-TB or MDR-TB, did not predict depression by itself. However, when stigma was included as a mediator in the relationship, the finding indicates that the DSS affects depression through stigma. Patients who were on DOTS, both DS-TB and MDR-TB regimens, were likely to develop depression when the level of perceived and internal stigma increases beyond a certain level. Patients who were on the MDR-TB regimen have more perceived and internal stigma and depression when compared to those who were on the DS-TB regimen, and this is consistent with previous findings (13, 14, 33). In the same way, stigma did not have a direct effect on treatment adherence, but when depression was considered in the equation as a mediator, we found that a greater stigma predicted higher depression which resulted in lower adherence. Internal stigma due to TB may lead a person to self-imposed social isolation with a desire to protect their loved ones from getting infected. They may sleep alone, eat alone, and restrict their social communications with friends and families. This social isolation with uncertainty about treatment prognosis along with decreased functionality occupationally makes them lose their self-esteem and leads to the development of a sense of worthlessness, ultimately leading to clinical depression (12, 33) which may affect adherence by negatively affecting motivation and self-care. We also found that DSS did not predict treatment adherence by itself but the indirect effect was found through both perceived and internal stigma and depression. Finally, the path analysis showed that years of education could predict treatment adherence through the reduced perception of stigma and lower depression. Fear and ignorance that are considered to be the drivers of both perceived and actually experienced stigma can be reduced by education (34). Higher education makes self-aware and conscious about one's health and motivates to engage with the healthcare system at an early stage of illness.

INTERVENTION PROVIDED TO THE DEPRESSED PARTICIPATION WITH PTB

All the participants who were found to have depression were provided a psychoeducation session by the interviewer and were referred to the psychiatry out-patient departments of SMIMS and STNMH for management.

STRENGTH AND LIMITATIONS

The study included patients with only pulmonary TB unlike other studies previously done where other clinical conditions, such as HIV, were present which may have affected the stigma score. This study also included measures that are specific for patients with TB. Most of the studies conducted on similar variables have not included such measures. However, due to the small sample size, the path analysis should be interpreted as a promising line for further investigation, and its results should be taken with caution. Finally, three of the 30 TBMAS' items described depressive behaviors (belonging to the three-item factor called mood disorders). The relationship found between TBMAS and depression might have been partially influenced by the existence of these three items. However, the reduced number of items belonging to mood disorders and the fact that we focused on the overall score suggest that our findings can be seen as a promising starting point. Future studies with TBMAS with a larger sample of participants could pay attention to the

individual-factor influences on depression and analyze the effects with a larger SEM model with more variables involved.

IMPLICATION OF THE STUDY AND CONCLUSION

This study has found an important relationship between different psychosocial variables which can affect medication adherence. We found that internal and perceived stigma affects patients with TB, more among those on the MDR-TB regimen. Many of them develop depression which ultimately affects their adherence to medication. There is an urgent need to integrate mental health with various TB control programs and to include sensitization course in formal education. Patients who are currently suffering from DS-TB may convert to MDR-TB if this cycle of internalized stigma, depression, and poor adherence is not taken care of. Countries, such as India, which is having an increasing number of MDR-TB cases, need to integrate mental healthcare with the National TB control program to reap the maximum benefit.

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 Sikkim Manipal Institute of Medical Sciences, Sikkim Manipal University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AP, PK, SD, HS, and IS: conceptualization. SB and PG-G: data analysis and interpretation. AP, PK, and SB: manuscript initial drafting. SD, HS, PG-G, and IS: critical analysis. All the authors have read and agreed the final draft and contributed to the article and approved the submitted version.

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SYSTEMATIC REVIEW
published: 31 May 2022
doi: 10.3389/fpubh.2022.855515

Mental Health Status and Its Impact on TB Treatment and Its Outcomes: A Scoping Literature Review

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Background: Tuberculosis (TB) infection interferes with the health-related quality of life (HRQOL), including physical, social, mental, emotional and financial domains of individuals. The goal of this scoping review is to outline the most frequent mental issues encountered by TB patients and evaluate the effects of mental health on TB treatment outcomes. Our findings identify research gaps that could help bridge the overall treatment outcomes in the near future.

Method: A systematic stepwise approach was adopted to search online resource databases like PubMed, Web of science, and gray literature to retrieve published scientific articles for the review. Titles and abstracts of selected studies were examined for their possible eligibility. The studies matching our eligibility criteria were taken into account for this scoping review.

Results: One hundred and ninety three articles were retrieved out of which 26 met the final inclusion criteria. We found that studies adopting interventional approaches reported good mental wellbeing outcomes and better medical compliance as compared with studies that just investigated the subjects. The data represented 15 countries including three low-income countries (LICs), four low-middle-income-countries (LMICs), seven upper-middle-income countries (UMICs), and one high-income country (HIC).

Conclusion: Depression, anxiety, and poor social support, and stigma affect the wellbeing of individuals across the globe irrespective of age, race, demographic characteristics, geographical location, and social status.

Keywords: tuberculosis, mental health, health-related quality of life, treatment, adherence

OPEN ACCESS

Edited by:
Harshavardhan Sampath, Sikkim Manipal University, India

Reviewed by:
Anmol Pradhan, Sikkim Manipal University, India
Shijo Joseph, Mar Sleeva Medicity, India

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

Received: *15 January 2022*
Accepted: *25 April 2022*
Published: *31 May 2022*

Citation:
Agbeko CK, Mallah MA, He B, Liu Q, Song H and Wang J (2022) Mental Health Status and Its Impact on TB Treatment and Its Outcomes: A Scoping Literature Review. Front. Public Health 10:855515. doi: 10.3389/fpubh.2022.855515

INTRODUCTION

Ever since its discovery and first global outbreak in the year 1882 (1), tuberculosis (TB) has been the leading infectious disease cause of death worldwide and remains a public health concern (2). A report released by the World Health Organization (WHO) estimated the TB-related death toll at 1.3 million as of 2017 with a projection of millions more getting infected in subsequent years (3). Despite the global implementation of Directly Observed Therapy, Short Course (DOTS), TB incidence is decreasing by only 1–2% per year (4). This is substantially lower than the estimated speed through mathematical modeling. The World Health Organization (WHO) clearly defines

health as an overall state of complete physical, mental and social wellbeing and not merely the absence of any infirmity or disease (5). TB infection interferes with the health-related quality of life (HRQOL), including physical, social, mental, emotional and financial domains of individuals (6). Adherence and HRQOL are both important indicators of the overall TB treatment spectrum. Evaluating psychiatric comorbidities in HRQOL is needed alongside the diagnosis of TB and likewise assessment with the continuity of anti-TB treatment (7).

Major mental health problems associated with TB are anxiety and depression (8). Anxiety disorders are characterized extensively by excessive worrying, apprehensiveness, the fear of future events, and uneasiness (9). Anxiety disorders make up one of the most common complications of psychiatric disorders. In 2013 alone, it was estimated that 8.2 million cases were reported in the general population of the UK with women being twice the number of people becoming anxious than men (10). Depression on the other hand is a common mental disorder that allows people to experience low mood, loss of self-interest or pleasure, the feeling of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration (11). According to the estimation by WHO, 300 million people are currently living with depression (12) and with no doubt, most people falling in this category are likely to be a patient suffering from TB or other chronic diseases (12). This has been reported in many studies that there is a three to six times increase in the tendency of becoming depressed due to TB and associated co-morbidities (13). These co-conditions pose a greater public health threat because it may lead to medication default.

However, psychological issues complicate treatment outcomes in people with infectious diseases like TB and chronic diseases such as diabetes, multiple sclerosis, Alzheimer's, HIV, and cancer (14). Maneuvering the gaps between the physical, mental and social aspects of health will affect the overall outcome of diseases. Therefore, assessing the association of TB on the mental wellbeing of its victims is usually underestimated in most institutions. Moreover, social support and stigma could be an important factor in the treatment outcomes of TB patients, leading to a decrement in mental wellbeing (15). The socioeconomic burden on households and individuals could pose a devastating effect if a strong social network within one's outreach is lost. Social support is defined as various means by which individuals help others or social interactions making the subject or individual believe he/she is being valued and cared for (16). Social support helps individuals to seek the appropriate and timely help when conditions and network interactions are strong and reliable for psychological support through stressful events especially when it's solely demonstrated through health-seeking behaviors (17). Stigma on the other hand is defined as a mark of disgrace or a form of disgrace associated with a particular circumstance. It's a process that usually begins when a trait of an individual is identified as disvalued or undesirable (15). This is a complex setting involving the community, institutions, and intrapersonal relationships leading to decrement of self-worth and self-value for one self (18).

The goal of this scoping review is to outline the most frequent mental issues encountered by TB patients and evaluate the effects of mental health on TB treatment outcomes. Our findings identify research gaps that could help bridge the overall treatment outcomes in the near future.

MATERIALS AND METHODS

Search Strategy and Study Selection

We systematically searched for studies in PubMed, Web of Science, and the gray literature. A systematic stepwise approach based on the methodological framework proposed by Arksey and O'Malley in 2005 (19) was adopted. An incorporated recommendation by Levac was also used to make the search more comprehensive (20) and up to date. Additionally, the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) (21) was employed to guide this review. The search approach was updated to February 2018 and publications in English were included. Keywords for database searching included "mental health status", "mental health", "treatment outcomes", "social support", "depression", "anxiety", "stigma", "tuberculosis", and "Mycobacterium tuberculosis" amongst others (full search strategies are detailed in **Supplementary File 1**). Titles and abstracts of selected studies were examined for their possible eligibility. The studies matching our eligibility criteria were taken into account for this scoping review. Studies were required to have all of the following characteristics: Papers included in our research included both qualitative and quantitative if they fit the mental health status. Articles were also included if they conformed with the search terms of TB and mental health co-morbidity with HIV/AIDS since the majority of studies showed that most people in Africa living with HIV are co-infected with TB. The paper selection flow chart is shown in **Figure 1**.

Data Extraction

At each stage of review, two reviewers extracted data independently and they subsequently met to resolve discrepancies. In case of continued disagreement, a third reviewer adjudicated study inclusion. The information extracted from the selected papers included Author(s) name, year of publication, country, aim or purpose of the study, the sample size of population, methodology, intervention type (if applicable), implications, concept, and key findings (**Table 1**). **Supplementary File 2** summarizes the data extracted for this scoping review.

Quality Control

The quality of the articles retrieved was evaluated using different tools. Cross-sectional and observational articles included in this review were cross-checked with the STROBE (strengthening the reporting of observational studies in epidemiology) (22). Longitudinal designs were subjected to a check using the PICO (P stands for population, I stands for intervention, C stands for control and O stands for outcome) (23). Qualitative studies were identified and were also cross-checked by critical appraisal checklist (24). This article was also guided by adopting the PRISMA (21) checklist. The data we retrieved were separated into anxiety, depression and social support, and stigma. The quality

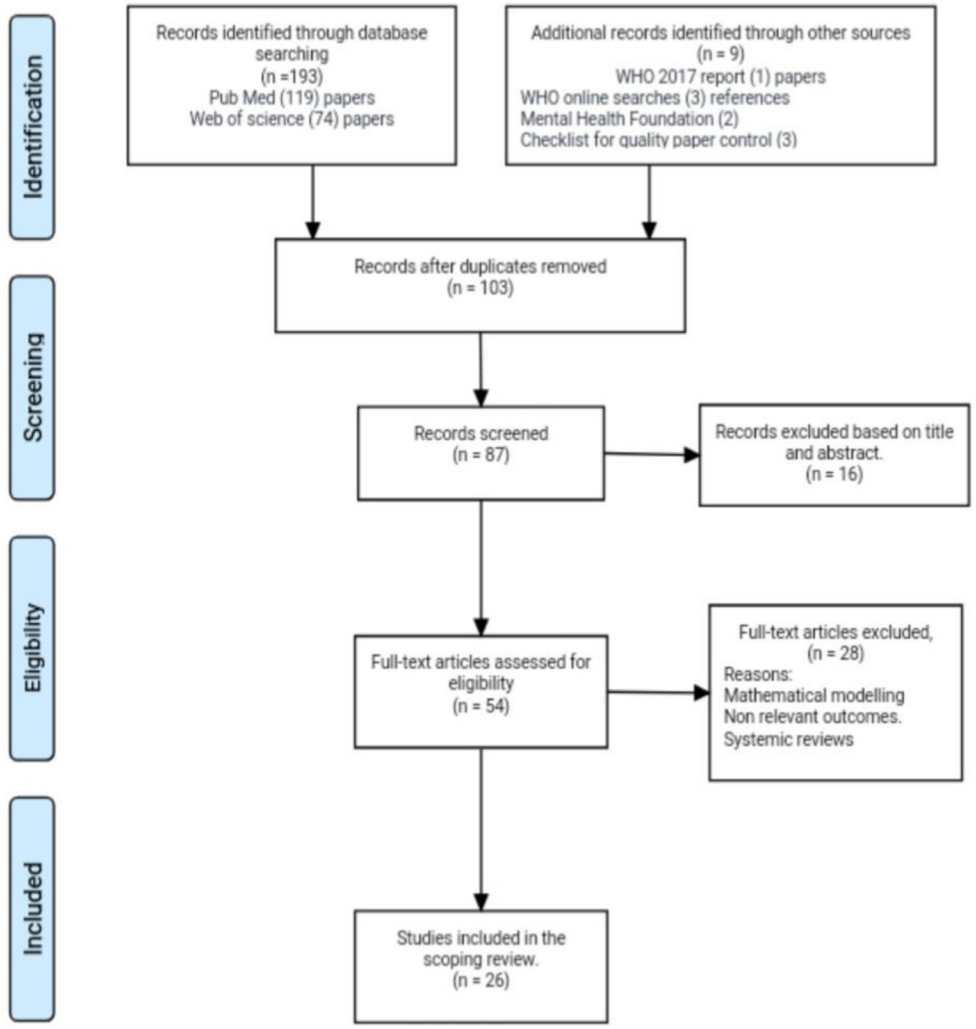


FIGURE 1 | Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) flow diagram for scoping review.

check was scored with a reference range of 0–5, where 0 was the least score if articles didn't meet the quality tool checklist and 5 was the highest score if the articles meet the checklist protocol. The three main categorized articles were then combined in one folder using endnote to check for duplications of articles. All studies included in this review met the quality assessment framework of their respective studies. **Table 2** shows the quality assessment for eligible studies included in Data extraction.

RESULTS

Study Selection

The results primarily yielded an overall number of 1,972 papers during the initial hit in the search engines. We then applied the combination of the mesh terms to yield 193 papers. Our online search also yielded two links from the mental health foundation, three quality checklist kits, three WHO online searches for statistics on depression, MDGs, and SDGs, and one pdf file from the current WHO report on TB. The first electronic extraction resulted in a total number of 193 papers. In PubMed after extraction hits, using Boolean extractions and screening it yielded a total of 119 articles, and the same was applied to the Web of Science database which consequently also yielded a total result of 74 papers. We screened both databases using abstracts and titles and handpicked 103 articles after duplication. Sixteen articles were further excluded after screening by abstract and titles. Eighty seven articles were eligible. Furthermore, 54 articles were pulled out after accessing their full text. A second reviewer provided recommendations after going through the list and screening. Twenty eight articles were excluded due to non-relevant outcomes and some study designs were mathematical in a model, which didn't fit our criteria, and some were also excluded due to information overlap. We then thoroughly read the full text and were able to get 26 available articles that met our inclusion criteria during our search (**Figure 1**). After cross-checking carefully, duplication

TABLE 1 | Data extraction summary.

#	References	Year	Country	Method	Size	Objective	Intervention	Findings	Implications
1	Fahad D Alosaimi	2014	Saudi Arabia	Case Report	1	A case of anxiety associated with military tuberculosis	YES	Association of TB causing mental disorders.	When TB was treated, it elevated the metal disorders.
2	Fentie Ambaw	2015	Ethiopia	Prospective cohort design	703	Examine the relationship between depression and TB among people newly diagnosed and accessing care for TB in a rural Ethiopian setting	NO	A sparse evidence based on mental health, TB and other chronic diseases in low-middle income countries	Anticipated impact
3	Muhammad Atif	2014	Malaysia	Prospective follow up	216	Follow up to measure the HRQOL of TB patients	YES	Compromised physical and mental health among study patients even at the end of their TB treatment.	Timely actions for addressing physical and/or mental well-being of the patients.
4	Sushil C Baral	2007	Nepal	Qualitative study	34	To take the first steps toward determining the causes of discrimination associated with TB.	NO	Causes of self-discrimination identified included fear of transmitting TB, and avoiding gossip and potential discrimination.	A comprehensive package of interventions, tailored to the local context, will be needed.
5	K. Chalco	2006	Peru	Qualitative study	Focus groups	To identify the forms and means of emotional support that nurses provide to patients living with multidrug-resistant tuberculosis (MTR-TB)	YES	An emotional support provided by both formal and informal means.	The nurse as a provider of emotional support in the development or implementation of similar programs.
6	M.J. Chinouya	2017	Africans (Zm = 3; Ug =3; Ni =2; Gh=1; Sd=1).	Qualitative study	10	To explore the experiences and meanings of stigma among African men with a previous TB diagnosis.	NO	Men were unable to recognize TB symptoms and subsequently made late clinical presentation when they were also diagnosed with HIV	Multidisciplinary teams supporting ongoing TB education programs should include African men's organizations.
7	Dos Santos	2017	Brazil	Cross sectional	750 beds	To evaluate the HRQL and the prevalence of symptoms of depression and anxiety in hospitalized patients with TB.	NO	Found a possible high prevalence of depression and anxiety in this population.	Health care workers should be aware of these psychological disorders to enable a better management of these patients
8	Juman Abdulelah Dujaili	2015	Iraq	Prospective cohort study	18 years and older	To determine how tuberculosis (TB) treatment affects the health-related quality of life (HRQL) of patients with pulmonary TB and to identify the predictors of favorable TB treatment outcomes in Baghdad, Iraq.	NO	FACIT-TB is a reliable tool to monitor HRQL during the course of TB treatment.	Therapeutic intervention had a positive impact on patient HRQL
9	Bereket Duko	2015	Ethiopia	Cross-sectional study	417	To assess prevalence and correlation of depression and anxiety among patients with TB	NO	The prevalence of depression and anxiety among patients with TB were 43.4 % (181) and 41.5 % (173) respectively.	Developing guidelines and training of health workers in TB clinics is useful
10	Ian F. Walker	2018	Nepal	Mixed quantitative and qualitative approach	135	Assessed the feasibility and acceptability of a psychosocial support package for people receiving treatment for MDR-TB in Nepal.	YES	Psychosocial support package is acceptable to patients	This requires additional investment of counselors in TB clinics.

(Continued)

TABLE 1 | Continued

#	References	Year	Country	Method	Size	Objective	Intervention	Findings	Implications
11	Mohammed O Husain	2008	Pakistan	Cross sectional	108	To determine the presence of depression, anxiety and illness perceptions in patients suffering from Tuberculosis (TB) in Pakistan.	NO	Found that about a half of patients in our sample met the criteria for probable depression and anxiety based on HADS score.	Depression and lack of perceived control are predictors of poor adherence
12	Petros Isaakidis	2013	India	Qualitative study	12	To understand patients' challenges in adhering to treatment for MDR-TB/HIV	YES	Family caregivers were crucial to maintaining the mental and physical health of patients, but reported high levels of fatigue and stress.	Requires high levels of support from family and caregivers to encourage patient adherence and retention in care.
13	Ammar Ali Saleh Jaber	2016	Yemen	Prospective study	243	To evaluate and to find the factors influencing the HRQoL of TB patients in two major TB-prevalent cities.	NO	Highly risk depression was found among TB patients	Efforts should be made to improve their QoL.
14	Tanja Kastien-Hilka	2017	South Africa	Observational longitudinal study.		The aim of this study was to assess the overall impact of TB on the health status	NO	HRQOL of the study participants was impaired in all physical, mental and psycho-social health domains at treatment start but improved during the course of standard TB treatment	The need for an integrative understanding of TB with HRQOL as core element.
15	Jean P. Mukasa	2015	Malawi Australia	Cross sectional study	35 Australian and 104 Malawian	To investigate differences in satisfaction rates among ethnically similar and different patients coming from two dissimilar health systems.	NO	Malawians were mostly inpatients, with recurrent TB episodes, and were more seriously ill with impaired physical and mental wellbeing.	Suggests that patients coming from similar ethnic backgrounds may express similar satisfaction.
16	Olanrewaju Oladimeji	2016	Nigeria	Cross sectional study	98	To assessed the psychosocial wellbeing of multidrug resistant TB (MDR-TB) patients in voluntary and isolated long-term hospitalization in Nigeria.	NO	Prolonged hospitalization resulted insignificant psychosocial burden for the MDR-TB patients in our study centers	There is a need to consider alternative approaches that place less psychosocial burden on patients without compromising quality of care.
17	Benvinda Xavier Paulo	2016	Angola	Cross-sectional study	81	To determine levels of anxiety, depression and emotional distress in patients with several types of TB	NO	Found high rates of anxiety, depression and emotional distress among TB patients.	Mental health services should be an integral part of TB programs.
18	Valerie A Paz-Soldán	2013	Peru	Qualitative	43	To understand psychosocial wellbeing during treatment.	NO	Patients described the need for psychosocial support to mitigate the difficulty of continually going to the clinic to take medications.	Extending educational opportunities to patients' families and the wider community.
19	Karl Peltzer	2012	South Africa	Cross sectional	4,900	Assessed the prevalence and predictors of psychological distress as a proxy for common mental disorders among tuberculosis (TB) patients in South Africa, where over 60 % of the TB patients were co-infected with HIV.	NO	High rates of psychological distress among tuberculosis patients	Improved training of providers in screening for psychological distress.
20	Grant Theron1	2015	Zambia Zimbabwe Tanzania South Africa	Randomized (1:1), parallel-arm, multi-centric trial	-	Correlation of psychological distress and their association with non-adherence to anti-TB treatment.	NO	Severe psychological distress is frequent amongst TB patients in Southern Africa	Targeted interventions to alleviate psychological distress, alcohol use, and improve health literacy in newly-diagnosed TB patients.

(Continued)

TABLE 1 | Continued

#	References	Year	Country	Method	Size	Objective	Intervention	Findings	Implications
21	Cesar Ugarte-Gi	2013	Peru	Longitudinal study	325	To estimate the significance and magnitude of major depressive episode as a hazard factor for negative outcomes.	YES	The presence of MDE at baseline is associated to negative outcome of TB treatment	Targeting detection and treatment of MDE may improve TB treatment outcomes.
22	Annelies Van Rie	2008	Thailand	Cross sectional	47 HIV;480 TB	To develop scales to measure tuberculosis and HIV/AIDS stigma in a developing world context.	YES	Identified two sub-scales associated with both tuberculosis and HIV/AIDS stigma: community and patient perspectives	Their use will help document the burden of stigma.
23	Paulo Benvinda Xavie	2015	Angola	Cross sectional	81	To determine levels of anxiety, depression and emotional distress in patients with several types of TB and to determine the association between social-demographic and economic factors, clinical variables and anxiety, depression and emotional distress.	NO	Found high rates of anxiety, depression and emotional distress among TB patients.	Mental health services should be an integral part of programs against tuberculosis.
24	Shaoru Zhang	2016	China	Qualitative studies	22	To explore the overall illness experience of Chinese high school TB patients and to investigate the individual and social causes of such experience.	NO	Their serious lack of awareness of TB, caused by the ignorance of school, parents and the students, becomes the biggest obstacle to timely diagnosis and treatment	Educational and medical institutions should develop more effective TB Control strategies based on these factors.
25	Shao-Ru Zhan	2010	China	Qualitative studies	17	To explore the experiences and psychological process of college students with pulmonary tuberculosis in Shaanxi, China.	NO	Psychological pressure was significant during the treatment	Colleges should follow governmental policies on TB.
26	Tanja Kastien-Hilka	2017	South Africa	Observational longitudinal	131	Aimed to evaluate the association between HRQOL and adherence in TB patients in South Africa	YES	HRQOL improved over 6-month TB treatment	HRQOL is affected by a number of different factors and not limited to effects of adherence.

TABLE 2 | Quality assessment for eligible studies included in data extraction.

Type of studies	Number of studies	Article number	Checklist	Reference score (0–5)
Qualitative studies	7	4, 5, 6, 12, 18, 24, 25	Glasgow Critical Appraisal	4.0
Cross sectional	9	7, 9, 11, 15, 16, 17, 19, 22, 23	STROBE	4
Cohort studies	3	2, 8, 13	STROBE	4.5
Mixed qualitative and quantitative studies	1	10	-	-
Case report	1	1	-	-
Follow up	1	3	-	-
Longitudinal studies	3	14, 21, 26	PICO	4.5
Randomized	1	20	-	-

methods were applied and handpicked to prevent a repetition of a particular study. Longitudinal studies were checked using the PICO element, cross-sectional and observational studies was cross-checked using the STROBE checklist and qualitative papers were crossed checked by the critical appraisal checklist. All the articles screened passed for eligibility. Seven qualitative searches were found, one mixed method of qualitative and quantitative, nine cross-sectional articles, and three cohort studies. We also encountered one case report, one follow-up study, three longitudinal studies, and finally one randomized study. Our study also comprised 15 different countries with three different multi-country studies. Articles concluded that decrement in mental health impacts TBs outcome and compliance hence there is an increase tendency to medication adherence and poor prognosis. With prior inclusion and exclusion criteria, our search was narrowed down to a total of 103 papers.

Location of Studies

Of the 26 studies we analyzed, three were multi-country related, three were in South Africa, two were in Peru, two were in Ethiopia, two were in Nepal, two were in China and the other nine studies were conducted across the globe. Based on the World Bank Report (25), we classified the countries into upper-middle-income countries (UMICs), low-middle-income countries (LMICs), low-income countries (LICs), and high-income countries (HIC). **Figure 2** illustrates the publications in different regions and different years.

Interventional Outcomes

We divided interventional outcomes into depression, anxiety, and social support, and stigma. There were 18 articles reporting depression but only four articles (#1, 3, 21, and 26) adopted interventions, and the outcome of mental health with medication adherence were improved in patients making up 22.2% of total articles in the depression category. The remaining 14 articles (#2, 7, 8, 9, 11, 13, 14, 15, 16, 17, 19, 20, 23, and 25) did not perform interventions but reported data on depression. There were four articles (#1, 3, 21, and 26) adopted interventions and the other 14 articles (#2, 7,8,9,11,13,14,15,16, 17, 19, 20, 23, 25) reported data on anxiety. Regarding social support and stigma, there were 4 articles (5, 10, 12, and 22) that adopted interventions and six articles (#4, 6, 18, and 24) that had no intervention but reported data on social support and stigma. **Table 3** gives the summary of the interventions and non-interventional outcomes.

Depression

Depression in TB patients leads to the outcome of delay in seeking medical care which eventually leads to negative medication adherence (6). Psychiatric comorbidity being reported as depression was a major decrement to health leading to a default in seeking appropriate health (26). In a research done in South Africa, a significant frequency of psychological distress among tuberculosis patients was found, with most individuals, particularly those from lower socioeconomic classes, becoming depressed throughout treatment, resulting in a lack of negative health-seeking behavior. (27). Furthermore, patients classified as MDR-TB experienced more depression (28). The impact of mental health on TB patients has hindered their wellbeing both emotionally and spiritually which makes it a hindrance to seeking a healthy behavior, hence affecting treatment outcomes in a long round (29, 30). In Peru, a study reported 37% depression in newly identified TB cases (31). A cross-sectional survey from 48 low and middle-income countries concluded that the proportion of depression is relatively high among TB patients with a consequent decrement in health status than in that among the general population (32). Depression peaks in patients on anti TB medications, hence we need strategic outlines and interventions to deal with the side effects of these medications. But fewer studies have been conducted on this subject matter (29).

Anxiety

The impact of anxiety has been demonstrated largely through the feeling of anger and ruminating over past events that led to contracting TB which could prolong treatment duration (31). Psychiatric co-morbidity increases the risk to decrement in health and default (26). Anxiety was found to be a key psychological domain in a Zambian study in which 37.6% of patients were found to be suffering from anxiety (31). A similar study conducted in Huambo Angola had similar findings outlining emotional distress and anxiety to be present among TB patients (33). Anxiety disorder and miliary TB were also reported in a case study of a 67-year-old Saudi man who qualified for anxiety definition under the Diagnostic and Statistical Manual of Mental disorders (DSM-5) with excessive anxiety, but his symptoms elevated due to treatment of TB (34). This report limits the studies only to identifying anxiety symptoms in association with TB but couldn't go on further to outline the mechanism involved in it (34). In Porto Algero, Brazil a study

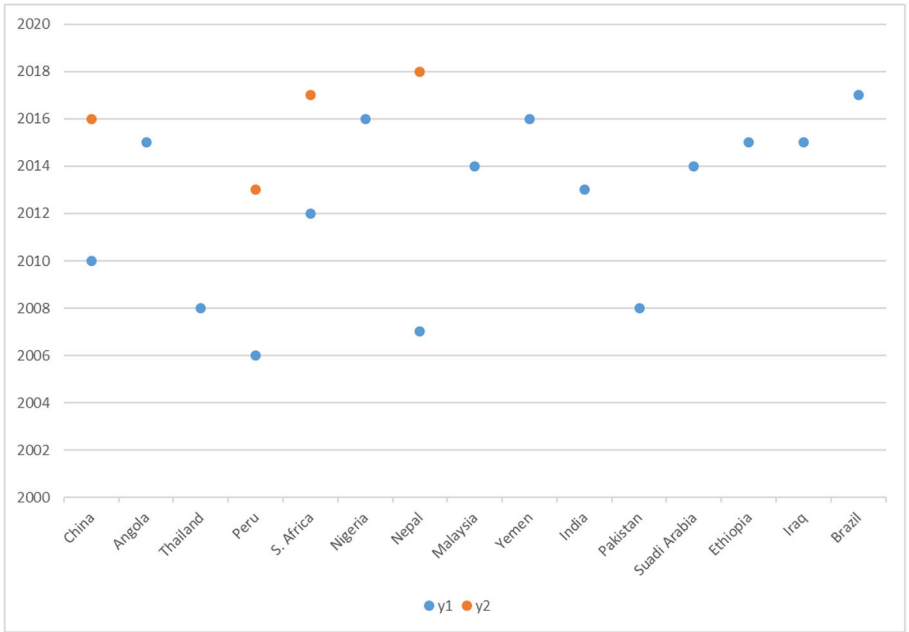


FIGURE 2 | Publications in different regions and in different periods.

TABLE 3 | Interventional outcomes.

Category of mental health	Article number; n%	Intervention (if applicable)	Outcomes (good or bad)
Depression	1, 3, 21, 26; $n = 22.22\%$	Intervene	Improve both physical and mental wellbeing
	2, 7, 8, 9, 11, 13, 14, 15, 16, 17, 19, 20, 23, 25; $n = 77.77\%$	No intervention	Compromise mental wellbeing
Anxiety	1, 3, 21, 26; $n = 22.22\%$	Intervene	Improve both physical and mental wellbeing
	2, 7, 8, 9, 11, 13, 14, 15, 16, 17, 19, 20, 23, 25; $n = 77.77\%$	No intervention	Compromise mental wellbeing
Social support and Stigma	5,10,12,22; $n = 50\%$	Intervene	Improve both physical and mental wellbeing
	4, 6, 18, 24; $n = 50\%$	No Intervention	Compromise mental wellbeing

also demonstrated generalized anxiety disorder prevalent in TB patients and quantified the number of psychiatry co-morbidity in 68% of hospitalized TB patients (6). Anxiety and mental health disorder have been demonstrated to be in poor accordance with effective treatment outcomes (6). Poor medical compliance and adherence to treatment were also demonstrative in a study conducted in Pakistan with an anxiety rating of 47% (35). Hence anxiety is also a key mental health problem in TB patients.

Social Support and Stigma

Despite the fear of being infected, family support and individual relationships have proven to help most TB patients overcome the fear of public rejection (36). A study conducted in Peru outlined that all patients with TB who disclosed their disease to their families were welcomed and cherished with an abundance of love, encouragement, financial support, and emotional strength as compared to those who hid it away from their loved ones (17). However, a crucial factor leading to high default of TB care is stigma (37). Stigma negatively affects the individuals by breeding depression, self-hate and disappointment, hindering patients from accessing the required healthcare he/she needs (38). With a good support system, family members and loved ones served as advocates who constantly reminded TB clients to seek help (17). External stigma as well as familial stigma both have huge impacts on the mental health wellbeing of people affected by TB. In the family settings, patients suffering from TB were sometimes left alone to fend for themselves, leading to isolation and self-neglect (37). Stigma and discrimination have led to a negative effect on health-seeking behavior in patients who suspects having TB due to long cough duration (39). Being highly portrayed in communities, especially in low and middle-income countries (LMICs), people suffering from TB tend to hide their symptoms and rather spread the infection (40). A research conducted in Peru assessed treatment outcomes when nurses served as emotional supporters to patients with TB and concluded that social support and networking was vital to the recovery as it helped their spiritual wellbeing (41). It is stipulated by other studies that, socio-cultural attributes of most

communities due to lack of public education on TB interfere with treatment adherence and may lead to new infections in the future (42, 43). Social support is hence an important determinant for a good outcome in all diseases. A study from Shaanxi province in China showed how lack of TB education among family members affected the outcome of TB and hence an integral program and campaign was needed to improve the outlook on TB (44, 45). The sparse evidence presented is also an indication of mental health neglect.

Interventional Approaches

Quality of Life is a multifaceted notion that spans the physical, social, psychological, economic, spiritual, and other realms. As a result, it's difficult to define and measure, but it may be roughly defined as people's judgments of their place in life in relation to their objectives, aspirations, standards, and worries in the context of the culture and value systems in which they live. As part of mitigations to improve patients' quality of life, some countries implemented interventions to combat clinical depression and anxiety observed among TB patients. One study conducted in Malaysia reported addressing mental wellness on time manner by first accessing it at baseline and during the treatment course. This aided early identification of depression and anxiety onset in TB patients for which psychosocial counseling was offered to improve the mental wellbeing (46). Additionally, two studies found that targeted detection and aggressive treatment of major depressive episodes from baseline would also improve the mental wellbeing of TB throughout treatment (31, 34). In Peru, there was a marked increase in mental health after providing necessary support to patients (41). Counselors were also provided in one setting in Nepal, which saw to counseling TB patients to cope with their disease and treatment side effects (47). An encouragement for a high level of support from family and friends also proved important and effective in the recovery process in India (48). Implementing interventions that measure and mitigate stigma at the local community level also proved an effective way of the intervening potential for depression among TB clients as was observed in Thailand (49). These interventions have a good impact on patients' treatment outcomes and quality of life. Hence, we entreat that such interventions will have in-depth research to help identify suitable measures in treating TB patients worldwide.

The requirement for a multidisciplinary team, such as incorporating the clinical psychologist when sent home or during an inpatient, was highlighted in certain literatures. The core of these disciplines will aid in bridging the gap between depression and home-based long-term care. Another intervention that may be used to reach remote settlers is the use of telemedicine. In its most basic form, telemedicine may be used. In the absence of a smart phone, satellite tiny phones can be used to call clients on a regular basis for a phone checkup. This is an interventional strategy that will be quite beneficial. It will also assist if DOT centers are established in health facilities or primary health care institutions. Health care workers who will staff these clinics should be given extra training in basic psychological assessments to aid in the rapid identification of symptoms for appropriate treatment or referral to a specialist (50). The examples above are only a handful of the interventional strategies that are required.

DISCUSSION

This review ascertained the effects of mental wellbeing on the impact of effective TB treatment around the world. Out of 26 articles retrieved, all articles well documented the observed impacts of mental health on treatment outcomes of TB and consequent decrement in the mental aspects of TB victims. However, limited research existed on the effects of possible interventions to improve the balance between mental wellbeing and improvement of TB outcome (6, 40, 47, 51, 52).

One qualitative study from Peru demonstrated how nurses helped hospitalized MDR-TB patients serving as treatment supporters to cope well with their infirmity and there was significant progress in the outcome of treatment (41). We subsequently think this type of intervention should be applied in different regions across the world to help promote the mental health of TB patients in addition to encouraging family members and immediate friends circle to join in the support. One of the interventions was timely actions taken within the treatment period to address mental wellbeing using feasible tools and designing indicators to help alleviate symptoms (46, 49). Another intervention was to extend educational programs to families and caregivers to encourage patient adherence to seeking positive health behavior (48). Educational programs can take place on different platforms such as social media, radio, and TV programs, marketplace campaigns in LMICs, and involving local celebrities to serve as ambassadors for educating the masses on such issues. We think this could help patients establish strong self-worth. A follow-up study in Penang General Hospital using SF-36 questionnaire found that even though other symptoms improved significantly with treatment, 23% of patients were at risk of depression at the end of TB treatment, which may be due to lack of psychological support during the treatment period (46). This implies that assessing psychological status at baseline and working toward improving every domain of HRQOL is significant in the pathway to a free TB world in the near future. We suggest that hospitals should include psychological therapy such as counseling as part of the treatment program. In another study, major depressive and anxiety episodes (MDE) were measured using a 5-item version in 325 patients (31). The presence of major depressive episodes at baseline was associated with negative outcomes (31). Depressive and anxiety are mostly found during an initial stages of diagnosis and may lead to negative outcomes if psychological packages are not strategized to encourage patients to adhere and retain care regimes (14, 48).

HRQOL in TB patients is usually underestimated in many settings, especially in LMICs where major resources are usually directed to improving only microbial symptoms, but neglecting the mental, physical and other domains in relation to HRQOL. A South Africa study adopted the SF-12, EQ-5D and St. George's respiratory scale, and observed a positive relationship between treatment adherence and HRQOL in patients with TB (53). It is therefore obvious that elevating microbial symptoms alone by using drugs will address some domains but others may be left out. LMICs with a high burden of TB may prioritize anti-TB drugs over psychological support. We think this phenomenon may be due to an extra financial burden that will be invested into getting more mental health workers which might not fit into

the budget plan of LMICs. Also, a prospective cohort study in Nepal suggested psychological support package is acceptable to patients and hence requires additional investment to counselors in TB clinics (47). This supports the recommendation that there is an urgent need for resource allocation to psychological support training in clinics and DOT centers in LMICs.

There is a need for further studies and improvement on caregivers training in recognizing, identifying, and implementing a social network approach to treating TB patients. National and provincial/district CDCs, primary care facilities, and other public health agencies have to mobilize workforces that will look into all aspects of health during the treatment course. Extra funding and research are needed, especially in the field of mental health. An integral effort by all agencies to increase the capacity of mental health workers in the field and national TB programs and the need to support primary caregivers should also be frontier on the agenda in most countries. Catastrophic cost on the victim's finances and family, socio-economic status considerations in that area of study, and cultural beliefs of the society in question are some of the driving factors we identified that could also lead to a decrement in the mental wellbeing of patients.

We further assessed the quality of reviewed studies and observed some limitations with some articles which may have affected the quality of the findings. For starters, interpreted findings in some articles were not expressed clearly due to data not being solely collected for analyzing the effect of mental wellbeing on medication adherence. Also, some studies used different measurements for assessing the mental wellbeing of patients. Some articles investigated just specific effects of how TB affects them mentally, while others considered measuring other factors leading to a potential decrease of mental wellbeing among TB patients. Other studies also focused on the measurement of physical wellbeing as compared to mental wellbeing but mostly neglected to make it an exclusive inclusion of all factors leading to medication adherence. This review also observed that qualitative studies mostly collected data only at one point in time without follow-up. We deem this an important gap as results may not reflect the true context of mood alterations, which could have led to a bias.

LIMITATION AND STRENGTH

This systemic review was limited in a number of ways. The search was limited to only 13 years from 2005 to 2018. During the search, we might have limited ourselves to only papers which were available in the databases used and their titles as well as abstracts matched our keywords. Moreover, taking data samples representing the whole population is very vital to understanding the variation and complexity of studies. The use of convenient sampling however seemed to be commonly utilized in most research and is a vital limitation to most studies (6, 17, 54). Representation of just a particular group of people, for example, smear-positive TB patients alone, cannot be used as a generalization for the whole population (46). Studies that were cross-sectional in nature did not really identify a clear-cut relation between anxiety, depression with reference to other factors that have been found to compromise the mental wellbeing (53). They were mostly focused on the determination of a link between depression, anxiety and TB excluding confounding factors that may contribute to a compromised mental health (53). Considering general factors will help identify areas to be addressed so as to get a quick intervention in that area. The correlation of anxiety, depression, and TB has been established in most studies but factors have been poorly outlined (52).

Irrespective of the above-noted limitations to the quality of the articles, a review of the data collated by them is highly informative and good enough to inform treatment policy formation and upgrade. This review combined findings from a case report, qualitative and quantitative studies together thereby ensuring the capture of all relevant information on the topic making it one of the strengths.

CONCLUSION

The evidence of the effects of mental health on TB outcomes has been well captured in this review. Depression, anxiety and poor social support, and stigma evidently affect the mental well-being of individuals across the globe, irrespective of age, race, demographic characteristics, geographical location, and social status. Moreover, there is an urgent need to address TB in a multidisciplinary approach to combat the overall quality of treatment outcomes. Patients with all forms of TB may or may not experience optimum mental wellbeing depending on a variety of reasons influencing the patient and this needs further research.

Implication of Research

This review underscores the importance of studies in the field of mental health in relation to TB patients across the globe. Further research needs to be conducted in the field of mental health to outline strategies that will help promote the mental wellbeing of TB patients during treatment across the world. Furthermore, recent research on mental health and its association to medication adherence using causal inference analysis and meditational modeling will optimize treatment protocols for better outcomes as well as help understand limitations and pathways leading to default in TB treatment.

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.

AUTHOR CONTRIBUTIONS

CA and JW: conceptualization, methodology, and software. CA: formal analysis and visualization. CA, MM, BH, QL, and HS: investigation and writing—original draft preparation. MM, BH, QL, and HS: data curation and validation. JW: supervision, project administration, resources, writing—review and editing, and funding acquisition. All authors have given final approval of the version to be published and agreed on the journal to which the article has been submitted.

FUNDING

This study was funded by the National Natural Science Foundation of China (81973103), Nanjing Major Science and Technology Project (2021-11005), Medical Research Project of Jiangsu Health Commission (ZDB2020013), and Key Project of Philosophy and Social Science Research in Colleges and Universities in Jiangsu Province (2020SJZDA096). The funding agencies had no role in the study design, data collection, analysis, decision to publish, or preparation of the manuscript.

ACKNOWLEDGMENTS

All authors of the manuscript thank and acknowledge their respective Universities and Institutes.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.855515/full#supplementary-material

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frontiers | Frontiers in Psychiatry

ORIGINAL RESEARCH
published: 02 June 2022
doi: 10.3389/fpsyt.2022.867080

The Impact of the COVID-19 Pandemic on the Mental Health of Healthcare Workers in Italy: Analyzing the Role of Individual and Workplace-Level Factors in the Reopening Phase After Lockdown

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Introduction: Italy is one of the high-income countries hit hardest by Covid-19. During the first months of the pandemic, Italian healthcare workers were praised by media and the public for their efforts to face the emergency, although with limited knowledge and resources. However, healthcare workers soon had to face new challenges at a time when the national health system was working hard to recover. This study focuses on this difficult period to assess the impact of the COVID-19 pandemic on the mental health of Italian healthcare workers.

Materials and Methods: Healthcare workers from all Italian regions [n = 5,502] completed an online questionnaire during the reopening phase after the first wave lockdown. We assessed a set of individual-level factors (e.g., stigma and violence against HCWs) and a set of workplace-level factors (e.g., trust in the workplace capacity to handle COVID-19) that were especially relevant in this context. The primary outcomes assessed were score ≥15 on the Patient Health Questionnaire-9 and score ≥4 on the General Health Questionnaire-12, indicators of clinically significant depressive symptoms and psychological distress, respectively. Logistic regression analyses were performed on depressive symptoms and psychological distress for each individual- and workplace-level factor adjusting for gender, age, and profession.

Results: Clinically significant depressive symptoms were observed in 7.5% and psychological distress in 37.9% of HCWs. 30.5% of healthcare workers reported having felt stigmatized or discriminated, while 5.7% reported having experienced violence.

OPEN ACCESS

Edited by:
Samrat Singh Bhandari,
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: 31 January 2022
Accepted: 02 May 2022
Published: 02 June 2022

Citation:
Moro MF, Calamandrei G, Poli R, Di Mattei V, Perra A, Kurotschka PK, Restrepo A, Romano F, La Torre G, Preti E, Mascayano F, Picardi A, Chiarotti F, Rapisarda V, Urban A, Alvarado R, Susser E and Carta MG (2022) The Impact of the COVID-19 Pandemic on the Mental Health of Healthcare Workers in Italy: Analyzing the Role of Individual and Workplace-Level Factors in the Reopening Phase After Lockdown. Front. Psychiatry 13:867080. doi: 10.3389/fpsyt.2022.867080

Feeling stigmatized or discriminated and experiencing violence due to being a healthcare worker were strongly associated with clinically significant depressive symptoms [OR 2.98, 95%CI 2.36–3.77 and OR 4.72 95%CI 3.41–6.54] and psychological distress [OR 2.30, 95%CI 2.01–2.64 and OR 2.85 95%CI 2.16–3.75]. Numerous workplace-level factors, e.g., trust in the workplace capacity to handle COVID-19 [OR 2.43, 95%CI 1.92–3.07] and close contact with a co-worker who died of COVID-19 [OR 2.05, 95%CI 1.56–2.70] were also associated with clinically significant depressive symptoms. Similar results were found for psychological distress.

Conclusions: Our study emphasizes the need to address discrimination and violence against healthcare professionals and improve healthcare work environments to strengthen the national health system's capacity to manage future emergencies.

Keywords: healthcare workers, COVID-19, mental health, stigma, violence, depression, psychological distress, Italy

INTRODUCTION

Italy is one of the high-income countries hit hardest by the Covid-19 pandemic, showing a mortality rate for SARS-CoV-2 among the highest in the world during the first wave in 2020 (1, 2). When the first cases of COVID-19 were confirmed in the country on 31 January 2020, Italy was preparing to face the pandemic with confidence (3). Despite the growing alarm for the decreases in the expenses allocated to the national healthcare system and the protests by citizens and service users' organizations against these cuts over the past years (4–6), official voices stated with pride that the Italian healthcare system was "one of the best in the world based on authoritative rankings," and it would have been well prepared to give a right answer to the threat (5, 7).

The pandemic has revealed the excessive optimism of these statements and has produced a shocking awareness in healthcare workers (HCWs) of the fragility and vulnerability of the Italian healthcare system (8). During the first months of the pandemic, a substantial number of health professionals found themselves without basic personal protective equipment, with scarce opportunities to get tested for the virus, and with the additional challenges of working in a system with considerable organizational deficiencies that soon went into crisis (9–13). In 2020, according to the Italian National Institute for Insurance against Accidents at Work, around 70% of over 100,000 work accidents claims due to COVID-19 were from HCWs, and 60% of the fatal cases concerned nurses (14). This situation heavily affected the mental wellbeing of Italian HCWs, as shown in previous studies. Using data collected during the first months of the pandemic, Lasalvia et al. (11) reported that 53.8% [95% CI (51.0–56.6%)] of the HCWs in their study showed symptoms of post-traumatic distress, 50.1% (95% CI [47.9–52.3%]) symptoms of clinically relevant anxiety and 26.6% [95% (CI 24.7–28.5%)] of at least moderate depression. Similarly, Rossi et al. (15) conducted a study among HCWs during the first wave of the pandemic and found that 49.4% of the respondents showed symptoms of post-traumatic stress disorder, 24.7% symptoms of depression, and 19.8% symptoms of anxiety.

On 18 May 2020, the national lockdown, which heavily restricted the movement of the population except for necessity, work, and health circumstances for 69 days, was lifted. Although this was seen with joy by the general population, it raised concerns among HCWs, who were worried that reopening prematurely after the first wave could be a recipe for disaster. There were also concerns that the National Health System would not be able to cope with a new wave at a time when staff was working hard to recover. Moreover, while during the first months of the pandemic HCWs were praised by the media and the public and even applauded from balconies as "heroes," this quickly changed after the reopening. Anger began to ferment in the community against the inefficiencies of the national healthcare system and HCWs, although victims themselves of these inefficiencies, began to be mistakenly seen as the culprits of the failures in addressing COVID-19. In a few weeks, they went from heroes to negligent professionals in the eyes of many persons, while a number of lawyers and prosecutors started to put their decisions and treatment choices under judiciary scrutiny (16). Although studies from other countries have shown the negative impact of stigma and violence related to COVID-19 on HCWs' mental wellbeing (17, 18), these factors have been neglected in previous research conducted in Italy. In the present paper, we used a large national sample of Italian HCWs to examine whether their mental wellbeing during the challenging reopening phase after lockdown was related to 1) individual-level factors such as stigma and violence against HCWs, and 2) workplace-level factors related to COVID-19.

MATERIALS AND METHODS

Study Design

This cross-sectional study is part of a prospective international project entitled "The COVID-19 HEalth caRe wOrkErS (HEROES) study" (NCT04352634) (19), which includes participants from 25 countries across 4 continents and was jointly launched by Columbia University Mailman School of Public Health and Universidad de Chile School of Public Health (Faculty of Medicine), in collaboration with the Pan American

Health Organization (PAHO) and with support from the World Health Organization (WHO). In Italy, the study was supported by the National Institute of Health.

Data were collected in all Italian regions during the reopening phase after the first wave lockdown, from May 2020 to July 2020 (follow-up assessments will be carried out at 18 and 24 months). Participants were clinical and non-clinical HCWs employed in in-patient or out-patient health facilities throughout the country. They were recruited through an invitation sent via email. A list of emails was previously obtained from: (1) HCWs national and/or local orders and organizations (the involvement of orders and organizations allowed to recruit health professionals working at the community level, such as general practitioners and HCWs employed in retirement homes and other facilities outside of the hospital system but heavily affected by COVID-19), (2) HCWs national and/or local unions (the involvement of unions allowed to recruit HCWs usually not organized in orders and organizations, such as cleaning staff, maintenance staff, and others), (3) selected health centers and hospitals. Particular attention was given to involve orders, organizations, unions, health centers, and hospitals and recruit participants from Italian areas differently affected by the COVID-19 pandemic in the North, Center, and South of the country. Further details on the sampling procedures can be found in the study protocol (19).

Measures

An on-line self-administered questionnaire including standardized measures and some items created *ad hoc* was used for data collection. The questionnaire included the following sociodemographic variables: gender, age, region, and members of household under 18 years, over 65 years, and with disabilities.

To assess mental wellbeing, we evaluated depressive symptoms and psychological distress. Depressive symptoms were measured by the Italian version of the 9-items Patient Health Questionnaire (PHQ-9) (20, 21). Total PHQ-9 scores range from 0 to 27. According to these scores, depression severity is categorized as "none or minimum" (0-4), "mild" (5-9), "moderate" (10-14), "moderately severe" (15-19), and "severe" (20-27). In this study, PHQ-9 scores $\geq$ 15 were categorized as indicative of clinically significant depressive symptoms (CSD), which suggest a high probability of major depression for which treatment is recommended (21). Psychological distress was measured by the Italian version of the General Health Questionnaire 12-Items (GHQ-12) (22, 23). Total GHQ-12 scores were calculated using the bimodal scoring method [0-0-1-1]. According to this method, GHQ-12 scores $\geq$ 4 were categorized as indicative of clinically significant psychological distress (GHQ+) (24). Cronbach's alphas were 0.87 for the PHQ-9 and 0.88 for the GHQ-12.

Individual-level covariates were measured as follows: Feeling stigmatized or discriminated against for the role as HCWs due to the pandemic (Agree, Disagree), Having experienced violence due to being a HCWs during the pandemic (Agree, Disagree), Fear of getting COVID-19 (Yes, No), Fear of infecting the loved ones (Yes, No), Having a loved one infected with COVID-19 (Yes, No), Having loved ones who provided support when needed (Yes, No). *Workplace-level covariates* were measured as follows: Days in isolation due to COVID-19 (0, 1-19, $\geq$ 20), hours worked per day on average ($\geq$ 10, $\leq$ 9), Assignment to a new team or functions (Yes, No), Lack of masks at work (Yes, No), Close contact with patients who were suspected or confirmed cases of COVID-19 (Yes, No, I don't know), Close contact at work with someone who passed away due to COVID-19 (Yes, No, I don't know), Having cared for patients with COVID-19 that passed away (Yes, No, I don't know), Trust in the workplace capacity to manage COVID-19 (low, high), Having a reliable network of supportive colleagues at work (Agree, Disagree). Further details on variables included in the study can be found in **Table 1** and the study protocol (19).

Analyses

First, respondents who did provide informed consent but did not continue the survey or did not work in a facility providing healthcare were excluded. Then, respondents who did not complete the survey questions on depressive symptoms and psychological distress were removed. Sensitivity analyses were performed to evaluate potential differences between completers and non-completers. Tabular analyses were used to examine clinically significant depressive symptoms and psychological distress by assessing frequencies for the whole sample and stratified by gender, age, and profession. To examine the association between the individual and workplace-level variables of interest shown in **Table 1** (selected a priori from the literature or based on clinical and empirical grounds) on HCWs mental wellbeing, we conducted logistic regression models on depressive symptoms and psychological distress for each variable while controlling for gender, age, and profession. Results were presented as odds ratios (ORs) with 95% confidence intervals. All analyses were performed using SAS (version 9.4 for Windows).

RESULTS

Characteristics of the Respondents

Overall, 5,502 healthcare workers were recruited at baseline. Eighty-nine respondents were excluded because they did provide informed consent but did not continue the survey or did not work in a facility providing healthcare (information on non-responders non-available). Then 1,093 respondents who did not complete the survey questions on depressive symptoms and psychological distress were removed ($n = 1,093$). In total, 4,320 healthcare workers (78.5%) completed the survey questions on depressive symptoms and psychological distress. There were no relevant differences between completers and non-completers regarding gender (completers: woman 70.8%, man 29.1, non-completers: woman 67.0, man 26.4) and median age (completers: 45, non-completers: 44). Questions on depressive symptoms and psychological distress were in the last section of the questionnaire, suggesting that missingness was mainly at random and due to the length of the questionnaire.

Tables 2–4 show respondents' characteristics, with clinically significant depressive symptoms (CSD) stratified by gender (**Table 2**), age (**Table 3**), and profession (**Table 4**). Overall,

TABLE 1 | Variables from the HEROES questionnaire used in this study.

Construct	Variables	Answers
Sociodemographic	- Age - Gender (Woman/Man/Other gender) - Region - Members of household under 18 years, over 64 years, and with disabilities (Yes vs. No) - Profession	Ad-hoc questions
Experiences, fears, and concerns about COVID-19 (Individual-level factors)	- Days of isolation for COVID-19 (continuos) - Fear of transmitting COVID-19 to loved ones (Likert scale recategorized as Yes/No) - Fear of being infected (Likert scale recategorized as Yes/No) - Having a loved one infected by COVID-19 (yes/no) - Having a loved one passing away due to COVID-19 (yes/no) - Feeling stigmatized as a health worker (Likert scale recategorized as Agree/Disagree) - Experiencing violence due to be a health worker (Likert scale recategorized as Agree/Disagree) - Support from loved ones (Likert scale recategorized as Agree/Disagree)	Ad-hoc questions
Work environment (Workplace-level factors)	- Change of functions since the start of the pandemic (yes/no) - Amount worked in the past week (hours) - Lack of masks (Likert scale recategorized as yes/no) - Contact with patients with COVID- 19 (yes/ I do not know / no) - Experience with the death of colleagues or patients with COVID-19 (yes / I do not know / No) - Trust in the workplace (Likert scale recategorized as low/high) - Support from colleagues (Likert scale recategorized as Agree/Disagree)	Ad-hoc questions
Psychological distress	Distress symptoms	General Health Questionnaire (GHQ-12)
Depression	Depressive symptoms	Patient Health Questionnaire (PHQ-9)

TABLE 2 | Characteristics of the respondents: CSD stratified by gender.

	CSD (%)	No CSD (%)	Total (%)	OR (95% CI)
Man	65	1,193	1,258 (29.12)	—
Woman	261	2,797	3,058 (70.79)	**1.71 (1.29-2.27)**
Other gender	0	4	4 (0.09)	**
Total	326 (7.55)	3,994 (92.45)	4,320 (100)	

***Not calculable.*

TABLE 3 | Characteristics of the respondents: CSD stratified by age.

	CSD (%)	No CSD (%)	Total (%)	OR (95% CI)
≤30	61	740	801 (18.54)	—
31-43	94	1,177	1,271 (29.42)	0.97 (0.69–1.35)
44-56	116	1,243	1,359 (31.46)	1.13 (0.82–1.56)
57-69	53	810	863 (19.98)	0.79 (0.54–1.16)
≥70	2	24	26 (0.60)	1.01 (0.23–4.38)
Total	326 (7.55)	3,994 (92.45)	4,320 (100)	

70.79% of participants identified as women, 29.12% as men, and 0.09% as other gender. The median age was 45. Most respondents were physicians (35.53%), nurses (12.55%), occupational therapists, educators, and rehabilitation technicians (8.96%), physical therapists (8.24%), speech therapists (4.72%), laboratory technicians (4.19%), and other staff, including pharmacists, healthcare assistants, dental hygienists, public health workers, and surveillance personnel (11.32%). Clinically significant depressive symptoms were reported by 326 participants, 7.55% of the overall sample. Women were more likely than men to report CSD [OR = 1.71 95% CI (1.29-2.27)]. When comparing the different professions, only nurses reported higher CSD than physicians [OR = 1.60: 95%CI (1.15–2.22)]. Regarding psychological distress, 1,637 respondents (37.89% of the overall sample) screened positive at the GHQ-12, with women reporting higher psychological distress than men [OR = 1.56: 95% CI (1.36–1.89)]. **Supplementary Materials 1–3** show respondents' characteristics, with clinically significant psychological distress stratified by gender (**Supplementary Material 1**), age (**Supplementary Material 2**), and profession (**Supplementary Material 3**). In addition, 30.51% of the participants reported having felt stigmatized or discriminated for their role as HCWs and 5.72% reported having experienced violence due to being a healthcare worker during the pandemic.

TABLE 4 | Characteristics of the respondents: CSD stratified by profession.

	CSD (%)	No CSD (%)	Total	OR (95% CI)
Physician	113	1,422	1,535 (35.53)	—
Social worker	0	5	5 (0.12)	**
Occupational therapist/educator/ rehabilitation technician	24	363	387 (8.96)	0.83 (0.53–1.31)
Physical therapist	30	326	356 (8.24)	1.16 (0.76–1.76)
Nurse	61	481	542 (12.55)	**1.60 (1.15–2.22)**
Speech therapist	13	191	204 (4.72)	0.86 (0.47–1.55)
Dietician	1	26	27 (0.63)	0.48 (0.06–3.60)
Socio-sanitary operator	7	86	93 (2.15)	1.02 (0.46–2.27)
First responder (e.g., EMT)	1	12	13 (0.30)	1.05 (0.14–2.27)
Dentist	4	60	64 (1.48)	0.84 (0.12–6.90)
Midwife	1	14	15 (0.35)	0.90 (0.12–6.90)
Psychologist	4	76	80 (1.85)	0.66 (0.24–1.84)
Administrator/secretary/admissions/patient information	7	108	115 (2.66)	0.82 (0.37–1.43)
Clinical and non-clinical manager (director)	3	38	41 (0.95)	0.99 (0.30–3.27)
Laboratory technician	10	171	181 (4.19)	0.74 (0.38–1.43)
Maintenance, food, and security staff	1	17	18 (0.42)	0.74 (0.10–561)
Cleaning staff	1	25	26 (0.60)	0.50 (0.07–3.75)
Radiology technician	10	116	126 (2.92)	1.08 (0.55–2.13)
Other staff	35	454	489 (11.32)	0.97 (0.65–1.44)
Total	326 (7.55)	3,991 (92.45)	4,317 (100)	

Missing data (n = 3).
***Not calculable.*

Association Between Healthcare Workers Individual- and Workplace-Level Factors and Clinically Significant Depressive Symptoms

Table 5 summarizes the results from regression analyses on depressive symptoms for individual-level factors. Feeling stigmatized or discriminated and experiencing violence due to being a HCW during the pandemic increased the likelihood of reporting CSD [*OR* = 2.98: 95% CI (2.36–3.77)] and [*OR* = 4.72: 95% CI (3.41–6.54), respectively]. Participants were more likely to report clinically significant depressive symptoms if they lived with persons older than 64 years [*OR* = 1.50: 95% CI (1.08–2.09)] or with disabilities [*OR* = 3.08: 95% CI (2.09–4.54)], or if they had a loved one infected with COVID-19 (*OR* = 1.78: 95% [CI 1.13–2.82]). On the contrary, having loved ones able to provide support when needed was a protective factor [*OR* = 0.26: 95% CI (0.20–0.35)].

Table 6 summarizes the results from regression analyses for workplace-level factors. Participants were more likely to show clinically significant depressive symptoms if they had spent up to 19 days [*OR* = 1.42: 95% CI (1.03–1.96)] or 20 or more days [*OR* = 1.52 95%CI (1.01–2.32)] in isolation due to COVID-19, or if they were assigned to a new team or functions [*OR* = 1.38: 95%CI (1.06–1.79)]. Furthermore, they were more likely to report clinically significant depressive symptoms if they were being close to patients who were suspected or confirmed cases of COVID-19 [*OR* = 1.39: 95% CI ([1.03–1.87)], if they had close contact at work with someone who later passed away due to COVID-19 [*OR* = 2.05: 95% CI (1.56–2.70)], or if they cared for patients with COVID-19 that then passed away [*OR* = 1.79: 95% CI (1.34–2.39).] In answering these three questions, even when respondents were not certain about the COVID-19 status of the patients or persons at work (in that period, it was not always possible to get COVID-19 tests in Italy, and many participants chose the option "I don't know"), they showed an increased risk of CSD. Having low levels of trust in the workplace capacity to manage COVID-19 increased the likelihood of reporting CSD [*OR* = 2.43: 95% CI (1.92–3.07)]. On the contrary, having a reliable network of supportive colleagues at work was a protective factor [*OR* = 0.31: 95% CI (0.24–0.39)].

Association Between Healthcare Workers Individual- and Workplace-Level Factors and Psychological Distress

Table 5 summarizes the results from regression analyses on psychological distress for individual-level factors. Feeling stigmatized or discriminated against and experiencing violence due to being a HCWs during the pandemic increased the likelihood of reporting GHQ + [*OR* = 2.30 95% CI (2.01-2.64)] and *[OR* = 2.85: 95% CI (2.16-3.75)], respectively). Participants were more likely to report clinically significant psychological distress if they lived with persons older than 64 years [OR = 1.22: 95% CI (1.01–1.49)] or with disabilities [OR = 1.94: 95% CI (1.46–2.56)]. Furthermore, they were more likely to show clinically significant psychological distress if they reported fear of

TABLE 5 | Association between health workers individual-level factors and CSD (PHQ-9 ≥ 15) or GHQ+ (GHQ-12 ≥ 4).

	OR (95% CI)	
	CSD	**GHQ+**
Living with persons younger than 18 years: Yes vs. No	0.89 (0.68–1.17)	0.90 (0.78–1.05)
Living with persons older than 64 years: Yes vs. No	**1.50 (1.08–2.09)**	**1.22 (1.01–1.49)**
Living with persons with disabilities: Yes vs. No	**3.08 (2.09–4.54)**	**1.94 (1.46–2.56)**
Fear of getting COVID-19: Yes vs. No	1.13 (0.73–1.74)	**1.80 (1.40–2.30)**
Fear of infecting the loved ones: Yes vs. No	0.73 (0.39–1.39)	**1.89 (1.22–2.89)**
Having a loved one infected with COVID- 19: Yes vs. No	1.26 (0.98–1.62)	**1.41 (1.22–1.63)**
Having a loved passed away due to COVID- 19: Yes vs. No	**1.78 (1.13–2.82)**	1.31 (0.98–1.74)
Feeling stigmatized or discriminated against as a health worker due to the pandemic: Agree vs. Disagree	**2.98 (2.36–3.77)**	**2.30 (2.01–2.64)**
Experienced violence due to being a health worker during the pandemic: Agree vs. Disagree	**4.72 (3.41–6.54)**	**2.85 (2.16–3.75)**
Having loved ones who support when needed: Agree vs. Disagree	**0.26 (0.20–0.35)**	**0.39 (0.31–0.49)**

TABLE 6 | Association between health workers workplace-level factors and CSD (PHQ-9 ≥ 15) or GHQ + (GHQ-12 ≥ 4).

	OR (95% CI)	
	CSD	**GHQ+**
Hours worked per day on average (in the last week): • ≥ 10 vs. • ≤ 9	1.16 (0.87–1.54)	**1.41 (1.20–1.65)**
Days in isolation due to COVID: • 1–19 vs. 0 • ≥ 20 vs. 0	• **1.42 (1.03–1.96)** • 1.52 (1.00–2.32)	• **1.57 (1.30–1.90)** • **1.71 (1.32–2.21)**
Assignment to a new team and/or functions: Yes vs. No	**1.38 (1.06–1.79)**	**1.53 (1.31–1.78)**
Being close to patients who were suspected or confirmed cases of COVID-19: • Yes vs. No • I don't know vs. No	• **1.39 (1.03–1.87)** • **1.70 (1.27–2.27)**	• **1.65 (1.40–1.96)** • **1.53 (1.29–1.82)**
Close contact at work with someone who later passed away due to COVID-19: • Yes vs. No • I don't know vs. No	• **2.05 (1.56–2.70)** • **2.01 (1.41–2.86)**	• **1.90 (1.62–2.24)** • **1.98 (1.60–2.45)**
Having any of the patients with COVID-19 that respondent cared for passed away: • Yes vs. No • I don't know vs. No	• **1.79 (1.34–2.39)** • **1.69 (1.18–2.41)**	• **1.76 (1.50–2.07)** • **1.64 (1.33–2.01)**
Lack of masks from the beginning of the pandemic: Yes vs. No	1.17 (0.72–1.90)	1.13 (0.872–1.48)
Trust in the workplace capacity to manage COVID: Low vs. High	**2.43 (1.92–3.07)**	**1.99 (1.74–2.28)**
Having a reliable network of supportive colleagues at work: Agree vs. Disagree	**0.31 (0.24–0.39)**	**0.37 (0.32–0.43)**

getting COVID- 19 [OR =1.80 95%CI (1.40–2.30)] or infecting the loved ones [OR= 1.89: 95% CI (1.22–2.89)], or if they had a loved one infected with COVID-19 [OR= 1.41: 95% CI (1.22–1.63)]. On the contrary, having loved ones who provided support when needed was a protective condition [OR =0.39 95% CI (0.31–0.49)].

Table 6 summarizes the results from regression analyses for workplace-level factors. Participants were more likely to show clinically significant psychological distress if they had spent up to 19 days [OR = 1.57 95% CI (1.30–1.90)] or 20 or more days in isolation due to COVID-19 [OR = 1.71 95% CI (1.32–2.21)], or if they were assigned to a new team or functions [OR = 1.53 95% CI (1.31–1.78)]. Furthermore, they were more likely to show clinically significant psychological distress if they were being close to patients who were suspected or confirmed cases of COVID-19 [OR = 1.65: 95% CI (1.40–1.96)], if they had close contact at work with someone who later passed away due to COVID-19 [OR = 1.90: 95% CI (1.62–2.240)], or if they cared for patients with COVID-19 that then passed away (OR = 1.76: 95% CI [1.50–2.07]). In answering these three questions, even when respondents were not certain about the COVID-19 status of the patients or persons at work, they showed an increased risk of psychological distress. Having low levels of trust in the workplace capacity to manage COVID-19 increased the likelihood of reporting GHQ + (OR = 1.99: 95% CI [1.74–2.28]). On the contrary, having a reliable network of supportive colleagues at work was a protective factor (OR = 0.37: 95% CI [0.32–0.43]).

DISCUSSION

The present study investigated the impact of the COVID-19 pandemic on the mental health of a large sample of Italian healthcare workers, analyzing the role of individual– and workplace–level factors in the reopening phase after the first, strict lockdown.

Among the individual-level factors examined, feeling stigmatized or discriminated against as a healthcare worker due to COVID-19 and having experienced violence due to being a healthcare worker during the pandemic were associated with both clinically significant depressive symptoms and psychological distress. It must be kept in mind that our study was conducted at the end of a period when HCWs were praised as "heroes", and it was generally believed that the Italian community had gathered around them with great solidarity, while in other countries HCWs were being strongly discriminated and attacked (25, 26). Among several studies conducted during the COVID-19 first wave in Italy, only one in Lombardy assessed discrimination and violence experienced by HCWs, 25% reported episodes of discrimination against themselves, their colleagues, or their family members and even episodes of physical assault and vandalism. Our study demonstrates that during the reopening period after the first wave, discrimination and violence against HCWs were not isolated to specific "high-risk" areas but widespread throughout the national territory. Furthermore, they were strongly associated with clinically significant depressive symptoms and psychological distress among HCWs.

Numerous other individual-level factors were related to negative mental health outcomes. For instance, living with a person older than 64 years or with a disability was associated with clinically significant depressive symptoms and psychological distress. Older adults and persons with disabilities were found at higher risk of severe forms of COVID-19 (27, 28). The increased risk of infection of HCWs and the consequent risk of infecting their family members, coupled with the difficulty of adopting strategies such as physical distancing or isolation in situations where HCWs were also caregivers or supporters in family life, could explain the increased levels of psychological distress. Furthermore, being a caregiver or a supporter has been found to increase the risk of developing depression due to the constant demands caregivers need to face while providing care (29). This is even more the case during a pandemic when HCWs have to deal with additional demands not only at home but also at work. Fear of getting COVID-19, fear of infecting the loved ones, and having a loved one infected with COVID-19 were associated with clinically significant psychological distress but not depression. On the contrary, having a loved one pass away due to COVID-19 was associated with clinically significant depressive symptoms but not psychological distress. A relationship between the loss of a loved one and depression has been shown in several studies (30, 31). The COVID-19 pandemic has complicated such relationship by disrupting the usual experiences of grief. This situation led to increased levels of depression in people grieving loved ones passed due to COVID-19, including HCWs (32–34). Given that HCWs are also at higher risk of getting the infection and thus transmitting it, in many situations, they may have felt responsible for causing the death of their loved ones or experienced survivors guilt and this, in turn, may have led to depression (35). In contrast with the other variables examined, having loved ones able to support when needed was a powerful protective factor against depression and psychological distress among HCWs.

Almost all the workplace-level aspects we analyzed appear to be associated both with clinically significant depressive symptoms and psychological distress. Low trust in the workplace capacity to manage COVID-19 and having a reliable network of supportive colleagues at work were the factors with the strongest association. This is not a surprise considering that the financial cuts to the national health system left Italian health services with limited resources and personnel (8), and thus in a difficult position to face the pandemic effectively. This could also explain why the assignment to a new team and functions was associated with depressive symptoms in Italy but not, for instance, in a country such as Spain that, although close to Italy in terms of organization of services, did not experience the same lack of resources and personnel (36–38). When health services are understaffed, as in Italy, the changes of teams and functions are more frequent and stressful, and having a network of supportive colleagues at work becomes more critical to protect mental wellbeing (39). Interestingly, in contrast with previous research (40), our study found that working long hours was associated with psychological distress but not with depressive symptoms.

Another point worth mentioning is that our depressive symptoms and psychological distress estimates were lower than those of similar Italian and international studies conducted during the pandemic. We found that 7.55% of HCWs showed symptoms of clinically significant depressive symptoms and 37.89% of clinically significant psychological distress while other surveys carried out in Italy among health professionals reported estimates of depression in the whole sample ranging from 13.2% to 62% (41–44). A survey conducted within the framework of the COVID-19 HEROES initiative in Spain, a country close to Italy in terms of geography, culture, and organization of services, found that 27% of the HCWs interviewed screened positive at the PHQ-9 and 74% at the GHQ-12 (36). The lower estimates in our study can be explained by the fact that we collected data during the re-opening phase after lockdown, when the number of COVID-19 cases and thus the workload of HCWs were decreasing, while in Spain and the other studies cited data were collected during the first wave (36, 41, 42) or at the beginning of the second wave (43, 44). Furthermore, we decided to adopt a very high cut-off both for the PHQ-9 (scores $\geq$ 15) and the GHQ-12 (scores $\geq$ 4 using the bimodal scoring method), while for instance, the Spanish group adopted lower cut-offs (PHQ-9 $>$ 9 and GHQ-12 $>$ 2) (36). Even when applying the same cut-offs adopted in Spain, we still found lower, although closer, estimates (22.3% of the HCWs screening positive at the PHQ-9 and 45.74% at the GHQ-12). Scores of 15 or greater on the PHQ-9 have high specificity, though low sensitivity, for major depressive disorder (sensitivity: 0.56, specificity: 0.96, PPV: 51%) (21, 45). Similarly, scores $\geq$ 4 at the GHQ-12 using the bimodal scoring method indicate the likely presence of clinically significant psychological distress (24). Since we aimed to examine the association between individual and workplace-level factors

and HCWs' mental wellbeing, we decided to adopt higher cut-offs to increase specificity and positive predictive value at the expense of sensitivity. Nevertheless, the prevalence of clinically significant psychological distress or depressive symptoms among the HCWs in our study is much higher than the prevalence of anxiety and depression found with less conservative cut-off scores in the general Italian population (46, 47) and in previous studies among Italian HCWs (48) before the pandemic.

Our study presents several strengths: the focus on the "reopening phase" after a strict lockdown, a phase of the pandemic overlooked in previous studies, the analysis of factors such as stigma and discrimination against HCWs previously thought peripheral in the Italian context, the inclusion of health professionals usually neglected in studies regarding the pandemic, such as non-clinical HCWs and HCWs employed outside the hospital system, the inclusion of HCWs from Italian areas differently affected by the pandemic (North, Center, and South), and the large sample size. However, our study is not without limitations. We used a non-probabilistic sampling approach, which may have hindered our findings' validity (49) and carries the risk of selection bias. The study's design was cross- sectional, and thus we cannot exclude reverse causation. In addition, we used self-report instruments and *ad-hoc* instruments that could introduce a bias in comparison with interview-based measures. However, we could not adopt a different methodology due to the COVID-19 restrictions at the time of data collection.

This study expands the literature on the psychological impact of the COVID-19 pandemic on healthcare workers. It shows that numerous individual and workplace-level factors were associated with clinically significant depressive symptoms and psychological distress among healthcare workers during the reopening phase after a strict lockdown. Our findings provide valuable information for policymakers, health service providers, and mental health professionals on the individual and workplace-level factors to target when developing and implementing interventions and preventive actions for future emergencies crises. In particular, the results of our study emphasize the need to address discrimination and violence against HCWs and improve healthcare work environments by eliminating or reducing risk conditions, enhancing social support by peers, and building trust in the healthcare institutions capacity to manage crisis situations in the future.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of restrictions in the Ethical Committee approval. Data can be obtained by MFM and MGC upon reasonable request. Requests to access the datasets should be directed to mfmoro@gmail.com.

ETHICS STATEMENT

The study was approved by the Ethics Committee of the Azienda Mista Ospedaliero-Universitaria of Cagliari, Italy. The research was conducted in compliance with the provisions that protect privacy in Europe (Articles 6 and 9 of EU Regulation No. 679). Informed consent was considered given when the health worker agreed to participate.

AUTHOR CONTRIBUTIONS

MM, ES, FM, and RA coordinated the international COVID-19 HEROES study. MM and MC coordinated the study in Italy and obtained funding. MM and MC conducted the analysis with input from ES and AR. MM drafted the paper and with input from MC, ES, FM, AR, RA, GC, RP, VD, AP, PK, FR, GL, EP, AP, FC, AU, and VR finalized the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

The COVID-19 HEROES study in Italy was funded by the Italian Ministry of Education, Universities and Research (Bando FISR 2020IP_05308) and Fondazione di Sardegna (Bando 2020).

ACKNOWLEDGMENTS

The authors thank all healthcare workers who participated in the study for their time and collaboration. The authors also acknowledge the following organizations and persons: Italian National Federation of Medical Boards, Provincial Medical Boards of Turin and Sassari, Società italiana di pedagogia medica (SIPEM), Società italiana interdisciplinare delle cure primarie (SIICP), Segretariato italiano Giovani Medici (SIGM), Sindacato Medici Italiani (SMI), Irene Bruschi, Alice Serafini, Pier Riccardo Rossi, Movimento Giotto, Ordine interprovinciale TSRM-PSTRP di Cagliari/Oristano, Federazione nazionale Ordini dei Tecnici sanitari di radiologia medica, delle professioni sanitarie tecniche, della riabilitazione e della prevenzione, and Roberta Famulari for their cooperation in the recruitment.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.867080/full#supplementary-material

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frontiers | Frontiers in Public Health

ORIGINAL RESEARCH
published: 01 June 2022
doi: 10.3389/fpubh.2022.882576

Development of an Online-Coaching Blended Couple-Oriented Intervention for Preventing Depression in Middle Adulthood: An Intervention Mapping Study

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Background: Although middle-aged adults in Korea are vulnerable to depression, there are few preventive interventions for depression in middle adulthood. Studies consistently suggest that interventions that include both spouses are effective in decreasing depression and relationship distress. Considering the busy lives of middle-aged couples, it is essential to develop an online-coaching blended couple-oriented intervention. This study aimed to describe the development, implementation, and evaluation of an online-coaching blended couple-oriented intervention using an online program and coaching *via* videoconference to prevent middle-aged couples' depression; this was done using an intervention mapping (IM) protocol.

Methods: Six steps of IM were used to systematically develop a tailored multi-level intervention specific to middle-aged couples' depression. These steps of the IM protocol involve needs assessment, formulation of change objectives, theory-based methods, and practical strategies for program design, program development, program implementation, and program evaluation.

Results: The results of the six steps were as follows: (a) middle-aged couples' needs and mental health problems were identified through a scoping review study, mixed-method study, and expert interviews; (b) six performance objectives (POs) were formulated based on the results of Step 1, and intrapersonal, interpersonal, and temporal/transpersonal determinants were identified based on the self-transcendence theory. Change objectives were developed by combining POs with determinants; (c) self-regulated learning was chosen for theoretical teaching methods and practical strategies to change the determinants of each level; (d) four modules consisting of 16 sessions were developed based on the self-transcendence theory; (e) experts evaluated the program and coaches were trained; and (f) the evaluation plan for the program's feasibility, acceptability, usability, and preliminary effects was developed.

Discussion: The systematic process using IM allowed us to develop an online-coaching blended couple-oriented intervention to prevent depression and promote couples'

OPEN ACCESS

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

Received: *24 February 2022*
Accepted: *27 April 2022*
Published: *01 June 2022*

Citation:
Kim S-S, Gil M and Kim D (2022) Development of an Online-Coaching Blended Couple-Oriented Intervention for Preventing Depression in Middle Adulthood: An Intervention Mapping Study. Front. Public Health 10:882576. doi: 10.3389/fpubh.2022.882576

relationships. The primary effects of this newly developed program should be evaluated in future studies. This may lead to the increased adoption and implementation of evidence-based and tailored interventions for psychological wellbeing in middle adulthood.

Keywords: intervention mapping, program development, online intervention, couples therapy, primary prevention, depression, middle aged adult

INTRODUCTION

Depression is a common mental disorder that contributes to the overall global disease burden (1, 2). There is growing concern about the increasing prevalence of depression among middle-aged Koreans (3). The prevalence of depression in middle-aged adults has gradually increased from ∼220,000 people in 2016 to 250,000 people in 2020 (4).

Many studies have identified the risk factors for middle-aged depression, including retirement, economic insecurity, changes in family structure, empty-nest syndrome, declining health, hormonal changes, sexual dysfunction, loneliness, and loss of social capital (5, 6). Previous research suggests that chronic exposure to risk factors makes middle-aged adults more vulnerable to depression (6). Because middle-aged adults in Korea often remain undetected and untreated despite their vulnerability to depression (3), it is important that preventive interventions for depression are tailored for a particular target group.

Couple-oriented interventions, targeting couple relationships, involved both spouses of committed relationships in conjoint sessions (7). Compared with individual-oriented interventions for depression focusing on individual cognitive and behavioral changes, couple-oriented interventions appeared more effective in improving depressive symptoms and enhancing couple relationships regardless of the degree of distress (7).

Common couple-oriented interventions for depression include traditional behavioral couple therapy (8), cognitive-behavioral couple therapy (9, 10), and emotionally focused couple therapy (11). However, recent research has emphasized that the integration of cognitive-behavioral couple therapy with communication, problem-solving training, and emotional acceptance is more effective in reducing depression and improving couple relationships (12, 13). Moreover, the development of integrated couple-oriented interventions is required to reflect the mental health needs of vulnerable populations across life stages, particularly in middle adulthood.

Furthermore, to increase the reach of couple-oriented interventions, researchers have developed blended interventions that combine both online self-help approaches, such as digital video lessons and practical materials, and online coaching approaches, such as phone calls and videoconferences with psychologists (12, 13). Blended interventions can reach more couples than traditional therapy due to reduced financial costs, time, and geographic restrictions (13, 14). Considering the busy lives of middle-aged couples and the COVID-19 pandemic era (15, 16), it is vital to develop a blended couple-oriented intervention adapted to an online self-help program with coach support to prevent depression and promote couple relationships.

This study describes the development of an online-coaching blended couple-oriented intervention using an online program and coaching for middle-aged couples' depression by applying intervention mapping (IM). The systematic planning protocol of IM has been widely used by many researchers to develop mental health programs (17), such as art therapy programs for patients with personality disorders (18), media smoking prevention programs for female high school students (19), and mental health education programs for pharmacy staff (20). However, to date, there have been few interventions applying the IM protocol to develop tailored interventions for middle-aged couples' depression. Therefore, the purpose of this study was to describe the development, implementation, and evaluation of an online-coaching blended couple-oriented intervention using an online program and coaching to prevent depression in middle-aged couples.

METHODS

Intervention mapping provides guidelines for systematically developing, implementing, and evaluating new programs based on a foundation of theory, empirical evidence, and the needs of the target population (16). The process of program planning of IM includes six steps: (a) identifying needs or health problems by conducting needs assessment; (b) creating a matrix of change objectives by combining performance objectives with determinants; (c) choosing theoretical methods and translating these into practical strategies or applications; (d) generating a program including scope and sequence of the components of the intervention and preparing program materials and protocols; (e) planning the adoption and implementation of the program; and (f) planning the evaluation of the newly developed program and its implementation.

This study focuses mainly on the results of steps 1–4 regarding the development of a new online-coaching blended couple-oriented intervention using an online program and coaching *via* videoconference, called the *MindGuide Couple* program. This study was approved by the Institutional Review Board of Ewha Womans University.

RESULTS

Step 1. Needs Assessment

To identify middle-aged couples' needs regarding the prevention of depression and promotion of psychological wellbeing, we conducted a needs assessment by integrating a scoping review, mixed-method study, and expert interviews.

Scoping Review

We systematically reviewed the characteristics, content, theory, and outcomes of couple-oriented interventions for both mental health promotion and the primary prevention of mental disorders. The protocol for this scoping review has been previously published (21). The results of the scoping review showed that couple-oriented interventions were classified as cognitive-focused (e.g., cognitive existential couple therapy), behavior-focused (e.g., integrative behavioral couple therapy), emotional-focused (e.g., emotionally focused couple therapy), communication-focused (e.g., couple-based supportive communication), and relationship-focused (e.g., couple and relationship education). These interventions targeted cancer patients and their spouses, couples with a specific problem (e.g., chronic pain, HIV, alcohol problems, relationship distress, and low income), and couples over the age of 18 years. However, interventions targeting specific age groups (e.g., young, middle-aged, and older couples) have not been found. Considering the high risk of middle-aged depression in South Korea, couple-oriented interventions to prevent depression in middle adulthood need to be developed.

Moreover, most interventions were conducted in the U.S.A. and delivered face-to-face. These findings indicate that there is a need to develop culturally tailored interventions for Asians and transition from face-to-face to online or blended interventions, considering the COVID-19 pandemic.

Need Assessment of Middle-Aged Couples

To determine and prioritize educational needs to promote middle-aged couples' psychological wellbeing, an exploratory sequential mixed-method study was conducted.

First, a qualitative study was conducted through couple interviews with 14 middle-aged couples who were recruited using the snowball sampling method. Open-ended questions regarding the experience of psychological wellbeing were asked, such as "What psychological wellbeing do you experience in middle adulthood?" and "Could you describe what is needed to improve your or your spouse's psychological wellbeing?" Three major themes were identified: (a) confronting vulnerability to mental health problems; (b) navigating life's journey together; and (c) progressing toward self-transcendence. Middle-aged couples were aware of the importance of mental health in middle adulthood while experiencing a midlife crisis as they aged. They overcame the midlife crisis by forming a We-ness in which couples have a depth of connection and support each other. Moreover, they moved toward self-transcendence based on the expansion of relationships with the self, others, environments, and a higher being.

Second, a self-administered questionnaire was developed based on the qualitative results and a literature review. The questionnaire included six competencies of psychological wellbeing: mental health, emotional regulation, spirituality, couple communication, and couple relationships, as well as barriers and facilitators of the couple-oriented intervention. Overall, 234 middle-aged adults were recruited *via* advertisements on several social media platforms. The inclusion criteria were as follows: (a) 40–65 years of age; and (b) individuals in a committed relationship. The Borich Needs Assessment Model compared differences between participants' perceptions of the importance of competencies regarding psychological wellbeing and their ability to perform these competencies. The priority needs found as follows: (a) couple communication issues (i.e., continuous communication, speaking, and listening); (b) mental health issues (i.e., stress, depression, anxiety, and suicide); (c) emotional issues (recognizing accepting and expressing emotions); (d) couple relationship issues (i.e., conflict, understanding the spouse, and leisure with the spouse); (f) change in middle age issues (i.e., role change, physical and psychological change); and (e) spirituality issues (i.e., meaning in life, altruistic life, and self-integration). In addition, 80.3% of the participants answered that couple-oriented intervention was necessary, but 91.9% did not participate because they were too busy and did not have enough time in their schedule.

Finally, the integrated results of the qualitative and quantitative study indicated that middle-aged couples could progress toward self-transcendence by expanding multidimensional boundaries in order to overcome vulnerabilities to depression. In addition, couple-oriented interventions for preventing depression should teach effective communication skills to help participants express emotions and thoughts to their spouses, which leads to the formation of We-ness in couples and promotes psychological wellbeing. The detailed results of this study have been previously reported in Korea (22).

Expert Interview

The expert interview was conducted with eight marriage and family therapists, including a psychiatrist, two psychiatric mental health nurses, and five psychologists. They had worked as marriage and family therapists for 8–30 years. Weekly counseling sessions have been reported to range between 1 and 20. Semi-structured interview questions included (a) reasons to start couple therapy; (b) benefits of couple therapy; (c) preferred techniques; and (d) the roles of couple therapists. They engaged in interviews at their workplace or over the phone for a duration of 45–73 min. The qualitative text analysis software MAXQDA was used to code and analyze the data using content analysis.

First, most therapists stated that couples received couple therapy for relationship distress. Couples with distress believe that relationship problems are caused by personal differences. However, therapists noted that weak management of couple conflict might lead to relationship problems, as well as poor mental health issues, such as depression.

Second, therapists said that couple therapy focuses on strengthening couples' relationships by equipping them with communication and problem-solving skills. Couple therapy helped couples to understand each other better and improve attachment and bonding with the spouse, which built more resilient relationships. Relational resilience can play a protective role in promoting mental health.

Third, the experts reported that integrative techniques from different therapies were used depending on clients' needs or

problems since integrative techniques provide flexibility in couple therapy and offer the opportunity to improve the efficacy of therapy. They used a family tree, imago conversation, healing inner child, mindfulness, cognitive restructuring, role-playing, and a gratitude diary. Moreover, they highlighted the importance of combining individual and conjoint sessions with one therapist in all sessions. As marriage problems are prone to be interactive, for one spouse to make a change for the better, both spouses need to work together.

Fourth, therapists emphasized that building a solid therapeutic alliance with a couple is a critical component of successful couple therapy. They also said that the primary role of a couple therapist is as a facilitator who helps couples strengthen relationships by understanding the spouse better and focusing on the strengths of a couple. They helped a couple enhance the emotional bond between spouses by caring about each other and navigating and resolving conflicts effectively.

Integrated Results

Based on the integrated findings from the scoping review, mixed-method study, and expert interviews, the research team discussed and identified the target population, purpose of the intervention, delivery method, and techniques. First, we found that it is necessary to develop a couple-oriented intervention targeting middle-aged couples' depression because they are at a higher risk of depression (3, 4), and their negative relationship influences depression. Second, the integrated results suggest that increased self-transcendence might promote psychological wellbeing and prevent depression. Hence, the goal of the intervention is to expand self-boundaries multidimensionally, according to the self-transcendence theory (23). Third, considering the busy lives of middle-aged couples, an online-coaching blended couple-oriented interventions using an online program and coaching should be developed to meet their needs. Finally, the findings highlight that integrating techniques in line with Korean culture increased the effectiveness of couple-oriented interventions for depression in couple relationships.

Step 2. Formulation of Change Objectives

Performance objectives (POs) were formulated to develop a new tailored intervention for preventing mental disorders, such as depression, and enhancing couple satisfaction for middle-aged couples based on the integrated results of step 1. POs are more specific than the traditional goal of a program because their statements include those who need to change and what needs to be changed (17).

A matrix of change objectives (COs) was developed by combining POs with determinants (**Table 1**). We selected intrapersonal, interpersonal, and temporal/transpersonal determinants derived from the self-transcendence theory (23). To prevent depression and enhance couple satisfaction for middle-aged couples by expanding boundaries, the intervention should increase knowledge, attitudes, and skills at an intrapersonal level, as well as relationship functioning at an interpersonal level and shared outcomes at a temporal/transpersonal level. Finally, we identified 32 COs that indicated the intervention.

Step 3. Theory-Based Method and Practical Strategies for Program Design

Based on the results from steps 1 and 2, we developed an online-coaching blended couple-oriented intervention. We selected self-regulated learning (SRL) based on social cognitive theory for theoretical teaching methods and practical strategies to change the determinants of each level because it is widely used in blended programs (24, 25).

We developed a blended intervention that incorporated both online programs and coaching *via* videoconference. An online-coaching blended couple-oriented intervention provides opportunities to apply effective methods in an innovative manner. It also allows couples to manage and control their learning activities at their pace and receive real-time mental health care as per their convenience and time. In this blended intervention, we used methods of organization, rehearsal, elaboration, record keeping, and monitoring to improve knowledge, attitude, and skills at the intrapersonal level. In addition, reflective dialogue and performance feedback were applied to increase relationship functioning and shared outcomes at interpersonal and temporal/transpersonal levels, respectively.

These methods have been translated into practical strategies. The organization method was utilized to structure video lectures, such as learning objectives, case studies, and summaries of the main points. For rehearsal, we provided audio and video materials on mobile and web-based platforms to watch the videos repeatedly. We applied the method of elaboration to connect new things and prior knowledge by answering guided questions such as, "Describe your own situation relevant to the learning contents."

Record keeping and monitoring were used to monitor their thinking and behavior to modify their behaviors. We encouraged couples to apply what they had learned in their lives and to write about their thoughts, emotions, and experiences on the mobile and web-based platforms. In conjoint sessions, we encouraged couples to share their writing with their spouses and complete tasks together.

For reflective dialogue and performance feedback, the coach started the sessions with quick reminders of the objectives and activities of the sessions to reflect on what they learned, and which of the activities helped them. In addition, the coach provided tailored feedback by analyzing their written responses to tasks.

Step 4. Program Development

The self-transcendence theory was selected as the theoretical framework to develop the *MindGuide Couple* program (**Figure 1**), which was designed to expand one's personal boundaries multidimensionally (i.e., at the intrapersonal, interpersonal, temporal, and transpersonal levels) to achieve POs.

For the enlargement of intrapersonal boundaries, Modules 1 and 2 were composed of new positive coping mechanisms, such as mindfulness (26) and gratitude journaling (27), to strengthen inner resources and a holistic understanding of their thoughts, emotions, and inner child to increase self-awareness. To extend the interpersonal boundaries, Module 3 focused on building a

TABLE 1 | Matrix of change objectives for *MindGuide Couple* Program.

Performance objectives	Intrapersonal determinants			Interpersonal determinants	Temporal/ transpersonal determinants
	Knowledge	**Attitude**	**Skill**	**Relationship functioning**	**Shared outcome**
PO1. Understanding mental health issues in middle adulthood	K1a. Understanding vulnerability to depression in middle adulthood K1b. Describing depressive symptoms K1c. Learning about the key suicide signs and warnings	A1a. Having positive attitude toward program A1b. Having empathy for people with depression or mental disorder	S1a. Performing a screening for depression	R1a. Recognizing depression in spouse	
PO2. Trying coping strategies for preventing depression	K2a. Knowing about healthy coping techniques	A2a. Getting motivated through the perceived benefits of healthy coping techniques	S2a. Developing healthy coping techniques		
PO3. Becoming more self-aware	K3a. Being aware of emotion, thought, and behavior	A3a. Cultivating a positive perspective in life through reflecting on the past	S3a. Managing the emotion, thought, and behavior effectively	R3a. Recognizing you and your partner's differences	
PO4. Building a healthy communication in couple relationships	K4a. Understanding positive and negative communication style	A4a. Communicating respectfully with your spouse	S4a. Sharing your needs and feelings in a respectful way	R4a. Understanding more deeply your spouse R4b. Becoming aware of your own communication style as well as your partner's communication style. R4c. Building empathy and improving communication skill	SO4a. Working together to resolve relationship conflicts SO4b. Respecting the needs of both partners
PO5. Making the therapeutic alliance in couple				R5a. Helping your spouse heal their emotional wounds R5b. Showing respect to your partner R5c. Providing emotional support R5d. Remembering you love each other	SO5a. Facilitating healing in a transpersonal connection SO5b. Supporting each other to grow together
PO6. Rebuilding life's meaning	K6a. Understanding your personal values and life meaning	A6a. Being strong and moving forward with a positive attitude		R6a. Making blueprint together as a couple	SO6a. Understanding both spouses' values and their role in life SO6b. Creating together joint values SO6c. Sharing love with others

healthy relationship with the spouse by training effective couples' communication skills and committing to practicing the spouse's love languages. Module 4 was designed to expand boundaries at the temporal and transpersonal levels by integrating the past, present, and future and to connect with a higher being.

Modules 1 and 2 were designed as individual sessions, in which each spouse worked separately. Modules 3 and 4 were planned as conjoint sessions, wherein couples completed structured interaction tasks. The four modules consisted of 16 sessions that provided integrative techniques from different therapies to accomplish POs (**Table 2**). Each session took about 20–30 min to complete, depending on the individual learning abilities. Videoconference calls with a professional coach were planned to support couples at the end of each module. Coaches helped couples apply program content, reinforce relationships, and improve communication for 1 h.

The *MindGuide Couple* program was developed through collaboration with interdisciplinary teams of one researcher, two psychiatric mental health nurse practitioners, one marriage and family therapist, one web designer, and two technical

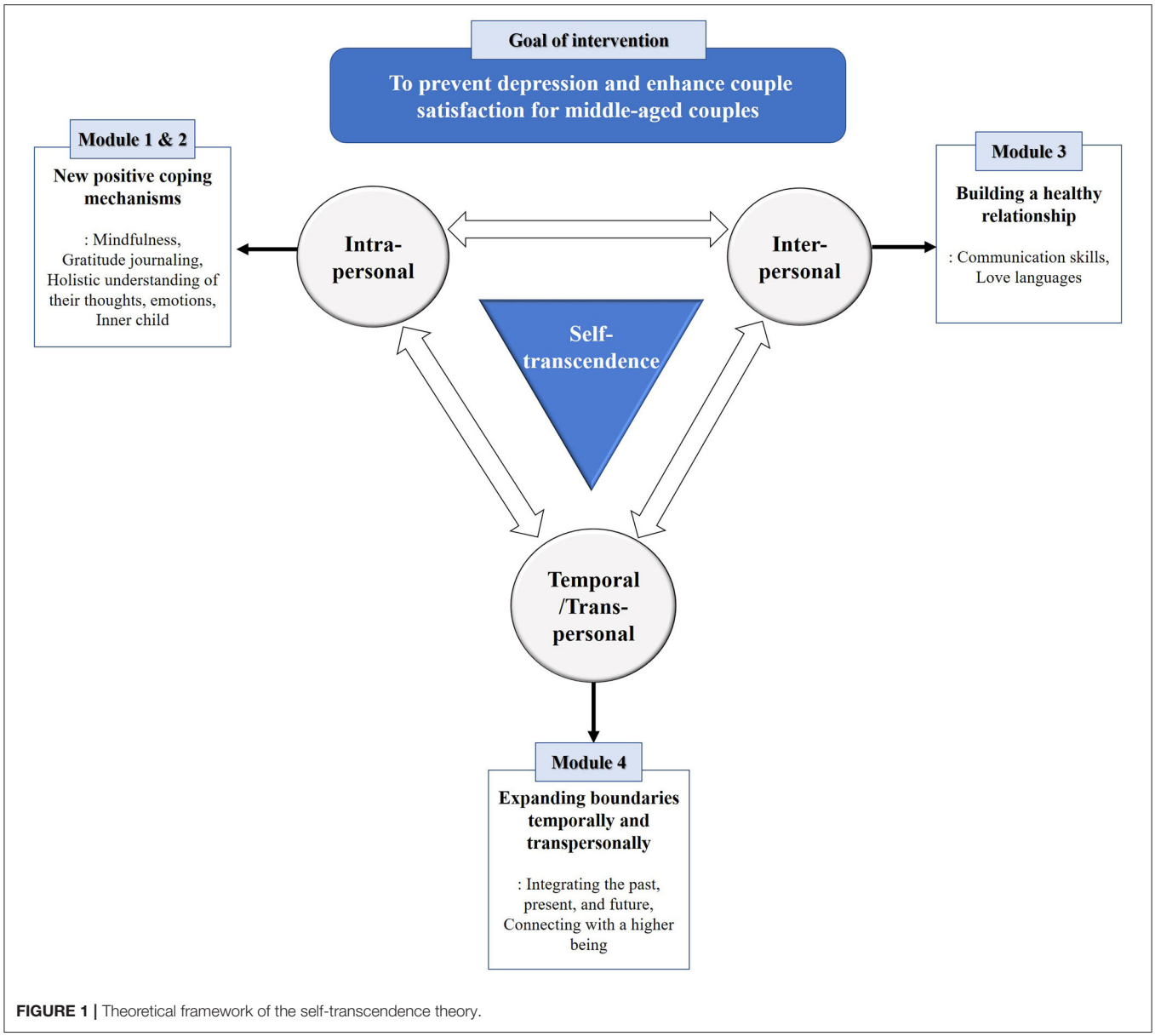


FIGURE 1 | Theoretical framework of the self-transcendence theory.

programmers. It was delivered online *via* mobile and web-based platforms and was divided into two pages: a user service page and an administrator dashboard. The user service pages contained (a) the *MindGuide Couple* program; (b) a gratitude journal; (c) mindfulness; (d) emotion cards, and (e) a discussion board. On the page of the *MindGuide Couple* program, participants engaged in the program and viewed their spouses' progress. In gratitude journal pages, participants wrote about one thing they were grateful for in a day. This journal was intended to help participants focus on emotional experiences. Participants could choose whether to disclose their journals to their spouses. Those desiring privacy could restrict access to the journals themselves. The administrator dashboard provides convenient management tools for the research team to organize and manage the web usage data. The *MindGuide Couple* program was developed and provided *via* mobile and web-based platforms (**Figure 2**).

Content Validation

Two couple and family therapists (CFTs), and three psychiatric mental-health nurse practitioners (PMHNPs) with practical experience in couple counseling and therapy evaluated the content validity of the program. The panel group was different from the experts in step 1. The content validity index (CVI) of a program is defined as the extent to which program components are relevant to the program goal and effectiveness in a target population (28). We developed 10 items of the assessment instrument for the CVI based on previous studies regarding the blended learning approach, program components and sequence, techniques, session length and frequency, and program outcomes

TABLE 2 | The contents of the *MindGuide Couple* program.

				Blended contents		
Theme of module	**PO**	**CO**	**Session**	**Online lectures**	**Tasks**	**Coaching**
Intrapersonal	PO1 PO2 PO3	A1a	1	Introduction to the program		Making couples set their goals Focusing on the present and future Helping couples perceive where they currently stand in their life
		K2a, A2a, S2a	2	Learn the mindfulness and gratitude journal	Mindfulness Writing a gratitude journal	
		K1a, K1b, K1c, A1b, R1a	3	Learn how to prevent depression and suicide	Mindfulness Depression screening test Writing a gratitude journal	
		A3a	4	Life map	Mindfulness Making a life map	
Intrapersonal	PO2 PO3 PO4	K2a, A4a	5	Discovering my true self	Mindfulness	Motivating couples with the required encouragement and support Helping couples understand how their minds operate differently Encouraging couples to be more self-aware Supporting to become a better person for their spouse Trying to ensure the couple's progress
		K3a, S3a	6	Exploring my inner self	Mindfulness Emotional focusing To find thinking-feeling connection	
		K3a, A2a, S2a, S3a	7	Inner child	Mindfulness Discovering my inner child Healing dialog	
Interpersonal	PO4 PO5	K4a, K4b, K4c	8	Communication style	Mindfulness Communication style test Understanding the characteristics of different communication style	Accepting yourself and your spouse's personality and characteristics differences Addressing communication problems between a couple Emphasizing self-responsibility rather than blaming the spouse Supporting during couples' communication Identifying a better way for couple relationship Helping the couple understand each other better Making couples act towards what they want for a better relationship Focusing on motivating couples toward a positive transition Restoring the couple relationship back to a balanced one
		K4a, K4b, K4c, A4a	9	Discover negative patterns of communication	Mindfulness Writing about negative patterns of communication each other	
		A4a, S4a, R4a	10	Identifying a conflict	Mindfulness Writing a conflict situation between a couple	
		A4a, S4a, R4a, R4b, SO4a	11	Exercises communication skills (1)	Mindfulness Exercises to develop communication skills (2)	
		K5a, A5b, S5a, R5a, SO4a	12	Exercises communication skills (2)	Mindfulness Exercises to develop communication skills (2)	
		K5a, A5a A5b, SO5a	13	Discovering your love language	5 love languages test Practical ways to speak the spouse's love language	

(Continued)

TABLE 2 | Continued

Theme of module	PO	CO	Session	Blended contents		
				Online lectures	Tasks	Coaching
Interpersonal [Temporal and transpersonal	PO6	K6a, A6a, R6a	14	To find values	Mindfulness How to find values How to find meaning of life	Communicating in a way that leads to deep understanding and shared meaning Helping couples obtain relational oneness Focusing on planning the couple's future
		A6a, S6a, R6a, S6a, SO6b	15	Building a healthy relationship	Mindfulness Creating a balanced relationship Creating vision for couple	Encouraging couples walk together toward their Creator-given dreams and desires
		R6a, SO6a, SO6b	16	Finding happiness as a couple	Mindfulness The blessing of love Writing love letter to spouse The pledge of love	

(i.e., mental health and couple relationship) (28, 29). Five experts evaluated the CVI using a four-point Likert Scale ranging from 1 (not valid at all) to 4 (very valid). The CVI result was 1.0, indicating that the program had acceptable CVI values (30). Each member of the panel took an overall look at the program individually and independently, evaluated the content validation, and provided feedback. Moreover, the panel group held a videoconference meeting to generate a consensus between different opinions.

Coaching Training

Three coaches, one couple, a family therapist, and two mental health nurses, were trained in the coaching sessions. They hold either a doctoral or master's degree and have experience as couples and family therapists. Coaches received training on a series of couple therapies and experienced the program once per week for 2 months. The coaching protocol provided the program information and outlined the structure of the coaching process using a semi-structured script. Coaches received regular coaching supervision from the first author.

Steps 5 and 6. Designing a Program Implementation and Evaluation Plan

The intervention implementation plan focused on the inclusion criteria for the participants and a plan for recruitment. The inclusion criteria for participation in the intervention will be as follows: (a) heterosexually married; (b) between the ages of 40 and 65 years; and (c) agreement to participate in the program. The exclusion criteria will be as follows: (a) having a spouse who was diagnosed with depression or other mental diseases; and (b) currently attending couple therapy and counseling and receiving drug treatment. When people are enrolled *via* the website, the research assistant will contact them for eligibility screening.

Participants will be recruited through advertisements, including study information on the *MindGuide Couple* website and several online communities, churches, and organizations (e.g., mental health and welfare centers, family support and treatment centers, and volunteer centers).

The effectiveness of the developed intervention will be evaluated in two stages. In the first stage, a feasibility study will aim to evaluate the feasibility, acceptability, usability, and preliminary efficacy of the intervention. In the second stage, we will apply the intervention to at-risk middle-aged couples and evaluate the effectiveness of the intervention on depressive symptoms and couple relationships. The preliminary effects of the program will be examined with primary outcomes, including the Center for Epidemiological Studies Depression Scale (31), Patient Health Questionnaire-9 (32), Generalized Anxiety Disorder 7-item (33), and Positive and Negative Affect Schedule (34). Secondary outcomes using the Couple Satisfaction Index 16-item (35), Family Relationship Assessment Scale (36), and the Satisfaction with Life Scale (37) will be evaluated before the program, immediately after program completion, and 2 months following the program.



FIGURE 2 | Screenshots of the *MindGuide Couple* program.

DISCUSSION

We described the development, implementation, and evaluation of an online-coaching blended couple-oriented intervention using an online program and coaching, called the *MindGuide Couple* program using IM. The IM approach appears useful in developing this tailored intervention that is specific to middle-aged couples' mental health. As aging enhances emotional sensitivity to stress, middle-aged adults are vulnerable to depression (3, 38). Furthermore, depression in mid-life increases the risk of dementia in late-life (39). Thus, preventing mid-life depressive symptoms is essential for improving the quality of life in older adults. In particular, because relationship distress in couples is associated with a higher risk of depression (8), couple-oriented interventions may provide the opportunity for middle-aged couples to prevent depression and promote couple relationships as well.

The *MindGuide Couple* program was developed by conducting a scoping review, a quantitative Borich's Needs Assessment of middle-aged couples, and an Integrative Needs Assessment process, including qualitative couple interviews with regard to couple-oriented intervention and expert interviews. Fernandez et al. (40) highlighted the need for the identification of multiple target adopters and implementers to develop a multi-level intervention. Consistent with this suggestion, we used couple interviews (41, 42) to collect data at both the individual and couple level. In addition, interpretative phenomenological analysis (42) was used to assess both the individuals' and couples' needs by exploring not only personal experiences but also shared couples' experiences of psychological problems in the context of interdependent relationships.

Another strength of this program is that it is structured around the self-transcendence theory, which is suitable for promoting middle-aged couples' psychological wellbeing (43, 44). The program helps participants gradually expand self-boundaries in multidimensional ways, according to the program modules. For example, in Modules 1 and 2 of the program, participants learned intrapersonal skills, such as self-awareness, mindfulness, and gratitude journaling. To expand interpersonal boundaries by building a healthy relationship with the spouse, Module 3 provides opportunities for understanding their spouse's emotions and needs, accepting the spouse's inner child, and helping the spouse heal their inner child. Finally, in Module 4, they develop a couple's mission, vision, and value statements together by integrating them with their past, present, and future.

The distinctive strength of this online-coaching blended program is that it involves both flexible schedule online learning on mobile and web-based platforms, and vis-a-vis coaching using videoconference. Several researchers have suggested that online programs may provide opportunities for couples to overcome mental health stigma, lack of financial resources, and geographic barriers and to increase access to the program (45, 46). In addition, considering the busy lives of middle-aged couples, this online-coaching blended *MindGuide Couple* program allows them to participate in the program from any place when they have time and energy. Moreover, this blended couple-oriented intervention with coaching can enhance and expand couple-oriented interventions to facilitate real-time interaction between a couple and coach (45).

In this study, the program was developed with a target population of middle-aged couples, marriage, and family therapists, and a literature review was conducted. However, further research is needed to evaluate the feasibility, acceptability, and preliminary effects of the *MindGuide Couple* program on mental health (e.g., depression and anxiety) and couple relationships (e.g., couple satisfaction). Another limitation of this study is that the program was developed at both the individual and couple levels; however, family and community levels also need to be considered when developing multi-level interventions.

CONCLUSION

This article provides a detailed description of how we systematically developed an online-coaching blended couple-oriented intervention for preventing depression and promoting couple relationships based on IM. The IM allowed us to develop a tailored multi-level intervention based on the needs of middle-aged couples. This newly developed online-coaching blended couple-oriented intervention may provide opportunities for couples to overcome mental health stigma and enhance real-time interaction between a couple and a coach. The primary

effects of this newly developed program should be evaluated in future studies.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of Ewha Womans University. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

S-SK, MG, and DK: study and manuscript conceptualization. S-SK and MG: contributed to methods, and results. S-SK and DK: contributed to background and results. S-SK: contributed to discussion. All authors contributed to the article and approved the submitted version.

FUNDING

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2019R1H1A2039669, 2019R1A2C1087398, and 2022R1A2C2004867).

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frontiers | Frontiers in Public Health

ORIGINAL RESEARCH
published: 10 June 2022
doi: 10.3389/fpubh.2022.858370

Development and Feasibility of an Online Brief Emotion Regulation Training (BERT) Program for Emerging Adults

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Mental wellness is a critical component of healthy development in emerging adulthood and serves to protect against stress and promote resilience against psychopathology. Emotion regulation is a key mechanism for effective prevention because of its role in socio-emotional competence and its transdiagnostic significance for psychopathology. In this feasibility study, a brief, time and cost-effective emotion regulation training program for emerging adults (BERT) was developed and tested using the RE-AIM framework. Importantly, building interventions within the context of an implementation framework, such as the RE-AIM framework, enhances the chances that an intervention will be able to scale out and scale up. First, the brainwriting premortem method was utilized to refine program content, conducting focus groups a priori to identify potential program failures prior to program implementation. Undergraduate students ($n = 12$) attended four focus groups presenting initial program content. Four clinicians were also interviewed to determine program barriers. Qualitative analyses aggregated participant feedback to identify compliments, changes, and concerns about BERT and critical feedback was immediately implemented prior to initial testing. BERT was rooted in cognitive-behavioral practices and informed by the Gross model of emotion regulation. The 5-week program was then examined in a college sample ($N = 42$) to evaluate implementation (low attrition, high content engagement, favorable attitudes, low incidence of technical errors, costs), reach (enrollment and completion demographics comparable to the population in which recruitment took place), and efficacy (positive change in emotion regulation pre- to post-program). Of the recruited participants, 36 remained in the study where 27 completed at least 80% of program content. Repeated-measures ANOVAs exhibited significant improvements in emotion regulation, psychological distress, and negative affectivity, suggesting promising initial efficacy. Initial data provide support for feasibility and a future randomized control trial. BERT has potential significance for promoting healthy development as its brief electronic format reduced barriers and the program development process incorporated stakeholder feedback at multiple levels to inform better implementation and dissemination.

Keywords: emotion regulation, emerging adults, technology, intervention, implementation science

OPEN ACCESS

Edited by:
Naseem Akhtar Qureshi, Al-Falah University, India

Reviewed by:
Krishan Kumar, Post Graduate Institute of Medical Education and Research (PGIMER), India
Lichao Xiu, Beijing Normal University, China

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

Received: *19 January 2022*
Accepted: *16 May 2022*
Published: *10 June 2022*

Citation:
Gatto AJ, Elliott TJ, Briganti JS, Stamper MJ, Porter ND, Brown AM, Harden SM, Cooper LD and Dunsmore JC (2022) Development and Feasibility of an Online Brief Emotion Regulation Training (BERT) Program for Emerging Adults. Front. Public Health 10:858370. doi: 10.3389/fpubh.2022.858370

INTRODUCTION

Mental wellness is a critical piece of healthy development in emerging adulthood, a time when youth transition from adolescence to adulthood (1, 2). For optimal functioning, emerging adults must utilize appropriate and effective regulatory strategies (3). Healthy emotional functioning is particularly relevant to this population as they take on new roles, solidify identities, and face more responsibility (4–6). This developmental period brings unique stressors and increased independence, making it difficult to translate skills from late adolescence into early adulthood (7, 8). This "perfect storm" is evident in the transition to college, when students often leave home for the first time facing new expectations for their socioemotional and executive functioning furthering inconsistent mental wellbeing (9–11).

Most college students are emerging adults [18-26 years of age] and are likely to experience violence, accidents, and substance use as well as psychological distress based on the collegiate schedule [i.e., multiple exams, course load, financial obligations; (12, 13)]. Without skills to cope with these stressors, emerging adults experience elevated risk for chronic illness, suicide, and addiction (14–16). Emotion regulation (ER), which encompasses responses to emotions and the ability to control emotion processes, is a foundational skill to target as it is critical for healthy development (17). ER deficits are associated with multiple disorders including depression, anxiety, substance-use, personality, eating, and somatoform disorders (18). Building ER skills through brief intervention has the advantage of targeting a common mechanism and resiliency factor underpinning multiple disorders, thereby broadening the range of impact (19, 20).

In emerging adulthood, optimal ER relates to college transitions through social competence, self-control, and academic achievement (21). ER is an excellent treatment target in this population because of the widespread effects of dysregulation, especially when emotional suppression can have negative influences on social functioning (22, 23). Focusing on this underlying transdiagnostic mechanism can help prevent multiple negative outcomes. Though existing interventions are efficacious (e.g., Emotion Regulation Therapy, Dialectical Behavior Therapy, Mindfulness-Based Stress Reduction), they often require significant clinician or instructor training and sustained participant engagement. A community-based prevention program targeting ER may achieve meaningful changes in ER that promote participants' wellbeing while reducing time and cost barriers for both instructors/clinicians and participants.

The Gross (24) model of ER provides a foundation for understanding the pathway of emotion generation and regulation. Gross (24) describes a path to an emotional response in which a situation calls forth attention, leading to appraisal and an eventual response. Along this pathway, there are five regulatory strategies: situation selection (e.g., choosing to engage or avoid), situation modification (e.g., changing a situation), attentional deployment (e.g., shifting attentional resources), cognitive change (e.g., modifying thoughts), and response modulation (e.g., adapting behaviors) (25). These may be implemented at any stage of emotion expression to change an emotional state. Houck et al. (26) extrapolated this model to develop a 12-week (24 session) adolescent ER program that successfully reduced risky sexual behaviors. These promising results support the applicability relevance of the Gross (24) model for emerging adults (26), potentially more than adolescents, as cognition and cognitive control become more critical for regulating emotions in emerging adulthood (27).

Mental health is often divided into mental illness and wellness, though these are better conceptualized as ends of a spectrum than dichotomous categories (3). Considerable research on prevention and intervention promotes wellness in emerging adulthood above the absence of disease (28, 29). As a system, colleges have invested in campus counseling and academic centers to provide individual treatment (30–32). Current investments in university counseling centers and mental health prevention programs remain insufficient as more than 25% of college students in need do not have adequate access mental health services (15).

Developing prevention programs requires careful consideration of program delivery, engagement, and reception by the intended audience (33). Online programs require considerations of scalability and accessibility in addition to program effectiveness, as dropout and other barriers such as self-reliance, awareness of symptoms, inadequate knowledge of psychological resources, and stigma may reduce impact (34–36). The RE-AIM framework was developed as a public health guideline for creating effective treatments that can be scaled out and implemented on a large scale (37, 38). Reach (e.g., recruit large/representative portion of target populations), Efficacy (e.g., intervention impact on behavioral target), Adoption (e.g., which settings and staff initiate/participate in program delivery), Implementation (e.g., fidelity to delivery and costs), and Maintenance (e.g., extending treatments broadly, long term effects) are described as the critical pieces of RE-AIM for developing interventions that can be adopted on a larger scale (37, 39).

Ensuring appropriate Implementation, Reach, and Efficacy requires actively engaging the target population and testing the program for intended and unintended consequences, eliciting feedback at multiple levels. Brief ER programs have yet to be developed for emerging adults; therefore, this study takes careful steps to produce an effective and sustainable practical program. After initial content development, scalability was enhanced by acquiring expert and target population feedback. Incorporating feedback from the onset helps ensure that the program will be adopted and well-received. This framework is consistent with participatory action research, integrating reflection and participant input while seeking to reduce inequity and appropriately engage target populations (40).

Intervention efforts are shifting to brief and electronic formats to combat costs and address growing needs for treatment (41–43). Electronic formats for treatment are increasingly popular for youth raised in a digital world (44). Electronic interventions can often overcome typical barriers to care (e.g., accessibility, cost, stigma) at the cost of a potential loss of connection and accountability that mental health professionals provide (45–47). Furthermore, online treatments simplify the incorporation of

measurement feedback systems [MFS; (48)]. In a community-based program, incorporating a MFS for continuous progress monitoring can help rapidly identify participant experience problems and diagnose program component reception in the moment. Brief online interventions have proven efficacious in college students for alcohol addiction (49–53), depression (54–56), and anxiety (57–60). Research comparing internet-based and face-to-face clinical interventions has shown equivalent overall effects, though acceptance of online interventions varies by clinician (41, 61–63).

The overall goal of this project was to systematically develop an online brief emotion regulation training (BERT) program designed to improve ER for emerging adults. Since BERT is a novel ER intervention delivered entirely online, this study aims to examine BERT's initial feasibility in preparation for a future randomized controlled trial. Additionally, it aimed to conduct preliminary tests of its Implementation, Reach and Efficacy. This study focused on the creation of BERT utilizing the brainwriting premortem method to refine program content to prepare for initial testing. The program was then tested in a college sample to evaluate implementation in delivering program content, reach to the recruited population, and preliminary efficacy through improved ER. This study was approved by the university institutional review board (IRB#20-018).

Intervention Development

To develop program content and design, the first author coordinated a team of data scientists, interaction and user experience designers, psychologists, and public health experts. The design team was mindful of guidelines for online design to meet standards of the 1990 Americans with Disabilities Act to ensure broad accessibility. The following sections outline the design of the BERT program and its four primary components: Emotion Regulation Orientation (ERO), Emotion Regulation Training (ERT), Self-Monitoring (SM), and Ecological Momentary Assessment (EMA) based on the Gross model (24).

Emotion Regulation Orientation

Participants completed an interactive 30-min online ERO at baseline describing the Gross (24) model of ER (see **Supplementary Figure 1**) and mental wellness resources (e.g., academic counseling, psychological support).

Emotion Regulation Training

Following the ERO, participants began the 5-week ERT. Each week, the ERT used short activities to break down a single ER strategy typically taught in one therapy session. Monday provided psychoeducation, Tuesday applied the strategy to daily life, Wednesday aimed to increase knowledge of the strategy, and Thursday's activity enhanced flexible implementation of these strategies (see **Table 1** for ERT exercises).

Self-Monitoring

Participants filled out weekly SM surveys at the start of each ERT week measuring emotional distress, substance use, vitality, exercise, sleep, progress toward goals, and presence/absence of major stressors that could affect functioning. Critical scores triggered delivery of help-seeing resources.

Ecological Momentary Assessment

Additionally, EMAs had participants label their emotions and rate their stress in the moment after ERT exercises, though they could be accessed at any time to track their daily mood. The EMA survey was open daily from 8 a.m. until 10 p.m.

Intervention Dosage

After initial ERO, participants were asked to complete ∼50 min of content in total per week (ERT), in addition to ∼25 min of measurement per week. Altogether, the full treatment dose was ∼6.75 h of intervention.

Preliminary Study

Premortem Focus Groups

Following recommendations for early engagement of program stakeholders (64) pre-implementation focus groups were conducted for *a priori* identification of program failures (65). Brainwriting premortem methods are more advantageous for evaluating a plan's success than pro/con generation, as they specifically address how a program is designed to fail (66). The brainwriting premortem approach provides an opportunity for psychological safety where data are collected in written form. To accomplish virtual brainwriting premortem within the COVID-19 pandemic, undergraduate focus groups were extended to a 1.5-h online session via videoconferencing software and anonymous contributions to a shared Google document. Clinicians attended 45-min individual interviews *via* videoconferencing software with notes taken by a research assistant during the interview.

Participants included 12 undergraduate students from three universities across four focus groups that took place between June and August 2020. The sample was predominantly female [$n = 10$; male ($n = 1$), trans male ($n = 1$)], heterosexual [$n = 8$; bisexual ($n = 2$)], queer ($n = 1$), lesbian ($n = 1$)], and white [$n = 7$; Asian ($n = 2$), American Indian/Alaskan Native/Latinx ($n = 1$), multiracial ($n = 2$)]. All were full-time students and were in their 2nd ($n = 2$), 3rd ($n = 2$), 4th ($n = 7$), or 5+ year ($n = 1$), with 2 transfer students. In addition, four white women clinicians from early- to mid-career were interviewed of whom two had doctorates in clinical psychology (PhD) and two were licensed clinical social workers (LCSW). All had experience working with emerging adults. Undergraduates and clinicians were all compensated with $10 Amazon gift cards for their participation.

The first author led a team of five trained undergraduate coders to identify themes regarding potential barriers. For each theme, changes to the program were identified in accordance with participant feedback, or a pragmatic or theory-based reason was noted for changes that could not be made (see **Table 2**). Themes included various skills (e.g., acceptance, coping), language (e.g., increase clarity, inclusivity), timing (e.g., longer or shorter), and external supports (e.g., discussion boards) among others. Though all specific program elements could not be presented in the focus groups and interviews due to

TABLE 1 | Daily emotion regulation training (ERT) program content is outlined below.

Week	Gross (24) Model (*Content area*)	Psychoeducation *Foundational information provided in the following content areas*	Gross (24) Model Activity *The ER model is provided step by step over the course of 5 weeks, with each week adding different skills in the emotion regulation process. Participants use examples from their current experiences.*	Practice 1 *This is represented in an interactive exercise to practice using the ER model or specific skill.*	Practice 2 *This reinforces or summarizes skills learned earlier in the week or continues practice using the ER model or specific skill.*
1	Situation selection (*Stressor identification and values*)	Stress, decision-making, and values	Identify situation, stressors, physical symptoms, associated values	Identify physical stress in the body, related emotions	Decode provided situation, rate stressors, pick least stressful situation
2	Situation modification (*Problem solving*)	Stressful situations, problem solving, changing situations	Identify situation, stressors, modifications to situation and stressors	Identify possible modifications to short scenarios	Problem solving puzzle: create your own adventure/ change the story
3	Attentional deployment (*mindfulness*)	Mindfulness, shifting attention	Identify situation, stressors, and ways to shift attention from stressors	Stressful situation presented, identify components without stress	"Take 5" grounding exercise (identifying senses)
4	Cognitive change (*CBT skills*)	Cognitive triangle, functional analysis	Identify situation, stressors, antecedents, behaviors, and consequences	Identify thoughts, behaviors, emotions for presented stressful situation, and place on cognitive triangle	Pick out thoughts, behaviors, emotions from provided scenario to interactive cognitive triangle, identify and change antecedents
5	Response modulation (*Healthy regulation* and *coping skills*)	Responding to unmanageable situations	Identify situation, stressors, thoughts, behaviors, emotions, coping strategies	Match list of coping skills to emotional states	Name favorite coping skills, practice present-moment implementation

ERT is specified for each day.

TABLE 2 | Number of changes across undergraduate focus groups and clinician interviews.

	Students			Clinicians		
	Change	**Concern**	**Keep**	**Change**	**Concern**	**Keep**
Now	10	9	0	8	2	1
Later	9	1	0	18	5	0
None	14	19	0	3	5	1
Embedded	22	18	0	13	6	0
Survey	11	25	0	5	7	0
Compliment	0	0	13	0	0	19
Total	66	72	13	47	25	21

Responses are coded as (a) address in survey at the end of BERT (1; survey); (b) change now (now); (c) change in later program iterations (later); (d) already in the program, and where (embedded); or (e) don't change, and why (none).

time limitations, some themes (29% of undergraduate themes, 26% of clinician themes) were already included in the initial program design. All other themes that could be immediately addressed were incorporated in BERT before initiating the pilot study described below. On a follow-up questionnaire, participants rated their likeliness of completing program content as high ($M = 4.00$, $SD = 1.13$, range = 2–5 on a 5-point scale), and likelihood of recommending BERT to others even higher ($M = 4.67$, $SD = 0.65$, range = 3–5 on a 5-point scale).

METHOD

Participants

A priori power analyses were conducted with G Power v3.1.9.2 (67) determining that a sample size of 36 yields power of 0.90 to complete planned repeated measures ANOVAs. As such, a new sample of undergraduate students ($N = 42$) aged 18–23 years ($M = 18.88$; $SD = 1.25$) was recruited in September 2020 to continue evaluating Implementation, Reach, and Efficacy. Participants were predominantly female ($n = 36$), non-Hispanic white ($n = 31$), heterosexual ($n = 38$), and first-year students ($n = 22$; see **Table 3**). Participants were recruited through Introductory Psychology classes using an internal extra credit system, academic classes, diversity offices, student centers, women's centers, and wellness centers to encourage recruitment of participants from diverse backgrounds (e.g., underrepresented racial/ethnic groups, sexual minorities, low income) to better evaluate Reach. Students enrolled in undergraduate coursework who did not receive a ceiling score on the DERS were eligible for participation, which took place entirely online. Participants provided informed consent electronically and were compensated with $10 Amazon gift cards at the end of the study. Recruitment completed in October 2020 when participants who enrolled in the study were engaged in the structured program content from October to December 2020. Program content was delivered synchronously to participants who all started week 1 of the ERT simultaneously.

TABLE 3 | Demographics for initial enrollment compared to the final sample.

Identity	**Initial enrollment**	**Final Sample**
Gender		
Female	36	27
Male	6	3
Sexual orientation		
Heterosexual	38	28
Bisexual	1	0
Gay	1	1
Don't know	1	1
Multiple sexualities	1	0
Race		
American Indian/Alaskan native	1	1
Asian	3	3
Black or African American	2	0
White	31	22
Multiracial	4	3
Ethnicity		
Hispanic	2	1
Non-Hispanic	40	29
Years in college		
1	22	16
2	10	8
3	4	3
4	3	2
5	2	0
6	1	1

Measures

Attitudes

Participants filled out a questionnaire on their attitudes about BERT during the final survey. These questions were free-response and Likert-scale items which are presented in **Supplementary Table 1**.

Difficulties With Emotion Regulation Scale

This 36-item self-report questionnaire (68) is designed to measure ER in six subscales: non-acceptance of emotional responses (NONACCEPT; $\alpha = 0.87–0.91$), difficulty engaging in goal-directed behavior (GOALS; $\alpha = 0.87–0.89$), impulse control difficulties (IMPULSE; $\alpha = 0.75–0.82$), lack of emotional awareness (AWARE; $\alpha = 0.86–0.92$), limited access to ER strategies (STRAT; $\alpha = 0.87–0.91$), and lack of emotional clarity (CLARITY; $\alpha = 0.80–0.82$), as well as the total score ($\alpha = 0.93–0.94$), all of which showed good to excellent internal consistency across time points (see **Table 4**).

Emotion Regulation Questionnaire

This 10-item self-report questionnaire (69) has two subscales: cognitive reappraisal (CR; $\alpha = 0.70–0.89$) and expressive suppression (ES; $\alpha = 0.76–0.82$; **Table 4**) which showed good internal consistency across time points.

Brief Adjustment Scale

This 6-item self-report questionnaire (70) measures overall psychological functioning. It showed good to excellent internal consistency across time points ($\alpha = 0.84–0.91$; see **Table 4**).

Modified Differential Emotion Scale

This 20-item self-report measure (71) assesses positive and negative affective experiences. Good to excellent internal consistency across time points was shown for the positive ($\alpha = 0.92–0.99$) and negative affect ($\alpha = 0.85–0.90$) scales (see **Table 4**).

COVID-19 Scales

This series of measures (72) was adapted from recommended CDC scales to measure impacts due to the COVID-19 pandemic. Three scales were utilized in this study: Perceived Coronavirus Threat Questionnaire (PCTQ; $\alpha = 0.82$), Coronavirus Impacts Questionnaire (CIQ; $\alpha = 0.70$), and the Coronavirus Experiences Questionnaire (CEQ; $\alpha = 0.69$). All exhibited acceptable to good internal consistency. The CIQ is divided into three subscales: financial ($\alpha = 0.54$), resource ($\alpha = 0.90$), and psychological ($\alpha = 0.83$). The CEQ is divided into 3 subscales: personal diagnoses/symptoms ($\alpha = 0.55$), proximity to others ($\alpha = 0.86$), and news ($\alpha = 0.60$; see **Table 4**).

Procedure

Participants completed initial (prior to ERO), midpoint (week 3), and final (following week 5) Qualtrics surveys to evaluate impacts of BERT on ER and psychological distress. All participants received content for ERT Week 1 on the same date, to ensure all participants were completing the program on the same timeline. For self-monitoring, participants completed a brief questionnaire including the BASE-6 and vitality subscale of the Thriving Scale (73) at the start of each week. Automatic feedback was provided with interpretation, graphing scale scores and self-monitoring reports of sleep and substance use. Graphed individual feedback could be viewed by participants on a password protected, Google Apps webpage which ingested individual participant data from Qualtrics (see **Supplementary Figure 2**). Every day participants received the mDES as an EMA to capture daily mood. This measurement was designed to enhance emotion identification and emotional granularity. Alongside this measurement, participants also engaged in the 5-week ERT curriculum. Participation was recorded through their responses to the Qualtrics survey, serving as a manipulation check. In other words, BERT engagement was tracked by participants' responses to the daily program content.

RESULTS

Data Cleaning

Data was screened for univariate and multivariate outliers; none were identified. Three participants did not complete the midpoint survey. Little's MCAR Test was performed to determine if values were missing at random [$\chi^2_{(147,N=42)} = 106.80$; $p = 0.995$]. Missing midpoint values were replaced by carrying forward initial survey values, providing a conservative estimate assuming no change. Two participants who completed BERT did not complete the final survey, with an additional participant missing parts of the survey. Little's MCAR Test was performed [$\chi^2_{(129,N=30)} = 104.57$; $p = 0.944$] and missing final values for these 3 participants were replaced by carrying forward midpoint survey values, or initial survey values if they did not complete the midpoint survey. The overall attrition rate was 11.8%. Participants initiated BERT if they completed the ERO prior to the first week of the ERT (34 of the 42 participants) and completed BERT if they completed program content through Week 5 ($n = 30$), though 2 completers did not complete the final survey (see CONSORT diagram, **Figure 1**).

Cost

BERT development took a substantial amount of time and had associated costs. Approximately 250 person hours were required for programming and graphic design, in addition to content development time. There were insufficient funds to build this program as an app-based software. Downstream costs associated with the Google Apps Script (GAS) platform included collaborative efforts between the grant team and five undergraduate students to ensure the program was delivered with fidelity. Approximately 1–2 h per day were required by team members to oversee the data collection process, send program content, and manage email reminders.

Enrollment

Females were represented in the study at a significantly higher rate (86%) than in the university [43%; $\chi^2_{(1,N=42)} = 14.13$; $p < 0.00$; see **Table 3**]. The ethnoracial distribution of this sample did not significantly differ from the university population. Because the university only reports ethnicity separately from race, results were extrapolated from two calculations: (1) assuming that no White students enrolled in the university during the semester the study took place were Hispanic/Latinx, and (2) assuming that all Hispanic/Latinx students enrolled in the university during the study took place were White. The true value for the population will fall somewhere between these two values. In both cases, the actual numbers of ethnoracial minority students (ERM; $n = 13$) and non-Hispanic White students (NHW; $n = 29$) were

TABLE 4 | Pilot study descriptive statistics and scale reliabilities for the full sample prior to data analysis or manipulation.

Survey		Initial				Midpoint				Final			
Scale	**Subscale**	**Mean (SD)**	**Skewness (SE)**	**Kurtosis (SE)**	**α**	**Mean (SD)**	**Skewness (SE)**	**Kurtosis (SE)**	**α**	**Mean (SD)**	**Skewness (SE)**	**Kurtosis (SE)**	**α**
BASE-6	Total	20.26 (9.11)	−0.11 (0.37)	−1.34 (0.72)	0.92	19.10 (8.31)	−0.11 (0.37)	−1.01 (0.83)	0.91	14.64 (6.19)	0.70 (0.44)	−0.14 (0.86)	0.85
DASS-21	Depression	6.57 (6.14)	1.67 (0.36)	3.83 (0.71)	0.85	8.07 (8.53)	0.88 (0.46)	−0.63 (0.89)	0.89	5.71 (6.22)	1.49 (0.44)	1.98 (0.86)	0.82
	Anxiety	4.48 (4.71)	1.67 (0.37)	3.59 (0.72)	0.43	7.08 (6.10)	0.51 (0.46)	−0.78 (0.89)	0.66	4.21 (4.22)	0.79 (0.44)	−0.54 (0.86)	0.53
	Stress	8.73 (5.87)	1.81 (0.37)	5.00 (0.73)	0.51	13.31 (7.67)	0.20 (0.46)	−0.92 (0.89)	0.74	10.43 (8.00)	1.00 (0.44)	1.06 (0.86)	0.85
DERS	Strategies	17.83 (6.74)	0.80 (0.37)	−0.14 (0.72)	0.88	17.46 (7.44)	0.54 (0.46)	−0.95 (0.89)	0.91	15.43 (5.78)	0.83 (0.44)	−0.51 (0.86)	0.86
	Non-acceptance	15.05 (6.62)	0.78 (0.37)	0.02 (0.72)	0.93	14.23 (6.41)	0.75 (0.46)	−0.24 (0.89)	0.92	13.29 (6.58)	1.12 (0.44)	0.37 (0.86)	0.95
	Goals	15.64 (5.47)	−0.27 (0.37)	−1.09 (0.72)	0.89	15.46 (4.75)	−0.26 (0.46)	−0.12 (0.89)	0.87	13.18 (4.14)	−0.40 (0.44)	−0.50 (0.86)	0.89
	Impulse	11.79 (4.64)	0.83 (0.37)	−0.12 (0.72)	0.86	11.00 (3.26)	0.38 (0.46)	0.11 (0.89)	0.75	10.04 (3.55)	0.72 (0.44)	−0.51 (0.86)	0.83
	Awareness	16.42 (5.57)	−0.05 (0.37)	−0.54 (0.72)	0.88	16.43 (4.96)	0.39 (0.46)	0.46 (0.89)	0.86	16.25 (5.53)	0.03 (0.44)	−0.34 (0.86)	0.92
	Clarity	12.67 (4.31)	0.58 (0.37)	−0.24 (0.72)	0.84	12.27 (3.61)	0.52 (0.46)	0.10 (0.89)	0.82	11.46 (3.23)	0.45 (0.44)	0.22 (0.86)	0.81
	Total	87.14 (24.87)	0.39 (0.37)	−0.09 (0.72)	0.95	84.69 (20.39)	−0.20 (0.46)	−0.20 (0.89)	0.93	77.57 (19.67)	−0.12 (0.44)	−0.55 (0.86)	0.93
ERQ	Cognitive reappraisal	27.67 (6.47)	−0.55 (0.37)	−0.37 (0.72)	0.85	27.67 (6.47)	−0.51 (0.46)	0.68 (0.89)	0.70	30.32 (5.71)	−0.52 (0.44)	0.79 (0.86)	0.87
	Expression suppression	16.62 (5.24)	−0.46 (0.37)	0.02 (0.72)	0.81	15.92 (5.05)	−0.54 (0.46)	0.28 (0.89)	0.76	16.25 (5.05)	−0.14 (0.44)	0.14 (0.86)	0.76
MDES	Positive affect total	24.90 (9.69)	0.16 (0.37)	−0.52 (0.72)	0.92					25.12 (10.74)	0.13 (0.44)	−1.00 (0.86)	0.94
	Negative affect total	12.19 (7.78)	0.49 (0.37)	−0.82 (0.72)	0.91					5.54 (5.56)	1.21 (0.44)	0.71 (0.86)	0.84

Data is presented for participants who completed the initial (n = 41–42), midpoint (n = 26–30) or final (n = 28) survey.

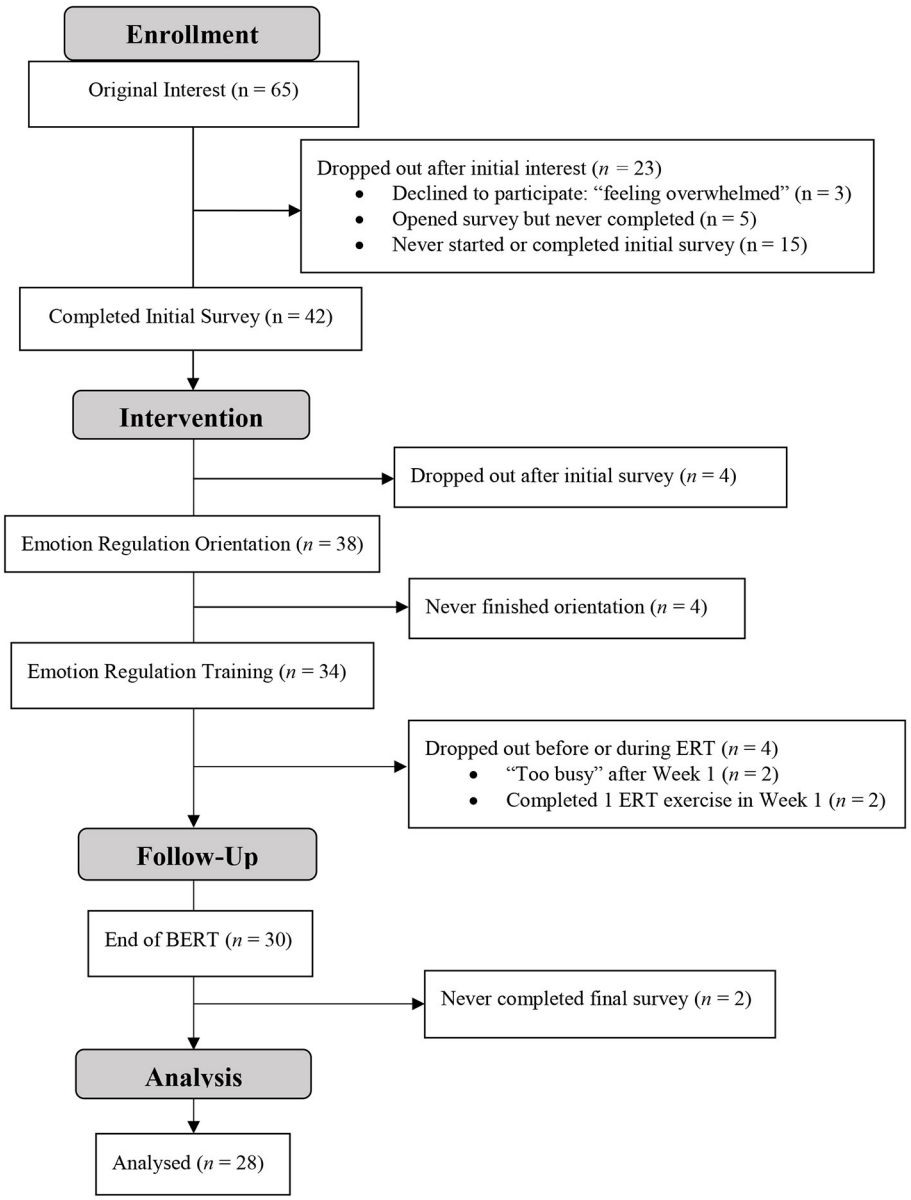


FIGURE 1 | Consort diagram to examine BERT completion rates and attrition.

not significantly different than expected based on university demographics ([1] ERM = 13.26, NHW = 28.74; $\chi^2_{(1,N=42)} = 0.007$; $p = 0.931$; [2] ERM = 16.8, NHW = 25.2; $\chi^2_{(1,N=42)} = 1.433$; $p = 0.231$). Thus, the success of Reach was mixed, with representation adequate by race/ethnicity, but not ideal by gender.

Engagement

Chi-square analyses were conducted to examine whether there were demographic differences between participants who completed the initial survey and continued on to BERT compared with those who did not initiate BERT. Completion rates for each part of the program are shown in **Table 5**. Though 38 participants started the ERO, 34 completed it, with 32 beginning the ERT. There were no significant differences based on minority status [$\chi^2_{(1,N=42)} = 35$; $p = 0.55$], gender [$\chi^2_{(1,N=42)} = 1.19$; $p = 0.28$], or first year status [$\chi^2_{(1,N=42)} = 0.02$; $p = 0.90$]. These results support the Reach of BERT. To explore the data, separate logistic regressions were conducted to examine whether there were study variable differences between participants who completed the initial survey and continued to BERT compared with those who did not initiate BERT. There were no significant differences based on age [$\chi^2_{(1,N=42)} = 0.68$; $p = 0.17$], BASE-6 [$\chi^2_{(1,N=42)} = 0.13$; $p = 0.72$], DERS subscales [$\chi^2_{(6,N=42)} = 2.90$; $p = 0.82$], or ERQ

TABLE 5 | Number of completed surveys or program content for the ecological momentary assessment (EMA), emotion regulation training (ERT), and self-monitoring (SM).

	%	*n*
EMA completions		
38	108.6	1
37	105.7	1
36	102.9	1
35	100	3
34	97.1	3
33	94.3	2
32	91.4	4
31	88.6	1
30	85.7	3
28	80	1
27	77.1	4
26	74.3	1
22	62.9	1
19	54.3	1
17	48.6	1
10	28.6	1
9	25.7	1
8	22.9	1
2	5.7	1
0	0	2
	N	**34**
ERT completions		
18	100	20
17	94.4	4
16	88.9	2
14	77.8	1
13	72.2	1
12	66.7	1
9	50	1
7	38.9	1
3	16.7	1
1	5.6	2
	N	**34**
SM completions		
5	100	9
4	80	16
3	60	4
2	40	1
1	20	1
0	0	3
	N	**34**

subscales [$\chi^2_{(2,N=42)} = 0.58$; $p = 0.75$], mDES scales [$\chi^2_{(4,N=42)} = 3.25$; $p = 0.52$; see **Table 5**].

Technical errors for collecting compliance, had ERT completion rates based on 18 exercises ($M = 16.57$; $SD = 2.81$). Nineteen participants completed 100% of the ERT content, with 26 (78.1%) completing more than 75% of the ERT exercises. Participants may not have had equal opportunities to complete all 5 SM surveys due to a technical error in Week 4, so the 75% criterion was set at 3 SM completions with 85.3% of participants completing more than 75% of the SM opportunities. There were 35 EMA opportunities (daily for 5-weeks), and the average number of EMAs completed was 28 (80% completion rate), and 70.6% ($n = 20$) of participants exceeded a 75% completion rate. Three participants completed the EMA more than 35 times. Thus, engagement data support Implementation of BERT.

Attitudes

Descriptive statistics for participants' attitudes about BERT reported on the final survey are presented in **Supplementary Table 1**. Overall, participants' responses suggest favorable attitudes, as all positively worded items had mean scores above the mid-points on their respective scales and all negatively worded items had mean scores below the mid-points on their scales. Notably, all components of BERT were reported as helpful ($Ms = 5.29$–5.79 on a 7-point scale). There were varied responses to the ease of remembering the program concepts ($M = 4.61$; $SD = 1.52$ on a 7-point scale) and application to daily life ($M = 4.89$; $SD = .96$ on a 7-point scale). Participants reported that it was not difficult to keep up with program demands ($M = 3.36$; $SD = 1.34$ on a 7-point scale), that they were engaged ($M = 6.11$; $SD = 0.79$ on a 7-point scale), and the wording was easy to understand ($M = 6.04$; $SD = 0.69$ on a 7-point scale). Participants reported they would be somewhat likely to recommend BERT to someone else ($M = 3.86$; $SD = 0.59$ on a 5-point scale). All of this supports the Implementation of BERT.

Independent samples *t*-tests were conducted to examine whether there were race/ethnicity (minority vs. White) differences in participants' favorable attitudes toward BERT on the follow-up survey. There were no significant differences in attitudes about helpfulness ($ps = 0.07$–0.93). There were no differences in difficulty remembering program concepts [$t_{(25)} = -0.93$; $p = 0.16$], applicability to daily life [$t_{(25)} = -1.27$; $p = 0.22$], keeping up with program demands [$t_{(25)} = 0.80$; $p = 0.71$], engagement [$t_{(25)} = -0.46$; $p = 0.60$], understanding wording [$t_{(25)} = -0.77$; $p = 0.15$], or recommending the program to others [$t_{(25)} = 0.13$; $p = 0.97$]. A similar *t*-test could not be conducted to test for gender differences because too few men completed BERT. The absence of differential attitudes based on ethnic/racial identity suggests no barriers to Reach.

Emotion Regulation

As the Bonferroni correction was utilized, the corrected alpha for the DERS was 0.007 and for the ERQ was 0.025. Repeated measures ANOVA showed overall difficulties with emotion regulation (DERS total score) significantly decreased from baseline to follow-up [$F_{(2,58)} = 9.07$; $p < 0.000$; partial η $\eta^2 = 0.24$; power = 0.97], consistent with hypotheses. Based on the Bonferroni-corrected alpha, no significant change was noted for the subscales: limited access to emotion regulation strategies [$F_{(2,58)} = 5.07$; $p = 0.009$; partial $\eta^2 = 0.15$; power = 0.80]; non-acceptance of emotional responses [$SD = 4.15$; $F_{(2,58)} = 5.11$; $p = 0.009$; partial $\eta^2 = 0.13$; power = 0.78]; difficulty engaging in goal-directed behavior [$F_{(2,58)} = 5.64$; $p = 0.009$; partial $\eta^2 = 0.29$; power = 0.82]; impulse control difficulties [$F_{(2,58)} = 4.52$;

$p = 0.015$; partial $\eta^2 = 0.14$; power = 0.75]; lack of emotional awareness ($F_{(2,58)} = 0.14$; $p = 0.870$; partial $\eta^2 = 0.01$; power = 0.07]; lack of emotional clarity [$F_{(2,58)} = 3.82$; $p = 0.028$; partial $\eta^2 = 0.12$; power = 0.67].

On the ERQ, cognitive reappraisal skills significantly improved from baseline to follow-up [$F_{(2,58)} = 7.73$; $p < 0.001$; partial $\eta^2 = 0.21$; power = 0.94], consistent with hypotheses, but there was not power to detect a similar statistically significant reduction in emotion suppression over time [$F_{(2,58)} = 2.49$; $p = 0.092$; partial $\eta^2 = 0.08$; power = 0.48].

Psychological Distress

Repeated measures ANOVA showed that psychological distress assessed on the BASE-6 significantly decreased from baseline to follow-up [$F_{(2,58)} = 8.42$; $p < 0.001$; partial $\eta^2 = 0.23$; power = 0.96]. Additionally, the predicted cutoff score for this measure is 19 (70), suggesting that the decrease from 20.50 to 14.97 also is a clinically meaningful decrease in scores.

mDES

As the Bonferroni correction was utilized, the alpha for the mDES was 0.025. Changes in mDES total positive and negative affect scores were examined between baseline and follow-up with a repeated-measures ANOVA to determine broader changes in affectivity following BERT engagement. There was no change from baseline to follow-up in positive affect [$F_{(1,29)} = 0.02$; $p = 0.882$; partial $\eta^2 = 0.00$; power = 0.05]. There was a significant decrease in negative affect over time [$F_{(1,29)} = 13.07$; $p = 0.001$; partial $\eta^2 = 0.31$; power = 0.94].

COVID-19

The COVID-19 pandemic caused a range of interference in students' lives as evidenced by scores on the PCTQ, CIQ, and CEQ (see **Table 6**). When compared to outcome variables, the CIQ was positively correlated with DERS, BASE-6, and mDES and the CEQ was positively correlated with the DERS (see **Table 6**).

DISCUSSION

An online Brief Emotion Regulation Training (BERT) program was developed and evaluated within the RE-AIM framework (37) to ensure this program is both efficacious and scalable. BERT was adapted based on focus groups and clinician feedback prior to pilot testing to determine its Implementation, prospective Reach, and Efficacy. Though there was substantial attrition between soliciting interest and initiating BERT, Implementation was mostly supported, and initial Efficacy was promising. BERT demonstrated Reach regarding race/ethnicity, but not gender, suggesting the importance of future program development exploring the barriers and preferences of undergraduate men for developing emotion regulation skills.

BERT's strength is as a brief and intensive online intervention that does not require the presence of a clinician. Taking a transdiagnostic and preventive lens, BERT focuses on ER as an underlying mechanism impacting a wide range of psychopathology in emerging adulthood. Additionally, BERT is sensitive to a health equity framework (74), attempting to circumvent traditional barriers to care and provide equitable care to vulnerable populations. The brief and intensive nature of this program is designed to be more immersive than traditional interventions (42). Each component was designed to mimic face-to-face evidence-based treatments. BERT was designed to build emotion regulation strategies guided by the Gross (24) process model of ER. Influenced by a cognitive-behavioral perspective, the program incorporates third-wave components (i.e., mindfulness, acceptance). Specifically, the orientation provides a grounding in psychoeducation on ER and mental health, the weekly self-monitoring is a weekly symptom check-in akin to measurement-based care (75), the EMA is intended to enhance emotional clarity, and the ERT is aimed at facilitating daily ER skills practice. While these components were delivered together, future iterations will disentangle these components to understand which ones are most significantly contributing to change.

Premortem Focus Groups

Incorporating stakeholders to identify changes and concerns early in BERT's development provided invaluable input for developing a sensitive and targeted treatment program. Pragmatically, the brainwriting premortem simplified qualitative data collection, as participants shared and responded to ideas in writing. Many suggested changes were already in the program, but critical observations by participants were incorporated prior to pilot launch, including steps for behavior change, types of coping, windows of completion, sensitive language, and general clarity. Further BERT development will integrate ancillary premortem and initial feedback to enhance the applicability of program content.

Reach

Promising initial results supported BERT's utility. Recruitment showed initial interest in BERT, though ∼1/3 of students screened did not continue to the initial survey, roughly consistent with dropout rates in studies of smartphone apps for depression (76). Most participants who engaged past the first week of ERT were still active in the final week. There was mixed evidence for BERT's Reach. Students with minoritized racial and ethnic identities participated at rates that would be expected given the university distribution, representing a strength in Reach. Ensuring equitable Reach is especially important because these students are likely to face race-related stressors that increase health risks (77). Strengthening emotion regulation skills may ameliorate physiological and psychological mechanisms for the detrimental effects of race-related stressors, thereby promoting health equity (Peterson et al., 2020). The female-dominated program enrollment did not adequately represent the 57% male overall student population. Gender biases may reduce male-identifying individuals' participation in a program explicitly focused on emotion, as there is still stigma around attending to emotional wellbeing in male-identifying individuals (78–80). There were too few male participants to test gender differences in engagement and favorable attitudes. There were no gender

TABLE 6 | Descriptive statistics on the short CDC COVID-19 scales: PCTQ, Perceived Coronavirus Threat Questionnaire; CIQ, Coronavirus Impacts Questionnaire; CEQ, Coronavirus Experiences Questionnaire.

Scale	Subscale	Range	Mean (SD)	Skewness (SE)	Kurtosis (SE)	
PCTQ	Total	3–17	9.78 (4.35)	−0.30 (0.45)	−1.07 (0.87)	0.82
CIQ	Total	6–33	15.67 (6.11)	0.62 (0.45)	0.99 (0.87)	0.70
	Financial	2–14	5.04 (2.82)	1.34 (0.45)	2.61 (0.87)	0.54
	Resources	2–10	4.22 (2.65)	1.09 (0.45)	0.01 (0.87)	0.90
	Psychological	2–12	6.41 (3.18)	0.27 (0.45)	−1.23 (0.87)	0.83
CEQ	Total	7–47	20.37 (12.01)	0.99 (0.45)	0.11 (0.87)	0.69
	Diagnoses/symptoms	3–20	7.81 (6.34)	1.04 (0.45)	−0.55 (0.87)	0.55
	Proximity	2–18	7.48 (6.39)	0.77 (0.45)	−1.04 (0.87)	0.86
	News	2–16	5.07 (3.68)	1.55 (0.45)	2.15 (0.87)	0.60

Subscales for the CIQ include: Financial Scale, Resource Scale, Psychological Scale. Subscales for the CEQ include: Personal Diagnoses/Symptoms Scale (Diagnoses/Symptoms), Proximity to Others Scale (Proximity), News Scale.

differences in attrition and no race/ethnicity differences in engagement, attrition, or favorable attitudes.

Implementation

Implementation was supported from participants' engagement, low attrition once initiating BERT, and favorable attitudes. However, there were time costs, technological errors, and known technological limitations that posed barriers to implementation and retention. Relying on Qualtrics and GAS instead of mobile apps limited the program design, preventing use of SMS and push notifications that could have simplified content access and reduced implementation team time cost. Personalizing program reminders and having participants choose their notification preferences (i.e., text, push notification, email) would improve accessibility and reduce confusion. Moreover, participants all had to begin the program at the same time, which could have constrained Reach due to delayed initiation or period-specific life circumstances.

Engagement measures including attrition (12%) and mean content completion (92%) compare favorably with app- or smartphone-based interventions for health behaviors and disease management (76, 81–83). BERT completers generally considered the program helpful, reporting positive impacts on emotional and mental wellbeing. The online format ensured that all participants completed measurements within the same timeframe and allowed participants to choose the location and timing of survey completion within administration windows.

Efficacy

This study sought to examine initial efficacy to determine whether further randomized controlled trials are indicated. Initial Efficacy of BERT was promising as there was improvement in DERS total and ERQ cognitive reappraisal scores. No significant changes were seen in DERS subscale scores which may reflect low power due to the small sample size or broad, rather than targeted, change in ER. Still, BERT shows significant improvements in overall ER and cognitive reappraisal, suggesting that foundational ER skills are increasing even if participants are not recognizing or reporting an increase in specific ER components. Interestingly, the mDES exhibited significant reductions in negative emotion but no significant change in positive emotion; this may have been limited by higher reports of positive emotion at baseline. Decreases in negative affectivity could result from increased regulation or management of negative emotional states. Unfortunately, a virtual platform does not allow for in the moment clinical judgment. Future research could expand measurement to include emotionally salient tasks, changes in risk-taking, and executive functioning tasks to better understand how BERT impacts specific ER components or skills.

Psychological distress also saw significant reductions, a powerful result in the context of a cascading "mental health pandemic" resulting from the isolating effects of social distancing and quarantining during COVID-19 (84). It is interesting that on average baseline scores on the BASE-6 were clinically elevated and returned to below the clinical cutoff after the BERT intervention. This secondary effect highlights BERT's prevention value and further supports focus on ER as a critical transdiagnostic factor underlying psychopathology in emerging adults. At this stage, it is challenging to conclusively determine efficacy since there is no control group. Future studies will focus on testing with a waitlist control to ensure that changes are not due to random effects or time-series variation.

COVID-19

An unavoidable limitation was conducting this work during the COVID-19 pandemic., which significantly impacted general mental health and wellbeing (85). As individuals were forced to stay indoors and away from others for safety, ER may have been especially critical to cope with distress. Participants who experienced greater adversity from the pandemic had worse ER and psychological outcomes. Interestingly, receiving a diagnosis of COVID-19 or experiencing symptoms of COVID-19 related to a decrease in anxiety. It is possible that after having the illness, there was less anxiety as there was a reduced fear of becoming infected, or individuals may have felt a sense of relief from the potential to re-open networks after acquiring antibodies. Notably, there were no necessary modifications to the proposed

BERT for it to be implemented during the pandemic, highlighting the flexibility of online interventions.

Limitations

Despite strong recruitment efforts, only 42 participants enrolled in BERT, limiting statistical power. The small, somewhat homogenous, sample also raises generalizability concerns about findings. Additionally, since this program is designed as a preventive intervention it is difficult to disentangle potential adverse effects, though none were observed during this study. Occasional technological errors in content delivery may have also impacted observed results, though statistically more likely to have biased effect estimates downward than upward. Since BERT was not yet fully automated, manual email reminders were sent to keep participants on track. Occasionally, difficulties in loading the participant homepage impacted data collection, making it impossible to know if participants were 100% compliant with program content. Replicating testing of BERT with a larger and more diverse sample and with fully automated program delivery are thus important next steps. This stage of program development focused primarily on implementation and feasibility, thus excluding a control group comparison to maximize statistical power. Future work will benefit from a waitlist control design.

Conclusions and Future Directions

Overall, results are promising for transdiagnostic treatment approaches to prevention like BERT. Approaching treatment development with the end in mind allows for critical examination of shortcomings and growth areas of BERT. While the online format lends itself to better fidelity, technological barriers still impeded implementation. By identifying and addressing dissemination barriers, BERT can be adapted to facilitate widespread program uptake. BERT takes an upstream approach to addressing a key mechanism underlying multiple forms of psychopathology, allowing it to effectively prevent a range of negative outcomes while promoting wellbeing. BERT can be widely disseminated because it is cost-effective, adaptable, and does not require significant clinician burden. BERT has great potential as a cost-effective tool to promote regulation and mitigate distress in emerging adulthood. Accessibility by individuals with disabilities was emphasized throughout the design process. Future development aims to test BERT with more ethnoracial and gender identity diverse samples to ensure an equitable program. When unmanaged, poor ER can manifest in deleterious ways (e.g., impulsive behaviors, outbursts, criminal behaviors, dropout) with a host of negative associated consequences (86). Proactively promoting ER strategies rather than reactively treating observed deficits can reduce individual and societal costs of mitigating the effects of dysregulation by preventing its emergence. BERT may also be modified for adolescent populations with the hopes of improving ER, reducing risk, and fostering resiliency in vulnerable youth. Integrating BERT into school settings may allow for increased accessibility and accountability, with professional support more readily available for youth in need of assistance with emotion identification and skill development. Additionally, BERT may be useful as a tool for individuals in need who are still waiting to receive clinical care. BERT has the potential to serve as a cost-effective prevention method for improving ER in vulnerable populations, by circumventing traditional barriers to care.

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 Virginia Tech Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AG came up with the intellectual property and BERT intervention as well as the primary manuscript drafts, which was supervised by LC and JD. SH provided consultation regarding implementation science. The data bridge team including AB, NP, MS, and TE assisted in the development of the technological components of BERT and assisted with data collection. All authors assisted with editing drafts of the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

This project was funded by the Southern Regional Education Board Dissertation Award, the Thomas H. Ollendick Ph.D. and Mary Catherine Haley Ollendick Graduate Fellowship in Clinical Child Psychology, and the Institute for Creativity, Arts, and Technology (ICAT) at Virginia Tech SEAD Grant. Open access publishing fees were supported by the Virginia Tech Open Access Subvention Fund.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.858370/full#supplementary-material

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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.

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frontiers | Frontiers in Psychiatry

ORIGINAL RESEARCH
published: 16 June 2022
doi: 10.3389/fpsyt.2022.815196

Associations Among Depression, Hemoglobin A1c Level, and Prognosis in Patients With Coronary Artery Disease: A Prospective Study

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Background: Depression is ubiquitous in patients with coronary artery disease (CAD). The relationship between depression and hemoglobin A1c (HbA1c) is controversial. The combined effect of high HbA1c and depression on prognosis is unclear, especially in non-diabetic CAD patients. We sought to explore these associations.

Methods: 558 CAD patients were included in this prospective study. Patients were grouped by HbA1c levels and the status of clinical depression. The average follow-up period was about 2.2 years, and Cox proportional hazards models were used to compare the differences of prognosis in all the groups.

Results: Clinical depression had no associations with HbA1c in all CAD patients (P for Pearson correlation = 0.74). In the all four groups, compared to group 1 (patients without clinical depression and low HbA1c), group 3 (without clinical depression and high HbA1c) had a higher risk of MACE (adjusted hazard ratio [aHR], 1.97; 95% confidence interval [CI], 1.2–3.25) and composite events (aHR, 1.67; 95% CI, 1.09–2.053). Group 4 (patients with clinical depression and high HbA1c) had higher HRs for MACE (aHR, 2.9; 95%CI, 1.32–6.38) and composite events (aHR, 2.12; 95% CI, 1.06–4.25). In CAD patients without diabetes, patients with clinical depression and high HbA1c had a higher risk of MACE (HR, 2.71; 95% CI, 1.02–7.19), non-cardiac readmission (HR,3.48; 95% CI, 1.26–9.57) and composite events (HR,2.44; 95% CI, 1.08–5.53) than those with no clinical depression and low HbA1c. In patients with comorbidities of depression and diabetes, patients with depression and high HbA1c more likely to experienced non-cardiac readmissions (HR, 4.49; 95% CI, 1.31–15.38) than patients with no depression and low HbA1c only. In all the above analysis, p-values for interaction between clinical depression and HbA1c were not statistically significant.

Conclusions: The presence of both depression and high HbA1c lead to a worse prognosis in CAD patients than one risk factor alone, no matter with or without the comorbidity of diabetes in these CAD patients. For patients with CAD and depression, lower HbA1c may be required.

Keywords: depression, coronary artery disease, HbA1c, prognosis, MACE

OPEN ACCESS

Edited by:
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Reviewed by:
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *15 November 2021*
Accepted: *27 May 2022*
Published: *16 June 2022*

Citation:
Li W, Yin H, Liu Q, Chen Y, Liang Y, Zhou H, Ma H and Geng Q (2022) Associations Among Depression, Hemoglobin A1c Level, and Prognosis in Patients With Coronary Artery Disease: A Prospective Study. Front. Psychiatry 13:815196. doi: 10.3389/fpsyt.2022.815196

INTRODUCTION

Coronary artery disease (CAD) is one of the major forms of cardiovascular diseases. It is well known that CAD is prevalent worldwide and has become a primary health concern in the general population over the past several decades (1). Depression is a prevalent mood disorder in patients with CAD. And numerous studies suggest that depression is highly correlated with the onset, development of CAD and means more cardiovascular morbidities and mortalities in CAD individuals (2–8). The prevalence of the comorbidity of depression and CAD in hospitalized patients have even reached 51% in China (9). In recent years, depression and glucose metabolism in CAD patients have received increasing and widespread attention (10–15).

HbA1c, a biomarker reflecting blood glucose status over the preceding 2–3 months, is considered the vital standard for predicting microvascular disease and atherosclerosis (16, 17). Previous studies have also shown that elevated HbA1c levels probably lead to dyslipidemia, hypercoagulability, and system inflammatory response which are well-established predictors of future mortality and cardiac events (18–22). And a positive association between elevated baseline HbA1c level and poor outcomes in CAD patients with and without diabetes has been reported (23–26).

HbA1c, a biomarker reflecting blood glucose status over the preceding 2–3 months, is considered the vital standard for predicting microvascular disease and atherosclerosis (8, 9). HbA1c is believed to be a risk factor of all-cause mortality and cardiac events (10–12). Previous studies have shown that elevated HbA1c levels probably lead to dyslipidemia, hypercoagulability, and system inflammatory response which are well-established predictors of future mortality (13, 14). And elevated baseline HbA1c level has a positive association with poor outcomes in CAD patients with and without diabetes (15–18).

Numerous studies have shown a significant correlation between depression and HbA1c (27–30). While several researchers found no correlations between depression and HbA1c (31, 32). Previous studies have focused on the association of HbA1c as well as depression and some debates existed, and only separate prognostic effect of depression and HbA1c was explored (20, 27, 28, 33). No investigators have yet explored the co-effects of depression and HbA1c levels to poor prognosis, especially about non-cardiac readmissions, in CAD patients. Our study aims to answer these questions.

METHODS

Study Design and Participants

This is a prospective study conducted in Guangdong Provincial People's Hospital, Guangzhou, China to investigate the association between depression, HbA1c, and poor prognosis in CAD patients. 558 patients with CAD (at least one epicardial coronary artery stenosis ≥50% by coronary angiography surgery) from October 2017 to January 2018 were included in the analysis. Our psycho-cardiologist explained the psychiatric scale to all the patient one day before the coronary angiography and helped those with impaired vision or poor reading ability to complete the scales. We excluded those who did not complete the Patient Health Questionnaire-9. Those with missing HbA1c data and other cardiac severe comorbidities were also excluded. The study was approved by the Medical Ethics Committee of Guangdong Provincial People's Hospital. Written informed consent was obtained from all participants. Details about recruitment and excluded methods have been declared in our previous article (11).

Follow-Up

All patients were followed up yearly by telephone or in-person for a total of 29 months. The average follow-up time was 26.3 ± 0.9 months. Major Adverse Cardiovascular Events (MACE) was defined as cardiac death, unplanned secondary revascularization, cardiac rehospitalization, non-fatal myocardial infarction and stroke. The composite endpoint included all-causes mortality, readmission for any reason and all kinds of MACEs. Readmissions were divided into cardiac and non-cardiac readmissions.

Questionnaire and Other Data

Patient Health Questionnaire-9 (PHQ-9) was widely used to assess depression and the Chinese version of PHQ-9 has been validated in Chinese cardiac patients (34). The respondents were asked 9 questions about specific symptoms, assigning values of 0 to 3 points (0-not at all, 1-several days, 2-more than half of the days, 3-nearly every day) with the higher score on each item representing more frequently being bothered by the symptom in the last 2 weeks. PHQ-9 has been demonstrated to be a reliable predictor of depression and getting a score ≥ 5 means having depression (35). The cut-off score of 10 or more was used to determine clinical depression, which was showed to have 89% sensitivity and 89% specificity (6).

HbA1c was used to evaluate each participant's condition of diabetes control. The Cockcroft-Gault formula was used to calculate the creatinine clearance (CCR) through the serum creatinine tested at admission (36). The socio-demographic characteristics included age, gender, education, economic situation, smoking status, marital status as well as clinical data like diabetes medication, family medical history, hypertension, and relevant laboratory indicators were collected.

Groupings

The HbA1c levels were assessed by comparing with the median value of the HbA1c value in the corresponding crowd. All of the 558 patients were divided into four groups according to the depression and HbA1c level. Patients without clinical depression and low HbA1c were defined as group 1, patients with clinical depression and low HbA1c were defined as group 2. Group 3 included participates without clinical depression and high HbA1c, and those with clinical depression and high HbA1c were defined as group 4.

Abbreviations: CAD, coronary artery disease; HbA1c, hemoglobin A1c; aHR, adjusted hazard ratio; CI, confidence interval; MACE, Major Adverse Cardiovascular Events; PHQ-9, Patient Health Questionnaire-9; CCR, creatinine clearance; HDLC, High-Density Lipoprotein Cholesterol.

Patients without clinical depression and low HbA1c were re-defined as group1' and group 1" in the non-diabetes and diabetes subgroup analysis, respectively. Similarly, patients with clinical depression and high HbA1c were divided into group3' and group3". Others were divided into group2' and group2".

Statistical Analyses

The data was described in the form of mean ± SD, median (interquartile range), or number and percentage when appropriate. One-way analyses of variance and Kruskal-Wallis rank-sum tests were used to analyze continuous variables. When analyzing categorical data, we used the Pearson chi-squared test.

Pearson correlation was used to examine the association between clinical depression and HbA1c. Cox proportional hazards regression models were used to evaluate the influence of the groups with depression and HbA1c level on MACE and composite events in CAD patients. We compared the baseline data first and put the variables with a baseline difference level of <0.05 in the univariate Cox regression analysis. Variables with a significance level of 0.05 in the univariate Cox regression analysis [MACE: p for High-Density Lipoprotein Cholesterol (HDLC) = 0.044; Composite endpoint: p for CCR = 0.042; p for sex = 0.035; Non-cardiac readmissions: p for sex = 0.005; p for taking furosemide = 0.016; p for CCR<0.001] were included in the final multivariate Cox regression. Other variables which were considered to be most closely associated to endpoint events, such as age, severity of coronary artery stenosis and diabetes were also regarded as necessary adjustment variables in the multivariate Cox regression. We adjusted sex, age, severity of coronary artery stenosis, diabetes and HDLC in the final multivariate MACE Cox regression. We adjusted sex, age, severity of coronary artery stenosis, diabetes and CCR in the final multivariate composite endpoint Cox regression. And in the final multivariate non-cardiac readmissions Cox regression, sex, age, severity of coronary artery stenosis, diabetes, taking furosemide, and CCR were adjusted.

P for interaction of depression and HbA1c for the outcomes were examined in all the Cox regressions. The level of significance was set at $p < 0.05$. Data was analyzed using SPSS version 25.

RESULTS

Baseline Characteristics

The baseline of clinical characteristics of 558 CAD patients included in this analysis was shown in **Table 1**. The mean age of the participants was 63.7 ± 10.1 years, 430 (77.1%) were male. 440 (78.9%) and 118 (21.1%) were diagnosed with angina pectoris, myocardial infarction, respectively. A total of 340 (60.9%) had hypertension, and 195 (34.9%) were diagnosed with diabetes. 210 (37.6%) individuals had mild to severe depression. 62 participates (11.1%) were diagnosed with clinical depression. There were 290 patients with the HbA1c values below the median level (HbA1c≤6.2%). All patients were divided into four groups: group 1 (no clinical depression and HbA1c ≤ 6.2, $n = 258$), group 2 (with clinical depression and HbA1c≤6.2, $n = 32$), group 3 (no clinical depression and HbA1c>6.2, $n = 238$), group 4 (with clinical depression and HbA1c>6.2, $n = 30$). No association was found between HbA1c and clinical depression (P for Pearson correlation was 0.74).

Main Outcomes

During a mean follow-up of approximately 26.3 months, 151 (27.1%) and 105 (18.8%) experienced composite endpoint event and MACE, respectively. 66 (11.8%) experienced a non-cardiac readmission. In the Cox analysis, we found that group 4 had a higher risk of MACE (**Figure 1A**; $P = 0.012$; HR, 2.47; 95%CI, 1.22–4.97) and the composite events (**Figure 1B**; $P = 0.041$; HR, 1.92; 95% CI, 1.03–358) than group 1. P for interaction between depression and HbA1c for MACE was 0.34. P for interaction between depression and HbA1c for composite events was 0.15. After multi-variable adjustment, we found group 4 remained at higher risk for MACE (**Figure 2A**; $P = 0.008$; HR, 2.90; 95%CI, 1.32–6.38) and the composite events (**Figure 2B**; $P = 0.035$; HR, 2.12; 95% CI, 1.06–4.25) than group 1. Moreover, group 3 had a higher risk of MACE (**Figure 2A**; $P = 0.008$; HR, 1.97; 95% CI, 1.20–3.25) and composite events (**Figure 2B**; $P = 0.02$; HR, 1.67; 95% CI, 1.09–2.53) than group 1 in the multivariate adjusted model, too. While no significant differences were found in all the four groups for non-cardiac readmission (**Supplementary Figure 1**).

Subgroup Analyses

We performed the subgroup analyses to explore whether similar findings existed in CAD patients with or without diabetes.

In the all 363 CAD patients without diabetes, 67 (18.5%) experienced MACE and 96 (26.4%) experienced composite events. We re-divided these 363 people into high (≥5.9%) and low (<5.9%) HbA1c groups according to the median of HbA1c. These non-diabetic patients were re-grouped into three groups according to the depression and HbA1c level−149 patients without clinical depression and low HbA1c (group1'), 15 patients with clinical depression and high HbA1c (group3'), the residual other patients were defined as group2'. The same conclusion remained, group3' still had a high risk of composite events (**Figure 3A**; $P = 0.045$; HR, 2.71; 95% CI, 1.02–7.19) and MACE (**Figure 3B**; $P = 0.033$; HR, 2.44; 95% CI, 1.08–5.53) than group 1'. What's more, group3' had a higher risk of non-cardiac readmission, too (**Figure 4**; $P = 0.016$; HR, 3.48; 95% CI, 1.26–9.57). P for interactions between depression and HbA1c in all the above Cox regression models were<0.05 (MACE: 0.67; Composite events: 0.96; Non-cardiac readmission: 0.41).

There were 195 patients with the comorbidity of CAD and diabetes. 38 (19.5%), 55 (28.2%) and 23 (11.8%) experienced MACE, composite events and non-cardiac readmissions, respectively. In these 195 patients, low and high HbA1c groups were defined as HbA1c less than the 50th percentile (7.7%) and HbA1c ≥7.7%, respectively. 77 patients without clinical depression and low HbA1c was defined as group1". 11 patients with clinical depression and high HbA1c were divided into group3", and others were included in the group2". Something different was found, group3" had a high risk of non-cardiac readmissions (**Figure 5**; $P = 0.017$; HR, 4.49; 95% CI, 1.31–15.38) than group1" only. P for interaction between depression and HbA1c for non-cardiac readmission was 0.88. While no

TABLE 1 | Baseline characteristic of all CAD patients grouped by clinical depression and HbA1c level.

Varites	Overall	Groupings				
	(*n* = 558)	Group1 (*n* = 258)	Group2 (*n* = 32)	Group3 (*n* = 238)	Group4 (*n* = 30)	*p*
Demographic						
Age, year	63.7 ± 10.1	63.6 ± 10.3	64.1 ± 9.8	63.8 ± 1.0	64.4 ± 10.9	0.97
Male,n (%)	430 (77.1)	212 (82.2)	21 (65.6)	175 (73.5)	22 (73.3)	0.044
BMI,kg/m²	24.5 ± 3.1	24.3 ± 2.9	23.8 ± 3.6	24.7 ± 3.0	24.8 ± 3.9	0.21
Education,n (<6 years/6-9 years/10-12 years/>12 years)	153/154/118/124	64/76/56/58	13/7/3/7	63/65/52/56	13/6/7/3	0.24
Marriage,n						
Married/Divorced or Widowed or Single	525/33	248/10	27/5	223/15	27/3.	0.078
Medication						
β-blockers,n (%)	486 (87.1)	218 (84.5)	27 (84.4)	214 (89.9)	27 (90.0)	0.29
CCB,n (%)	130 (23.3)	61 (23.6)	9 (28.1)	52 (21.8)	8 (26.7)	0.82
Taking furosemide, n (%)	67 (12.0)	17 (6.6)	4 (12.5)	39 (16.4)	7 (23.3)	0.002
Medical history						
Diabetes mellitus,n (%)	195 (34.9)	16 (6.2)	1 (3.1)	155 (65.1)	23 (76.7)	<0.001
Hypertension,n (%)	340 (60.9)	146 (56.6)	20 (62.5)	152 (63.9)	22 (73.3)	0.18
Family history of Diabetes, n (%)	91 (16.3)	23 (8.9)	4 (12.5)	58 (24.4)	6 (20.0)	<0.001
Family history of CAD,n (%)	97 (17.4)	37 (14.4)	4 (12.5)	47 (19.7)	9 (30.0)	0.092
Family history of Hypertesion, n (%)	173 (31.0)	75 (29.1)	10 (31.3)	76 (31.9)	12 (40.0)	0.64
Laboratory and technical test						
Severity of coronary artery stenosis,n (1/2/3)	108/112/338	64/54/140	8/10/14	35/43/160	1/5/24.	0.002
CCR,ml/min/1.73 m2	63.1 (50.9,77.4)	64.1 (53.5,78.9)	52.5 (45.1,69.0)	63.3 (48.6,77.8)	56.4 (43.5,79.8)	0.012
LDLC,mmol/L	2.9 ± 0.9	2.9 ± 0.9	2.7 ± 0.7	2.9 ± 0.9	3.1 ± 1.2	0.54
TC,mmol/L	4.2 (3.5,5.0)	4.2 (3.5,5.0)	4.2 (3.3,4.9)	4.3 (3.5,5.0)	4.0 (3.5,5.9)	0.94
HScrp,mg/L	2.5 (0.9,8.1)	1.8 (0.7,5.9)	2.9 (0.8,10.8)	2.8 (1.1,10.2)	5.9 (1.0,12.5)	0.017
CKMB,U/L	10.4 (8.3,13.1)	10.3 (8.0,12.7)	9.9 (7.9,11.9)	10.6 (8.6,14.1)	10.6 (8.3,13.6)	0.088
HDLC,mmol/L	0.9 (0.8,1.1)	1.0 (0.8,1.1)	1.0 (0.8,1.2)	0.9 (0.8,1.1)	0.9 (0.7,1.1)	0.028

BMI, body mass index; CCB, calcium channel blockers; LVEF, left ventricular ejection fractions; CCR, creatinine clearance rate; LDL-C, low-density lipoprotein cholesterol; TC, total cholesterol; HDLC, high density liptein cholesterol; CKMB, creatine kinase isoenzymes.
Group1: patients without clinical depression and low HbA1c; Group2: patients with clinical depression and low HbA1c; Group3: patients without clinical depression and high HbA1c; Group4: patients with clinical depression and high HbA1c.

significant differences were found in the three groups for MACE and composite events (**Supplementary Figure 2**).

Due to the low number of endpoint events, no multifactor Cox regression analysis was carried out in the above two subgroup analyses.

DISCUSSION

To our knowledge, this is the first study to explore the relationship between HbA1c levels and depression on MACE events and noncardiac rehospitalization in CAD patients.

In our study, no correlation was found between clinical depression and HbA1c. This is consistent with the findings of a previous study by Josephine Akpalu et al. (32). As for all the CAD populations, higher HbA1c led to an increased probability of MACE and composite endpoint events **(HR for MACE and composite events: 1.97, 1.67)**. This was consistent with the conclusions of many previous studies (23, 26, 37, 38). What's more, when combined with clinical depression, the prognosis got even worse **(HR for MACE and composite events: 2.9, 2.12)**. However, clinical depression alone did not significantly worse the prognosis in the low HbA1c level groups (group2 vs group1), which warned us to pay more attention to CAD patients with the comorbidity of clinical depression and poor glycemic control (high HbA1c level).

Elevated inflammatory activity was proved as a potential mechanism causing adverse cardiovascular events of depression (8). A higher level of HbA1c is clearly associated with higher inflammatory biomarkers such as high-sensitivity C-reactive protein, leukocyte counts, fibrinogen, D-dimer and so on. Individually or in combination, these inflammatory factors associated with hyperglycemia had a direct role on the progression of atherosclerotic artery disease and adverse cardiovascular events (18, 26, 39–43). The dual inflammatory effect of both depression and high HbA1c levels may lead to the prognosis significantly worse.

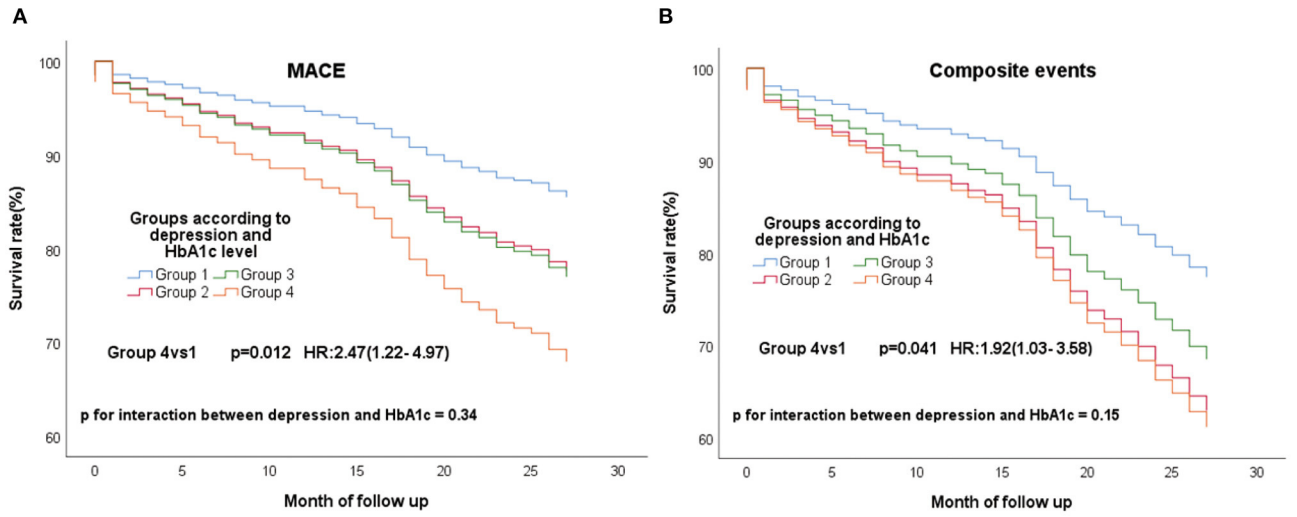


FIGURE 1 | Cox regression curves for MACE **(A)** and composite endpoint **(B)** by the four groups of all patients. (Group1: patients without clinical depression and low HbA1c; Group2: patients with clinical depression and low HbA1c; Group3: patients without clinical depression and high HbA1c; Group4: patients with clinical depression and high HbA1c).

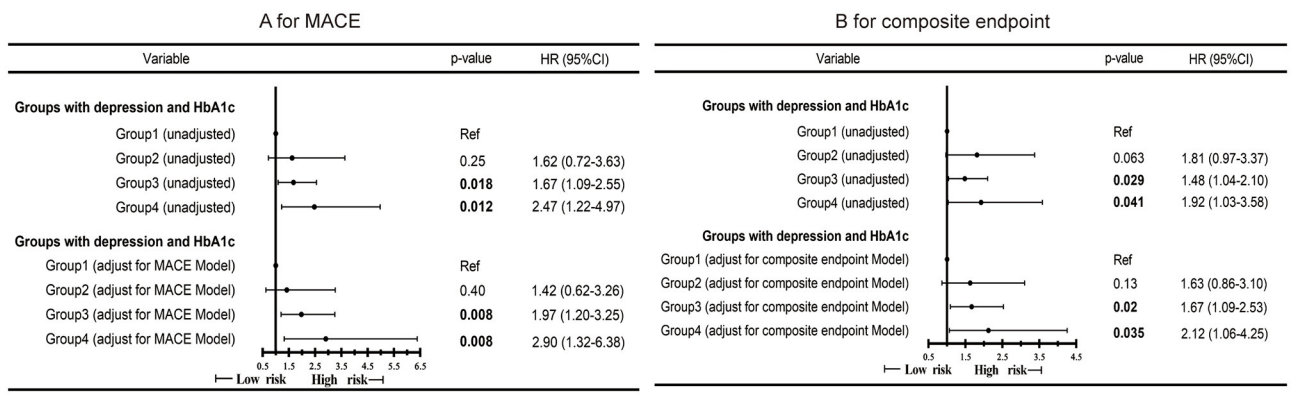


FIGURE 2 | Cox proportional hazard ratios for MACE **(A)** and composite endpoint **(B)** by the four groups of all CAD patients in different models. MACE Model: Adjusted for sex, age, severity of coronary artery stenosis, diabetes and HDLC. Composite endpoint Model: Adjusted for sex, age, severity of coronary artery stenosis, diabetes and CCR.

Most of previous studies have only explored the separate effects of depression and HbA1c levels on the prognosis. Moreover, they did not focus on non-cardiac readmissions. Our subgroup analysis illustrated that in CAD patients without diabetes, clinical depression and high HbA1c significantly associated with MACE, non-cardiac readmission, and composite endpoint. The reason may be patients with elevated HbA1c but without known diabetes likely have diabetes that was neither diagnosed nor treated, which causing worse prognosis without corresponding treatment.

And in the CAD patients with diabetes in our study, clinical depression and high HbA1c only led to more non-cardiac readmissions. Those patients with multiple major complications of diabetes and CAD are more likely to be treated with insulin and control the established risk factors such as hypertension and dyslipidemia, which are closely associated with MACE. This difference in treatment may partly explain the difference of outcomes. On the other hand, clinical depression is a psychological illness that can present with somatic symptoms. And HbA1c level has strong associations with dyslipidemia, hypercoagulability, and system inflammatory that may lead to multi-system diseases (26). So in addition to the cardiovascular system-related events, non-cardiac readmissions should also receive adequate attention and evaluation, which is essential to improve the quality of life and longevity of CAD patients.

Decreased exercise due to depression, sedentary lifestyle and poor medication adherence can all contribute to high glycation. But no relationship between depression and HbA1c was found. The insufficiency of sample, differences in grouping patterns

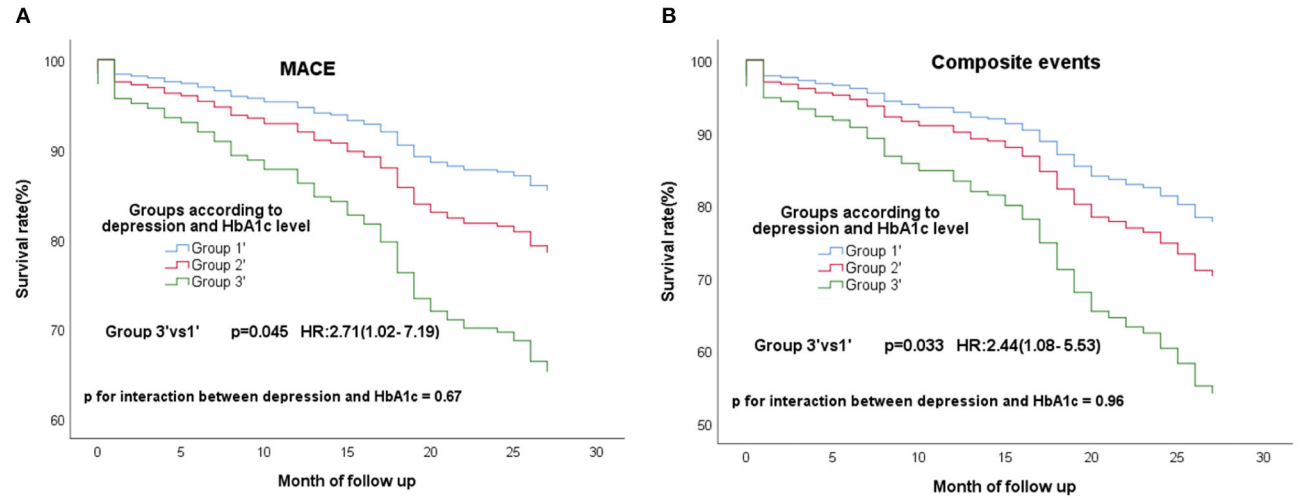


FIGURE 3 | Cox regression curves for MACE **(A)** and composite endpoint **(B)** by the four groups of CAD patients without diabetes. (Group1': patients without clinical depression and low HbA1c; Group2': patients with clinical depression and low HbA1c, patients without clinical depression and high HbA1c; Group3': patients with clinical depression and high HbA1c).

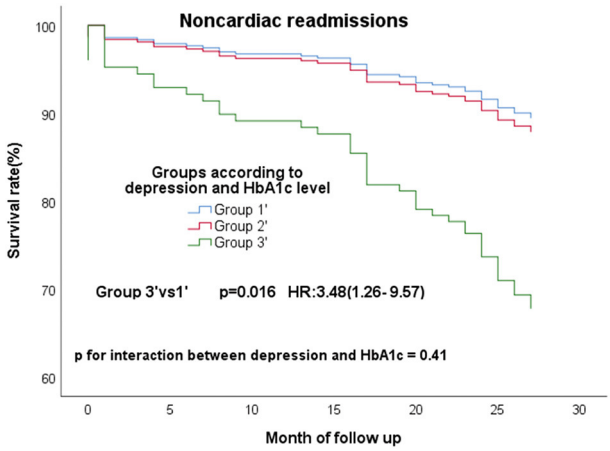


FIGURE 4 | Cox regression curves for noncardiac readmission by the four groups of CAD patients without diabetes. (Group1': patients without clinical depression and low HbA1c; Group2': patients with clinical depression and low HbA1c, patients without clinical depression and high HbA1c; Group3': patients with clinical depression and high HbA1c).

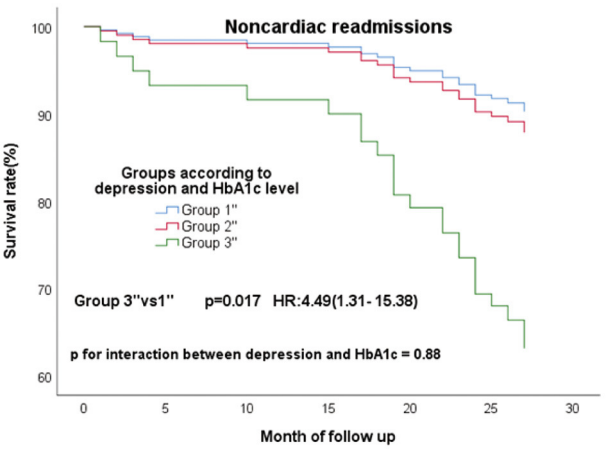


FIGURE 5 | Cox regression curves for noncardiac readmission by the four groups of CAD patients with diabetes. (Group1": patients without clinical depression and low HbA1c; Group2": patients with clinical depression and low HbA1c, patients without clinical depression and high HbA1c; Group3": patients with clinical depression and high HbA1c).

and adjusted variables may influence the associations between depression and HbA1c. The relationship between them in CAD patients still needs further investigation.

Inflammatory activity may be a key mechanism of depression and HbA1c leading to poor prognosis in CAD patients. Whether controlling the systemic inflammatory state can improve the prognosis needs further study. Besides, increasing physical activity may be particularly beneficial for reducing depression and improving glycemic control at the same time (44). Moderate exercise may significantly improve the prognosis of CAD patients.

There are still several limitations in this study. At first, this prospective research was conducted in a single center from a southern central hospital, which can't represent patients in the entire China. Secondly, the small sample sizes of our study might lead to inaccurate results, especially in the diabetic and non-diabetic subgroups analysis. Thirdly, the prognostic information of most patients was obtained through telephone follow-up by our professional cardiologists, which might lead to inaccurate results of re-hospitalization and MACE. Finally, patients who experienced emergency percutaneous coronary intervention surgery were not included in this study, which might

lead to an underestimation of the influence of high HbA1c and depression to poor prognosis.

CONCLUSION

In conclusion, the presence of both depression and high HbA1c lead to a worse prognosis in CAD patients than one risk factor alone, no matter with or without the comorbidity of diabetes in these CAD patients. For patients with CAD and depression, lower HbA1c may be required.

DATA AVAILABILITY STATEMENT

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

AUTHOR CONTRIBUTIONS

HY surveyed all patients. WL, HM, YL, and YC collected and entered data into database. WL, QL, and HZ did statistical analyses. WL, HY, and QG wrote the paper. QG and HM were senior physicians principally responsible for the study. All authors read and approved the final manuscript.

FUNDING

This research was supported by the grants from National Natural Science Foundation of China (No. 8160284), Natural Science Foundation of Guangdong Province (Nos. 2019A1515011224, 2021A1515011118, and 2021A1515011781), Start-up Funding of National Natural Science Foundation of China (Nos. 8207120182, 8207050582, 8217142362, and 8197091267), the National Key R&D Program of China (No. 2018YFC2001805), Guangdong Medical Science and Technology Research Fund, China (2019118152336191 and A2020017), Guangzhou Science and Technology Foundation and Application Foundation Research Project (Nos. 202102080368 and 202102080033), Traditional Chinese Medicine Bureau of Guangdong Province (20201008), Leading Medical Talents Project in Guangdong Province (Climbing Plan Special Fund) (No. KJ012019431), and High-level Hospital Construction Project of Guangdong Provincial People's Hospital (Nos. DFJH201811, DFJH201922, DFJH2020003, and DFJH2020029).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.815196/full#supplementary-material

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frontiers | Frontiers in Psychiatry

REVIEW
published: 26 July 2022
doi: 10.3389/fpsyt.2022.898009

Mental Health Prevention and Promotion—A Narrative Review

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Extant literature has established the effectiveness of various mental health promotion and prevention strategies, including novel interventions. However, comprehensive literature encompassing all these aspects and challenges and opportunities in implementing such interventions in different settings is still lacking. Therefore, in the current review, we aimed to synthesize existing literature on various mental health promotion and prevention interventions and their effectiveness. Additionally, we intend to highlight various novel approaches to mental health care and their implications across different resource settings and provide future directions. The review highlights the (1) concept of preventive psychiatry, including various mental health promotions and prevention approaches, (2) current level of evidence of various mental health preventive interventions, including the novel interventions, and (3) challenges and opportunities in implementing concepts of preventive psychiatry and related interventions across the settings. Although preventive psychiatry is a well-known concept, it is a poorly utilized public health strategy to address the population's mental health needs. It has wide-ranging implications for the wellbeing of society and individuals, including those suffering from chronic medical problems. The researchers and policymakers are increasingly realizing the potential of preventive psychiatry; however, its implementation is poor in low-resource settings. Utilizing novel interventions, such as mobile-and-internet-based interventions and blended and stepped-care models of care can address the vast mental health need of the population. Additionally, it provides mental health services in a less-stigmatizing and easily accessible, and flexible manner. Furthermore, employing decision support systems/algorithms for patient management and personalized care and utilizing the digital platform for the non-specialists' training in mental health care are valuable additions to the existing mental health support system. However, more research concerning this is required worldwide, especially in the low-and-middle-income countries.

Keywords: mental health, promotion, prevention, protection, intervention, review, preventive psychiatry, novel interventions

OPEN ACCESS

Edited by:
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Reviewed by:
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *16 March 2022*
Accepted: *08 June 2022*
Published: *26 July 2022*

Citation:
Singh V, Kumar A and Gupta S (2022) Mental Health Prevention and Promotion—A Narrative Review. Front. Psychiatry 13:898009. doi: 10.3389/fpsyt.2022.898009

INTRODUCTION

Mental disorder has been recognized as a significant public health concern and one of the leading causes of disability worldwide, particularly with the loss of productive years of the sufferer's life (1). The Global Burden of Disease report (2019) highlights an increase, from around 80 million to over 125 million, in the worldwide number of Disability-Adjusted Life Years (DALYs) attributable to mental disorders. With this surge, mental disorders have moved into the top 10

significant causes of DALYs worldwide over the last three decades (2). Furthermore, this data does not include substance use disorders (SUDs), which, if included, would increase the estimated burden manifolds. Moreover, if the caregiver-related burden is accounted for, this figure would be much higher. Individual, social, cultural, political, and economic issues are critical mental wellbeing determinants. An increasing burden of mental diseases can, in turn, contribute to deterioration in physical health and poorer social and economic growth of a country (3). Mental health expenditure is roughly 3–4% of their Gross Domestic Products (GDPs) in developed regions of the world; however, the figure is abysmally low in low-and-middle-income countries (LMICs) (4). Untreated mental health and behavioral problems in childhood and adolescents, in particular, have profound long-term social and economic adverse consequences, including increased contact with the criminal justice system, lower employment rate and lesser wages among those employed, and interpersonal difficulties (5–8).

Need for Mental Health (MH) Prevention

Longitudinal studies suggest that individuals with a lower level of positive wellbeing are more likely to acquire mental illness (9). Conversely, factors that promote positive wellbeing and resilience among individuals are critical in preventing mental illnesses and better outcomes among those with mental illness (10, 11). For example, in patients with depressive disorders, higher premorbid resilience is associated with earlier responses (12). On the contrary, patients with bipolar affective- and recurrent depressive disorders who have a lower premorbid quality of life are at higher risk of relapses (13).

Recently there has been an increased emphasis on the need to promote wellbeing and positive mental health in preventing the development of mental disorders, for poor mental health has significant social and economic implications (14–16). Research also suggests that mental health promotion and preventative measures are cost-effective in preventing or reducing mental illness-related morbidity, both at the society and individual level (17).

Although the World Health Organization (WHO) defines health as "a state of complete physical, mental, and social wellbeing and not merely an absence of disease or infirmity," there has been little effort at the global level or stagnation in implementing effective mental health services (18). Moreover, when it comes to the research on mental health (vis-a-viz physical health), promotive and preventive mental health aspects have received less attention vis-a-viz physical health. Instead, greater emphasis has been given to the illness aspect, such as research on psychopathology, mental disorders, and treatment (19, 20). Often, physicians and psychiatrists are unfamiliar with various concepts, approaches, and interventions directed toward mental health promotion and prevention (11, 21).

Prevention and promotion of mental health are essential, notably in reducing the growing magnitude of mental illnesses. However, while health promotion and disease prevention are universally regarded concepts in public health, their strategic application for mental health promotion and prevention are often elusive. Furthermore, given the evidence of substantial links between psychological and physical health, the non-incorporation of preventive mental health services is deplorable and has serious ramifications. Therefore, policymakers and health practitioners must be sensitized about linkages between mental- and physical health to effectively implement various mental health promotive and preventive interventions, including in individuals with chronic physical illnesses (18).

The magnitude of the mental health problems can be gauged by the fact that about 10–20% of young individuals worldwide experience depression (22). As described above, poor mental health during childhood is associated with adverse health (e.g., substance use and abuse), social (e.g., delinquency), academic (e.g., school failure), and economic (high risk of poverty) adverse outcomes in adulthood (23). Childhood and adolescence are critical periods for setting the ground for physical growth and mental wellbeing (22). Therefore, interventions promoting positive psychology empower youth with the life skills and opportunities to reach their full potential and cope with life's challenges. Comprehensive mental health interventions involving families, schools, and communities have resulted in positive physical and psychological health outcomes. However, the data is limited to high-income countries (HICs) (24–28).

In contrast, in low and middle-income countries (LMICs) that bear the greatest brunt of mental health problems, including massive, coupled with a high treatment gap, such interventions remained neglected in public health (29, 30). This issue warrants prompt attention, particularly when global development strategies such as Millennium Development Goals (MDGs) realize the importance of mental health (31). Furthermore, studies have consistently reported that people with socioeconomic disadvantages are at a higher risk of mental illness and associated adverse outcomes; partly, it is attributed to the inequitable distribution of mental health services (32–35).

Scope of Mental Health Promotion and Prevention in the Current Situation

Literature provides considerable evidence on the effectiveness of various preventive mental health interventions targeting risk and protective factors for various mental illnesses (18, 36–42). There is also modest evidence of the effectiveness of programs focusing on early identification and intervention for severe mental diseases (e.g., schizophrenia and psychotic illness, and bipolar affective disorders) as well as common mental disorders (e.g., anxiety, depression, stress-related disorders) (43–46). These preventive measures have also been evaluated for their cost-effectiveness with promising findings. In addition, novel interventions such as digital-based interventions and novel therapies (e.g., adventure therapy, community pharmacy program, and Home-based Nurse family partnership program) to address the mental health problems have yielded positive results. Likewise, data is emerging from LMICs, showing at least moderate evidence of mental health promotion intervention effectiveness. However, most of the available literature and intervention is restricted mainly to the HICs (47). Therefore, their replicability in LMICs needs to be established and, also, there is a need to develop locally suited interventions.

Fortunately, there has been considerable progress in preventive psychiatry over recent decades, including research on it. In the light of these advances, there is an accelerated interest among researchers, clinicians, governments, and policymakers to harness the potentialities of the preventive strategies to improve the availability, accessibility, and utility of such services for the community.

The Concept of Preventive Psychiatry

Origins of Preventive Psychiatry

The history of preventive psychiatry can be traced back to the early 1900's with the foundation of the national mental health association (erstwhile mental health association), the committee on mental hygiene in New York, and the mental health hygiene movement (48). The latter emphasized the need for physicians to develop empathy and recognize and treat mental illness early, leading to greater awareness about mental health prevention (49). Despite that, preventive psychiatry remained an alien concept for many, including mental health professionals, particularly when the etiology of most psychiatric disorders was either unknown or poorly understood. However, recent advances in our understanding of the phenomena underlying psychiatric disorders and availability of the neuroimaging and electrophysiological techniques concerning mental illness and its prognosis has again brought the preventive psychiatry in the forefront (1).

Levels of Prevention

The literal meaning of "prevention" is "the act of preventing something from happening" (50); the entity being prevented can range from the risk factors of the development of the illness, the onset of illness, or the recurrence of the illness or associated disability. The concept of prevention emerged primarily from infectious diseases; measures like mass vaccination and sanitation promotion have helped prevent the development of the diseases and subsequent fatalities. The original preventive model proposed by the Commission on Chronic Illness in 1957 included primary, secondary, and tertiary preventions (48).

The Concept of Primary, Secondary, and Tertiary Prevention

The stages of prevention target distinct aspects of the illness's natural course; the primary prevention acts at the stage of pre-pathogenesis, that is, when the disease is yet to occur, whereas the secondary and tertiary prevention target the phase after the onset of the disease (51). Primary prevention includes health promotion and specific protection, while secondary and tertairy preventions include early diagnosis and treatment and measures to decrease disability and rehabilitation, respectively (51) (**Figure 1**).

The primary prevention targets those individuals vulnerable to developing mental disorders and their consequences because of their bio-psycho-social attributes. Therefore, it can be viewed as an intervention to prevent an illness, thereby preventing mental health morbidity and potential social and economic adversities. The preventive strategies under it usually target the general population or individuals at risk. Secondary and tertiary prevention targets those who have already developed the illness, aiming to reduce impairment and morbidity as soon as possible. However, these measures usually occur in a person who has already developed an illness, therefore facing related suffering, hence may not always be successful in curing or managing the illness. Thus, secondary and tertiary prevention measures target the already exposed or diagnosed individuals.

The Concept of Universal, Selective, and Indicated Prevention

The classification of health prevention based on primary/secondary/tertiary prevention is limited in being highly centered on the etiology of the illness; it does not consider the interaction between underlying etiology and risk factors of an illness. Gordon proposed another model of prevention that focuses on the degree of risk an individual is at, and accordingly, the intensity of intervention is determined. He has classified it into universal, selective, and indicated prevention. A universal preventive strategy targets the whole population irrespective of individual risk (e.g., maintaining healthy, psychoactive substance-free lifestyles); selective prevention is targeted to those at a higher risk than the general population (socio-economically disadvantaged population, e.g., migrants, a victim of a disaster, destitute, etc.). The indicated prevention aims at those who have established risk factors and are at a high risk of getting the disease (e.g., family history of psychiatric illness, history of substance use, certain personality types, etc.). Nevertheless, on the other hand, these two classifications (the primary, secondary, and tertiary prevention; and universal, selective, and indicated prevention) have been intended for and are more appropriate for physical illnesses with a clear etiology or risk factors (48).

In 1994, the Institute of Medicine (IOM) Committee on Prevention of Mental Disorders proposed a new paradigm that classified primary preventive measures for mental illnesses into three categories. These are indicated, selected, and universal preventive interventions (refer **Figure 2**). According to this paradigm, primary prevention was limited to interventions done before the onset of the mental illness (48). In contrast, secondary and tertiary prevention encompasses treatment and maintenance measures (**Figure 2**).

Although the boundaries between prevention and treatment are often more overlapping than being exclusive, the new paradigm can be used to avoid confusion stemming from the common belief that prevention can take place at all parts of mental health management (48). The onset of mental illnesses can be prevented by risk reduction interventions, which can involve reducing risk factors in an individual and strengthening protective elements in them. It aims to target modifiable factors, both risk, and protective factors, associated with the development of the illness through various general and specific interventions. These interventions can work across the lifespan. The benefits are not restricted to reduction or delay in the onset of illness but also in terms of severity or duration of illness (48).On the spectrum of mental health interventions, universal preventive interventions are directed at the whole population without identifiable risk factors. The interventions are beneficial for the general population or sub-groups. Prenatal care and

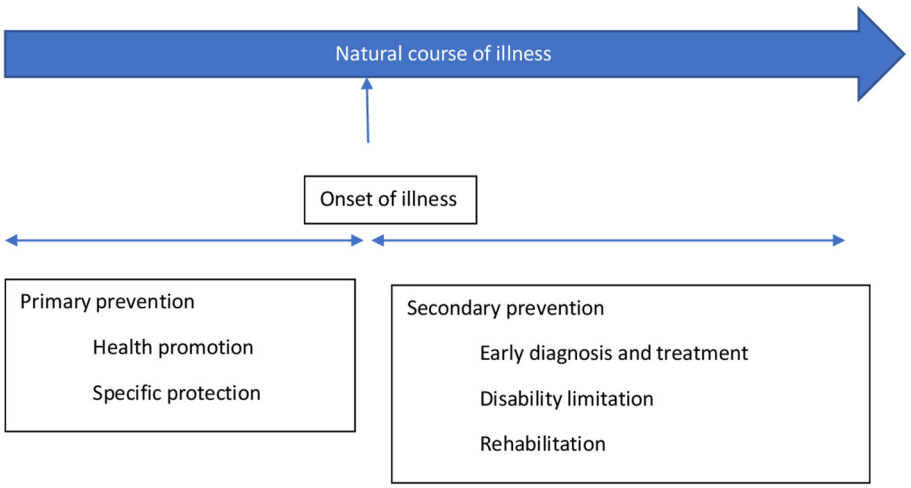


FIGURE 1 | The concept of primary and secondary prevention [adopted from prevention: Primary, Secondary, Tertiary by Bauman et al. (51)].

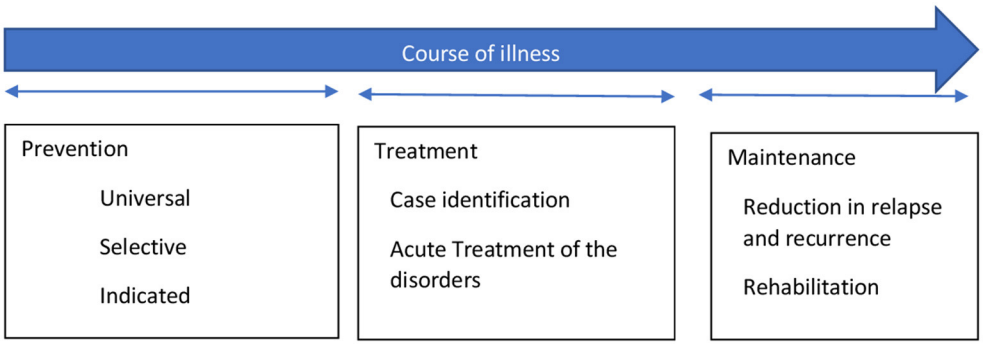


FIGURE 2 | The interventions for mental illness as classified by the Institute of Medicine (IOM) Committee on Prevention of Mental Disorders [adopted from Mrazek and Haggerty (48)].

childhood vaccination are examples of preventative measures that have benefited both physical and mental health. Selective preventive mental health interventions are directed at people or a subgroup with a significantly higher risk of developing mental disorders than the general population. Risk groups are those who, because of their vulnerabilities, are at higher risk of developing mental illnesses, e.g., infants with low-birth-weight (LBW), vulnerable children with learning difficulties or victims of maltreatment, elderlies, etc. Specific interventions are home visits and new-born day care facilities for LBW infants, preschool programs for all children living in resource-deprived areas, support groups for vulnerable elderlies, etc. Indicated preventive interventions focus on high-risk individuals who have developed minor but observable signs or symptoms of mental disorder or genetic risk factors for mental illness. However, they have not fulfilled the criteria of a diagnosable mental disorder. For instance, the parent-child interaction training program is an indicated prevention strategy that offers support to children whose parents have recognized them as having behavioral difficulties.

The overall objective of mental health promotion and prevention is to reduce the incidence of new cases, additionally delaying the emergence of mental illness. However, promotion and prevention in mental health complement each other rather than being mutually exclusive. Moreover, combining these two within the overall public health framework reduces stigma, increases cost-effectiveness, and provides multiple positive outcomes (18).

How Prevention in Psychiatry Differs From Other Medical Disorders

Compared to physical illnesses, diagnosing a mental illness is more challenging, particularly when there is still a lack of objective assessment methods, including diagnostic tools and biomarkers. Therefore, the diagnosis of mental disorders is heavily influenced by the assessors' theoretical perspectives and subjectivity. Moreover, mental illnesses can still be considered despite an individual not fulfilling the proper diagnostic criteria led down in classificatory systems, but there is detectable dysfunction. Furthermore, the precise timing of disorder

initiation or transition from subclinical to clinical condition is often uncertain and inconclusive (48). Therefore, prevention strategies are well-delineated and clear in the case of physical disorders while it's still less prevalent in mental health parlance.

Terms, Definitions, and Concepts

The terms mental health, health promotion, and prevention have been differently defined and interpreted. It is further complicated by overlapping boundaries of the concept of promotion and prevention. Some commonly used terms in mental health prevention have been tabulated (**Table 1**) (18).

Mental Health Promotion and Protection

The term "mental health promotion" also has definitional challenges as it signifies different things to different individuals. For some, it means the treatment of mental illness; for others, it means preventing the occurrence of mental illness; while for others, it means increasing the ability to manage frustration, stress, and difficulties by strengthening one's resilience and coping abilities (54). It involves promoting the value of mental health and improving the coping capacities of individuals rather than amelioration of symptoms and deficits.

Mental health promotion is a broad concept that encompasses the entire population, and it advocates for a strengths-based approach and tries to address the broader determinants of mental health. The objective is to eliminate health inequalities *via* empowerment, collaboration, and participation. There is mounting evidence that mental health promotion interventions improve mental health, lower the risk of developing mental disorders (48, 55, 56) and have socioeconomic benefits (24). In addition, it strives to increase an individual's capacity for psychosocial wellbeing and adversity adaptation (11).

However, the concepts of mental health promotion, protection, and prevention are intrinsically linked and intertwined. Furthermore, most mental diseases result from complex interaction risk and protective factors instead of a definite etiology. Facilitating the development and timely attainment of developmental milestones across an individual's lifespan is critical for positive mental health (57). Although mental health promotion and prevention are essential aspects of public health with wide-ranging benefits, their feasibility and implementation are marred by financial and resource constraints. The lack of cost-effectiveness studies, particularly from the LMICs, further restricts its full realization (47, 58, 59).

Despite the significance of the topic and a considerable amount of literature on it, a comprehensive review is still lacking that would cover the concept of mental health promotion and prevention and simultaneously discusses various interventions, including the novel techniques delivered across the lifespan, in different settings, and level of prevention. Therefore, this review aims to analyze the existing literature on various mental health promotion and prevention-based interventions and their effectiveness. Furthermore, its attempts to highlight the implications of such intervention in low-resource settings and provides future directions. Such literature would add to the existing literature on mental health promotion and prevention research and provide key insights into the effectiveness of such interventions and their feasibility and replicability in various settings.

METHODOLOGY

For the current review, key terms like "mental health promotion," OR "protection," OR "prevention," OR "mitigation" were used to search relevant literature on Google Scholar, PubMed, and Cochrane library databases, considering a time period between 2000 to 2019 (**Supplementary Material 1**). However, we have restricted our search till 2019 for non-original articles (reviews, commentaries, viewpoints, etc.), assuming that it would also cover most of the original articles published until then. Additionally, we included original papers from the last 5 years (2016–2021) so that they do not get missed out if not covered under any published review. The time restriction of 2019 for non-original articles was applied to exclude papers published during the Coronavirus disease (COVID-19) pandemic as the latter was a significant event, bringing about substantial change and hence, it warranted a different approach to cater to the MH needs of the population, including MH prevention measures. Moreover, the COVID-19 pandemic resulted in the flooding of novel interventions for mental health prevention and promotion, specifically targeting the pandemic and its consequences, which, if included, could have biased the findings of the current review on various MH promotion and prevention interventions.

A time frame of about 20 years was taken to see the effectiveness of various MH promotion and protection interventions as it would take substantial time to be appreciated in real-world situations. Therefore, the current paper has put greater reliance on the review articles published during the last two decades, assuming that it would cover most of the original articles published until then.

The above search yielded 320 records: 225 articles from Google scholar, 59 articles from PubMed, and 36 articles from the Cochrane database flow-diagram of records screening. All the records were title/abstract screened by all the authors to establish the suitability of those records for the current review; a bibliographic- and gray literature search was also performed. In case of any doubts or differences in opinion, it was resolved by mutual discussion. Only those articles directly related to mental health promotion, primary prevention, and related interventions were included in the current review. In contrast, records that discussed any specific conditions/disorders (post-traumatic stress disorders, suicide, depression, etc.), specific intervention (e.g., specific suicide prevention intervention) that too for a particular population (e.g., disaster victims) lack generalizability in terms of mental health promotion or prevention, those not available in the English language, and whose full text was unavailable were excluded. The findings of the review were described narratively.

TABLE 1 | Commonly used terms in mental health prevention.

Term	Common definitions
Mental health	WHO defines MH as a state of wellbeing in which a person is cognizant of their potential, equipped to deal with typical life stressors, capable of productive and fruitful employment, and capable of contributing to their community (18).
Mental health promotion	It is a means of empowering people to take more control of their own health and wellbeing. It encompasses several initiatives aimed at positive effects on mental health and relates to mental wellbeing rather than mental illness (18). Any intervention is done to improve individuals' and communities' mental health and wellbeing (52). Improving an individual's, family, group's, or community's ability to reinforce or promote good emotional, cognitive, and associated experiences (53).
Mental health protection	There is no universally agreed-upon definition of mental health protection. The definition has been derived from the literal meaning of protection, that states "the act of keeping somebody/something safe so that he/she is not harmed or damaged." In the prevention model of illness, health protection comes under primary prevention to prevent the occurrence of the illness, physical or mental.

FINDINGS

Interventions for Mental Health Promotion and Prevention and Their Evidence

Various interventions have been designed for mental health promotion and prevention. They are delivered and evaluated across the regions (high-income countries to low-resource settings, including disaster-affiliated regions of the world), settings (community-based, school-based, family-based, or individualized); utilized different psychological constructs and therapies (cognitive behavioral therapy, behavioral interventions, coping skills training, interpersonal therapies, general health education, etc.); and delivered by different professionals/facilitators (school-teachers, mental health professionals or paraprofessionals, peers, etc.). The details of the studies, interventions used, and outcomes have been provided in **Supplementary Table 1**. Below we provide the synthesized findings of the available research.

The majority of the available studies were quantitative and experimental. Randomized controlled trials comprised a sizeable proportion of the studies; others were quasi-experimental studies and, a few, qualitative studies. The studies primarily focussed on school students or the younger population, while others were explicitly concerned with the mental health of young females (60). Newer data is emerging on mental health promotion and prevention interventions for elderlies (e.g., dementia) (61). The majority of the research had taken a broad approach to mental health promotion (62). However, some studies have focused on universal prevention (63, 64) or selective prevention (65–68). For instance, the Resourceful Adolescent Program (RAPA) was implemented across the schools and has utilized cognitive-behavioral and interpersonal therapies and reported a significant improvement in depressive symptoms. Some of the interventions were directed at enhancing an individual's characteristics like resilience, behavior regulation, and coping skills (ZIPPY's Friends) (69), while others have focused on the promotion of social and emotional competencies among the school children and attempted to reduce the gap in such competencies across the socio-economic classes ("Up" program) (70) or utilized expressive abilities of the war-affected children (Writing for Recover (WfR) intervention) (71) to bring about an improvement in their psychological problems (a type of selective prevention) (62) or harnessing the potential of Art, in the community-based intervention, to improve self-efficacy, thus preventing mental disorders (MAD about Art program) (72). Yet, others have focused on strengthening family (60, 73), community relationships (62), and targeting modifiable risk factors across the life course to prevent dementia among the elderlies and also to support the carers of such patients (61).

Furthermore, more of the studies were conducted and evaluated in the developed parts of the world, while emerging economies, as anticipated, far lagged in such interventions or related research. The interventions that are specifically adapted for local resources, such as school-based programs involving paraprofessionals and teachers in the delivery of mental health interventions, were shown to be more effective (62, 74). Likewise, tailored approaches for low-resource settings such as LMICs may also be more effective (63). Some of these studies also highlight the beneficial role of a multi-dimensional approach (68, 75) and interventions targeting early lifespan (76, 77).

Newer Insights: How to Harness Digital Technology and Novel Methods of MH Promotion and Protection

With the advent of digital technology and simultaneous traction on mental health promotion and prevention interventions, preventive psychiatrists and public health experts have developed novel techniques to deliver mental health promotive and preventive interventions. These encompass different settings (e.g., school, home, workplace, the community at large, etc.) and levels of prevention (universal, selective, indicated) (78–80).

The advanced technologies and novel interventions have broadened the scope of MH promotion and prevention, such as addressing the mental health issues of individuals with chronic medical illness (81, 82), severe mental disorders (83), children and adolescents with mental health problems, and geriatric population (78). Further, it has increased the accessibility and acceptability of such interventions in a non-stigmatizing and

tailored manner. Moreover, they can be integrated into the routine life of the individuals.

For instance, Internet-and Mobile-based interventions (IMIs) have been utilized to monitor health behavior as a form of MH prevention and a stand-alone self-help intervention. Moreover, the blended approach has expanded the scope of MH promotive and preventive interventions such as face-to-face interventions coupled with remote therapies. Simultaneously, it has given way to the stepped-care (step down or step-up care) approach of treatment and its continuation (79). Also, being more interactive and engaging is particularly useful for the youth.

The blended model of care has utilized IMIs to a varying degree and at various stages of the psychological interventions. This includes IMIs as a supplementary approach to the face-to-face-interventions (FTFI), FTFI augmented by behavior intervention technologies (BITs), BITs augmented by remote human support, and fully automated BITs (84).

The stepped care model of mental health promotion and prevention strategies includes a stepped-up approach, wherein BITs are utilized to manage the prodromal symptoms, thereby preventing the onset of the full-blown episode. In the Stepped-down approach, the more intensive treatments (in-patient or out-patient based interventions) are followed and supplemented with the BITs to prevent relapse of the mental illness, such as for previously admitted patients with depression or substance use disorders (85, 86).

Similarly, the latest research has developed newer interventions for strengthening the psychological resilience of the public or at-risk individuals, which can be delivered at the level of the home, such as, e.g., nurse family partnership program (to provide support to the young and vulnerable mothers and prevent childhood maltreatment) (87); family healing together program aimed at improving the mental health of the family members living with persons with mental illness (PwMI) (88). In addition, various novel interventions for MH promotion and prevention have been highlighted in the **Table 2**.

Furthermore, school/educational institutes-based interventions such as school-Mental Health Magazines to increase mental health literacy among the teachers and students have been developed (80). In addition, workplace mental health promotional activities have targeted the administrators, e.g., guided "e-learning" for the managers that have shown to decrease the mental health problems of the employees (102).

Likewise, digital technologies have also been harnessed in strengthening community mental health promotive/preventive services, such as the mental health first aid (MHFA) Books on Prescription initiative in New Zealand provided information and self-help tools through library networks and trained book "prescribers," particularly in rural and remote areas (103).

Apart from the common mental disorders such as depression, anxiety, and behavioral disorders in the childhood/adolescents, novel interventions have been utilized to prevent the development of or management of medical, including preventing premature mortality and psychological issues among the individuals with severe mental illnesses (SMIs), e.g., Lets' talk about tobacco-web based intervention and motivational interviewing to prevent tobacco use, weight reduction measures, and promotion of healthy lifestyles (exercise, sleep, and balanced diets) through individualized devices, thereby reducing the risk of cardiovascular disorders (83). Similarly, efforts have been made to improve such individuals' coping skills and employment chances through the WorkingWell mobile application in the US (104).

Apart from the digital-based interventions, newer, non-digital-based interventions have also been utilized to promote mental health and prevent mental disorders among individuals with chronic medical conditions. One such approach in adventure therapy aims to support and strengthen the multi-dimensional aspects of self. It includes the physical, emotional or cognitive, social, spiritual, psychological, or developmental rehabilitation of the children and adolescents with cancer. Moreover, it is delivered in the natural environment outside the hospital premises, shifting the focus from the illness model to the wellness model (81). Another strength of this intervention is it can be delivered by the nurses and facilitate peer support and teamwork.

Another novel approach to MH prevention is gut-microbiota and dietary interventions. Such interventions have been explored with promising results for the early developmental disorders (Attention deficit hyperactive disorder, Autism spectrum disorders, etc.) (105). It works under the framework of the shared vulnerability model for common mental disorders and other non-communicable diseases and harnesses the neuroplasticity potential of the developing brain. Dietary and lifestyle modifications have been recommended for major depressive disorders by the Clinical Practice Guidelines in Australia (106). As most childhood mental and physical disorders are determined at the level of the *in-utero* and early after the birth period, targeting maternal nutrition is another vital strategy. The utility has been expanded from maternal nutrition to women of childbearing age. The various novel mental health promotion and prevention strategies are shown in **Table 2**.

Newer research is emerging that has utilized the digital platform for training non-specialists in diagnosis and managing individuals with mental health problems, such as Atmiyata Intervention and The SMART MH Project in India, and The Allillanchu Project in Peru, to name a few (99). Such frameworks facilitate task-sharing by the non-specialist and help in reducing the treatment gap in these countries. Likewise, digital algorithms or decision support systems have been developed to make mental health services more transparent, personalized, outcome-driven, collaborative, and integrative; one such example is DocuMental, a clinical decision support system (DSS). Similarly, frameworks like i-PROACH, a cloud-based intelligent platform for research outcome assessment and care in mental health, have expanded the scope of the mental health support system, including promoting research in mental health (100). In addition, COVID-19 pandemic has resulted in wider dissemination of the applications based on the evidence-based psycho-social interventions such as National Health Service's (NHS's) Mind app and Headspace (teaching meditation *via* a website or a phone application) that have utilized mindfulness-based practices to address the psychological problems of the population (101).

TABLE 2 | Depiction of various novel mental health promotion and prevention strategies.

Name of program/intervention and MH condition	Setting and modality	Component of the program	Condition	Remarks
Level of prevention: Health promotion				
Community-Based MH Services Community pharmacy program (Australia)	*Mode of delivery:* physical *Resource person:* community pharmacist who dispense medicines to the public	• Distributing in-store leaflets on mental wellbeing, posters display and linking with existing national • MH organizations/ campaigns	MH promotion of adults visitors to the pharmacy.	• A suitable environment for MH promotion, particularly for a person with lived experience. • Community pharmacy is widely distributed and easily accessible. • Lack of privacy and the busy pharmacy environment were, however, identified as potential barriers.
Technology-based mental health promotional intervention for later life (89)	*Study design:* Systematic review	Technology use for elderly education, computer/internet exposure or training, telephone/internet communication, and computer gaming.	$n = 25$ interventional studies, significant positive effects on psychosocial outcomes among the intervention recipients.	• Digital inclusion and training of elderlies are important. • Initiatives early in the life can promote and protect wellbeing in later life.
GUIDE- training of teachers in MH promotion (Canada) (90)	*Study design:* Multisite pre-post study	• Duration of in-class teaching: 8–12 h, 1 day of teachers training. • Teacher's self-study guide, teacher's knowledge self-assessment, student evaluation materials, and six-core modules for the teachers[#]. **Supplementary Materials**: A-Vs and web-linked resources.	*Results:* Significant improvements in teachers' knowledge and attitudes toward mental wellbeing and illness with large effect sizes.	A scalable model can be incorporated in the routine professional training and education for the teachers.
Myhealth Magazine (Canada) (90) MH literacy	Online interactive health and MH programming and materials for teachers and students on MH literacy	• Series of online and classroom-based activities and workshops. • Smartphone and desktop/ tablet versions also available	• *Findings*: a high percentage of students use these resources for MH information. • Students with considerable distress use more online resources and likely to access further help (e.g., school-based MH center) • High satisf'n with web site	A scalable model that has high usability and accessibility.
Level of prevention: Universal prevention				
Community program/campaign R U OK? (2009, Australia) And Beyondblue campaign for the public (91, 92)	• *Mode of delivery:* online/ telephonic conversion. • Condition: Suicide prevention	• To connect with those experiencing MH problems. Providing resources and tips for the same. • People are advised to ask; listen non-judgementally; encourage the person to take action, e.g., visit an MHP; and follow up with that person.	Knowledge about the causes and recognition of mental illness had increased over time, increased willingness of the people to talk with others about their MH problems and seek professional help, including decreasing stigma a/w help-seeking.	Can be replicated in the low-resource setting; however, feasibility and effectiveness studies are warranted before implementation.

(Continued)

TABLE 2 | Continued

Name of program/intervention and MH condition	Setting and modality	Component of the program	Condition	Remarks
Workplace	• Workplace wellness program (Canada) • Mode of delivery: offline and online activities	Promoted MH as well as healthy behaviors such as physical activity, adequate sleep, proper nutrition, and work-life balance to encourage presenteeism	Increased presentism, decreasing workplace stress and depression.	• The program needs to be tailored to the needs which could vary from place to place. • Implementation in low-resource settings may be a challenge.
	• Green exercise (Norway) (93) Municipality employees • Condition: workplace stress	Stress Mgt. program: exercising in nature (information meeting and 2 exercise sessions, biking bout and circuit strengthening exercise), over traditional indoor exercise routines, in promoting MH and reducing stress.	Higher environmental potential for restoration and Positive Affect, which persisted on 10 wks follow-up.	• May be logistically challenging. • Require further exploration.
	• Guided E-Learning for Managers • *Mode of delivery:* online	Intervention to identify sources of stress, better understand the link of mental and physical illness and improve managers' capacity to help their employees proactively deal with stressful working conditions	Better understanding among the managers further impacts the psychosocial needs of their teams.	• Lesser engagement of the managers. • Greater involvement is required. • Identifying key personnel challenging.
• School-based program secondary education students (age 13–16 yrs.) (93) • Condition: eating disorders	*Mode of delivery:* Young[E]spirit stepped program (IA) vs. online-psychoeducation intervention (CG)	Screening and customized risk feedback with recommendations for specific self-help modules, monitoring of symptoms and risk behavior and synchronous group and Individual online chats till the individual FTF counseling.	• $n = 1,667$ adolescent receiving the online intervention (IA) in two waves. • *Outcome:* Prevention of EDs • *Results:* significantly reduced ED onset rates in the IA vs. CG) schools in the first wave (5.6%, vs. 9.6%) but no significant diff. in the second wave	Replicability, acceptability, and feasibility concerns in low-resource settings.
Level of prevention: Selective prevention				
• Home-based • Nurse family partnership program (Elmira, Memphis, and Denver) (87). • Condition: Women with some psycho'cal problems due to early pregnancy (<19 yrs), single mother, unmarried women low-socio-economic status, etc.	• *Study design: a* review of 3RCTs • *IA:* women receive home visitation services during pregnancy and in the first 2 yrs post-partum • *CG:* comparison services.	• Specific assessments of maternal, child, and family functioning that correspond to pregnancy and 2 yrs thereafter. • Dietary monitoring, assessment and mgt. of smoking, alcohol, and other illicit substance use; teach women to identify the signs and Symptoms of pregnancy complications; curricula are used to promote parent-child interaction.	• $n = 1,139$. • improved the quality of diets, lesser cigarette smoking, fewer preterm delivery, fewer behavioral problems due to substance use, • IA: Children more communicative and responsive toward their mothers, had lesser emergency visits, lesser childhood maltreatment, fewer behavioral problems.	• Reduce stigma among mothers with psychological problems. • Can be replicated in a country like India with a huge community health workforce (Anganwadi workers, ANM, etc.)

(Continued)

TABLE 2 | Continued

Name of program/intervention and MH condition	Setting and modality	Component of the program	Condition	Remarks
Family healing together program	• Family mental health recovery program. • *Mode of delivery:* Online	Eight-week online aimed at recovery-oriented psychoeducation and coping with an MH challenge in the family.	• *Study design:* Qualitative. • Emphasized hope toward recovery, improved accessibility. • The curriculum was user friendly incorporating diversity to make it useful for everyone. • Greater need of such programs Need of scholarship and sponsorship for participation • The service fee is a limitation.	Replication in resource-poor and LMIC can be an issue.
• (SHUTi) (Australia) (94) • *Condition:* sleep problems in patients with a history of depression	• Mode of delivery: online • Unguided fully automated Internet-based intervention for (SHUTi) or to Healthwatch.	• Six sequential modules comprising Sleep hygiene, cognitive restructuring, relapse prevention, • Maintenance of sleep diary • *Outcome:* PHQ-9	• *N* = SHUTi (*n* = 574) or HealthWatch (*n* = 575). • Significant improvement in complaints of insomnia and depression symptom at 6 wks and 6 months FUs (vs. Healthwatch gr.). • Decrease in prevention of the depressive episose non-significant	Long-term data is warranted to conclude its efficacy in the prevention of depressive episodes.
Internet chat groups for relapse prevention (95) • Conditions: various mental illnesses	• Transdiagnostic non-manualized Internet-chat group as a stepped-care intervention following in-patient psychotherapy. • Mode of delivery: online	• *Group activities:* 8–10 participants/gr., who communicate with a therapist in an internet chat room @ once/week at a fixed time for 1 ½ h to communicate in written format. • Number of sessions:10–12 • *The focus of chat:* support patients in maintaining treatment gains and assisting them in practicing skills they learned during their hospital stay to everyday life.	• *N* = 152, • *IA:* internet chat groups • *CG:* TAU • Outcome: 1 year after discharge. • For any relapse: fewer participants (22.2%) of IA (vs. CG: 46.5%) experienced a relapse	Generalizability across the setting and users' privacy could be the issues.
Level of prevention: Indicated prevention				
• Get.ON mood enhancer prevention (96) • Condition: sub-syndromal depression	• Internet-based cognitive-behavioral intervention (IA) vs. online passive psychoeducation intervention (CG). • *Mode of delivery:* online	• Involves behavior therapy and problem-solving therapy. • Total six lessons with two sessions/week, • Lessons involve text, exercises, and testimonials which are interactive involving Audio (relaxation ex.)-Visual clips	• *N* = 406, • Significantly lesser participants of the IA (32 vs. 47% CG) experienced an MDD at 12 m follow-up. • NNT = 5.9	The utility needs to be established in those with previous depressive episodes.

(Continued)

TABLE 2 | Continued

Name of program/intervention and MH condition	Setting and modality	Component of the program	Condition	Remarks
		(concept of behavioral activation). Transfer of tasks (home assignments) in daily routine.		
• Internet-based CBT (97) • Condition: self-report symptoms of depressive, but not meeting the diagnostic criteria for MDD	• Internet-based CBT (Delivered in comic form) vs. waitlist. • Comic format increases the motivation of the participants and facilitated easy learning.	• Six- web-based training in stress mgt. delivered over 6 weeks with each session of 30 min/week. • *Components:* self-monitoring, cognitive restructuring, assertiveness, problem-solving, and relaxation with homework	• $N = 822$ • lower incidence of the depressive episode at the 12 months FU, with the prevalence of 0.8 and 3.9% in IA and CG, respectively. • NTT = 32	Needs to be tailored as per the different cultural contexts.
• Project UPLIFT (98) • Condition: adult epilepsy patients with • Sub-syndromic depression	• 8-week web or telephone-delivered mindfulness-based • stand-alone intervention vs. TAU waitlist (CG)	• 8-module, delivered in a group format. • Component: increase knowledge about depression; observing, challenging, and changing of thoughts; relaxing and coping techniques; attention and mindfulness; focusing on pleasure; the significance of reinforcement; and relapse prevention. • *Outcome:* self-reported outcomes on depression and MDD, knowledge/skills, and life satisfaction. • At baseline, 10 weeks, and 20 weeks FUs.	• $N = 64$ • *Result:* incidence of depressive episode and depressive symptoms were significantly lower IA vs. CG. No difference b/w web-based vs. telephonic intervention. • Better knowledge, skills and life satisfaction increased significantly in the IA.	• Increased accessibility for persons with epilepsy whose mobility has been affected by the illness. • Could cater to the hard-to-reach population. • Can be replicated in other disabling medical illnesses.
• Naslund et al. (99) • Digital Technology for Building Capacity of Non-specialist Health Workers for Task-Sharing and Scaling Up Mental HealthCare Globally	• Type of article: • Perspective. • Role of digital technology for enabling non-specialist health professionals in implementing evidence-based MH interventions	• Use of digital platforms in different LMICs for providing training to HCWs, diagnosis and treating mental disorders and providing an integrated service. Such as: • The Atmiyata Intervention and The SMART MH Project in India, • TACTS for Thinking Healthy Program in Pakistan, • The Friendship Bench in Zimbabwe, • The Allillanchu Project in Peru, • Community-based LEAN in China, • EXPONATE for Perinatal Depression in Nigeria	Some of the interventions have reported significant positive outcomes while other interventions are being evaluated for their effectiveness	These interventions highlight the potential of better implementation of task sharing with non-specialist health professional approach and may help in reducing the global treatment gap esp. in low resource countries

(Continued)

TABLE 2 | Continued

Name of program/intervention and MH condition	Setting and modality	Component of the program	Condition	Remarks
• Maron et al. (100) • Manifesto for an international digital mental health network	• The international network for digital mental health (IDMHN): work for implementation of digital technologies in MH services like DocuMental: a clinical decision support system (DSS) for MH service staff including physician, nurses, health care managers and coordinators • i-PROACH: a cloud based intelligent platform for research, outcome, assessment and care in mental health utilizing DSS, algorithm on generic data, digital phenotyping, and artificial intelligence	• Diagnostic module: digitized structured ICD-10 diagnostic criteria liked with DSS algorithms for increased accuracy and allow verification and differentiation. • Treatment module: linked to DSS algorithms for medication and treatment plan selection which can help in planning treatment in a standardized manner and to avoid mistreatment • History and routine assessment modules: for comprehensive and standardized assessments	Such novel interventions/algorithm have potential to address the current mental health needs especially by making it more transparent, personalized, standardized, more proactive and responsive for collaboration with other specialties and organizations.	This type of model may be best suited for HICs at the same time implementation in LMICs need to be assessed
• Antonova et al. (101) • Coping With COVID-19: Mindfulness-Based Approaches for Mitigating Mental Health Crisis	Type of article - Viewpoint	Various interventions that have utilized mindfulness skills like observing, non-judging, non-reacting, acting with awareness, and describing such as NHS's Mind app, Headspace (teaching meditation *via* a website or a phone application)	Help healthcare personnel to cope with excessive anxiety, panic, and exhaustion while fulfilling their duties and responsibilities during the COVID-19 pandemic	Such novel interventions based on the mindfulness practices can help individuals to cope with the difficulties posed by major life events such as pandemic.

[#]*MH stigma, understanding MH and wellness, information about different mental disorders, experiences of mental illnesses, help seeking and garnering support, and importance of positive MH.*

a/w, associated with; A-V, audio-visual; b/w, between; CBT, Cognitive Behavioral Therapy; CES-Dep., Center for Epidemiologic Studies-Depression scale; CG, control group; FU, follow-up; GAD, generalized anxiety disorders-7; IA, intervention arm; HCWs, Health Care Workers; LMIC, low and middle-income countries; MDD, major depressive disorders; mgt, management; MH, mental health; MHP, mental health professional; MINI, mini neuropsychiatric interview; NNT, number needed to treat; PHQ-9, patient health questionnaire; TAU, treatment as usual.

Challenges in Implementing Novel MH Promotion and Prevention Strategies

Although novel interventions, particularly internet and mobile-based interventions (IMIs), are effective models for MH promotion and prevention, their cost-effectiveness requires further exploration. Moreover, their feasibility and acceptability in LMICs could be challenging. Some of these could be attributed to poor digital literacy, digital/network-related limitations, privacy issues, and society's preparedness to implement these interventions.

These interventions need to be customized and adapted according to local needs and context, for which implementation and evaluative research are warranted. In addition, the infusion of more human and financial resources for such activities is required. Some reports highlight that many of these interventions do not align with the preferences and use the pattern of the service utilizers. For instance, one explorative research on mental health app-based interventions targeting youth found that despite the burgeoning applications, they are not aligned with the youth's media preferences and learning patterns. They are less interactive, have fewer audio-visual displays, are not youth-specific, are less dynamic, and are a single touch app (107).

Furthermore, such novel interventions usually come with high costs. In low-resource settings where service utilizers have limited finances, their willingness to use such services may be doubtful. Moreover, insurance companies, including those in high-income countries (HICs), may not be willing to fund such novel interventions, which restricts the accessibility and availability of interventions.

Research points to the feasibility and effectiveness of incorporating such novel interventions in routine services such as school, community, primary care, or settings, e.g., in low-resource settings, the resource persons like teachers, community health workers, and primary care physicians are

already overburdened. Therefore, their willingness to take up additional tasks may raise skepticism. Moreover, the attitudinal barrier to moving from the traditional service delivery model to the novel methods may also impede.

Considering the low MH budget and less priority on the MH prevention and promotion activities in most low-resource settings, the uptake of such interventions in the public health framework may be lesser despite the latter's proven high cost-effectiveness. In contrast, policymakers may be more inclined to invest in the therapeutic aspects of MH.

Road Ahead

Such interventions open avenues for personalized and precision medicine/health care vs. the traditional model of MH promotion and preventive interventions (108, 109). For instance, multivariate prediction algorithms with methods of machine learning and incorporating biological research, such as genetics, may help in devising tailored, particularly for selected and indicated prevention, interventions for depression, suicide, relapse prevention, etc. (79). Therefore, more research in this area is warranted.

To be more clinically relevant, greater biological research in MH prevention is required to identify those at higher risk of developing given mental disorders due to the existing risk factors/prominent stress (110). For instance, researchers have utilized the transcriptional approach to identify a biological fingerprint for susceptibility (denoting abnormal early stress response) to develop post-traumatic stress disorders among the psychological trauma survivors by analyzing the expression of the Peripheral blood mononuclear cell gene expression profiles (111). Identifying such biological markers would help target at-risk individuals through tailored and intensive interventions as a form of selected prevention.

Similarly, such novel interventions can help in targeting the underlying risk such as substance use, poor stress management, family history, personality traits, etc. and protective factors, e.g., positive coping techniques, social support, resilience, etc., that influences the given MH outcome (79). Therefore, again, it opens the scope of tailored interventions rather than a one-size-fits-all model of selective and indicated prevention for various MH conditions.

Furthermore, such interventions can be more accessible for the hard-to-reach populations and those with significant mental health stigma. Finally, they play a huge role in ensuring the continuity of care, particularly when community-based MH services are either limited or not available. For instance, IMIs can maintain the improvement of symptoms among individuals previously managed in-patient, such as for suicide, SUDs, etc., or receive intensive treatment like cognitive behavior therapy (CBT) for depression or anxiety, thereby helping relapse prevention (86, 112). Hence, such modules need to be developed and tested in low-resource settings.

IMIs (and other novel interventions) being less stigmatizing and easily accessible, provide a platform to engage individuals with chronic medical problems, e.g., epilepsy, cancer, cardiovascular diseases, etc., and non-mental health professionals, thereby making it more relevant and appealing for them.

Lastly, research on prevention-interventions needs to be more robust to adjust for the pre-intervention matching, high attrition rate, studying the characteristics of treatment completers vs. dropouts, and utilizing the intention-to-treat analysis to gauge the effect of such novel interventions (78).

RECOMMENDATIONS FOR LOW-AND-MIDDLE-INCOME COUNTRIES

Although there is growing research on the effectiveness and utility of mental health promotion/prevention interventions across the lifespan and settings, low-resource settings suffer from specific limitations that restrict the full realization of such public health strategies, including implementing the novel intervention. To overcome these challenges, some of the potential solutions/recommendations are as follows:

- The mental health literacy of the population should be enhanced through information, education, and communication (IEC) activities. In addition, these activities should reduce stigma related to mental problems, early identification, and help-seeking for mental health-related issues.
- Involving teachers, workplace managers, community leaders, non-mental health professionals, and allied health staff in mental health promotion and prevention is crucial.
- Mental health concepts and related promotion and prevention should be incorporated into the education curriculum, particularly at the medical undergraduate level.
- Training non-specialists such as community health workers on mental health-related issues across an individual's life course and intervening would be an effective strategy.
- Collaborating with specialists from other disciplines, including complementary and alternative medicines, would be crucial. A provision of an integrated health system would help in increasing awareness, early identification, and prompt intervention for at-risk individuals.
- Low-resource settings need to develop mental health promotion interventions such as community-and school-based interventions, as these would be more culturally relevant, acceptable, and scalable.
- Utilizing a digital platform for scaling mental health services (e.g., telepsychiatry services to at-risk populations) and training the key individuals in the community would be a cost-effective framework that must be explored.
- Infusion of higher financial and human resources in this area would be a critical step, as, without adequate resources, research, service development, and implementation would be challenging.
- It would also be helpful to identify vulnerable populations and intervene in them to prevent the development of clinical psychiatric disorders.
- Lastly, involving individuals with lived experiences at the level of mental health planning, intervention development, and delivery would be cost-effective.

CONCLUSION

Clinicians, researchers, public health experts, and policymakers have increasingly realized mental health promotion and prevention. Investment in Preventive psychiatry appears to be essential considering the substantial burden of mental and neurological disorders and the significant treatment gap. Literature suggests that MH promotive and preventive interventions are feasible and effective across the lifespan and settings. Moreover, various novel interventions (e.g., internet- and mobile-based interventions, new therapies) have been developed worldwide and proven effective for mental health promotion and prevention; such interventions are limited mainly to HICs.

Despite the significance of preventive psychiatry in the current world and having a wide-ranging implication for the wellbeing of society and individuals, including those suffering from chronic medical problems, it is a poorly utilized public health field to address the population's mental health needs. Lately, researchers and policymakers have realized the untapped potentialities of preventive psychiatry. However, its implementation in low-resource settings is still in infancy and marred by several challenges. The utilization of novel interventions, such as digital-based interventions, and blended and stepped-care models of care, can address the enormous mental health need of the population. Additionally, it provides mental health services in a less-stigmatizing and easily accessible, and flexible manner. More research concerning this is required from the LMICs.

AUTHOR CONTRIBUTIONS

VS, AK, and SG: methodology, literature search, manuscript preparation, and manuscript review. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.898009/full#supplementary-material

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 04 August 2022
DOI 10.3389/fpsyt.2022.893235

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OPEN ACCESS

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

RECEIVED 10 March 2022
ACCEPTED 12 July 2022
PUBLISHED 04 August 2022

CITATION
Gao R-C, Wu L, Shi P-L, Sang N, Hao M and Wu G-C (2022) The impact of distress disclosure and anxiety on the association between social support and quality of life among Chinese women with systemic lupus erythematosus.
Front. Psychiatry 13:893235.
doi: 10.3389/fpsyt.2022.893235

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The impact of distress disclosure and anxiety on the association between social support and quality of life among Chinese women with systemic lupus erythematosus

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The evidence on the relationship between social support and quality of life in female systemic lupus erythematosus (SLE) patients is complex. The purpose of this study was to explore the impacts of distress disclosure and anxiety on the association between social support and quality of life among Chinese women with SLE. A cross-sectional study was conducted, and 237 samples were obtained. Measures included demographic characteristics, Lupus Quality of Life (LupusQoL), social support rate scale (SSRS), distress disclosure index (DDI), and self-rating anxiety scale (SAS). Descriptive statistics, correlation analysis, and moderated mediating effect analysis were carried out. The LupusQoL was negatively correlated with age, systemic lupus erythematosus disease activity index (SLEDAI), DDI, and SAS. SSRS had a positive predictive effect on the LupusQoL, while SLEDAI and DDI had the opposite effect. SAS had a negative predictive effect on the LupusQoL. There were interactive effects of SAS and DDI on LupusQoL. In the moderated mediation model, SAS played moderating effect in the role of DDI on LupusQoL; the DDI of female patients with SLE played a partial mediator role, the mediation effect was 0.19, and the mediation effect ratio was 33.3%. In conclusion, to pay attention to the QOL, we should consider the mediator role of distress disclosure and the moderating role of anxiety.

KEYWORDS

disclosure, anxiety, social support, quality of life, systemic lupus erythematosus

Introduction

Systemic lupus erythematosus (SLE) is a typical autoimmune disease, with systemic multi-system and multi-organ involvement, recurrence, and remission alternately. So far, the pathogenesis has not been fully understood, but it may be related to the environment, hormones, and nutrition (1). Its prevalence is estimated to be 6.5–178.0 per 100,000 people, with an annual incidence ranging from 0.3 to 23.7 per 100,000 people (2). The prevalence varies by population; African Americans and Asians are more likely to have SLE (3). The prevalence rate in China is about 30–70 per 100,000 people, and the ratio of prevalence between men and women, especially in women of childbearing age (4) is about 1:10–12 (5). SLE is still uncurable. SLE patients experience significant negative emotional effects during treatment as a result of adverse factors such as recurrent episodes, unsatisfactory treatment effect, and heavy economic burden, which seriously affect the physical and mental health of middle-aged and young women. Although there has been continuous improvement in the level of diagnosis and treatment and the survival rate of patients with SLE has been greatly improved (6), the quality of life is still very low, which is lower than that of other chronic diseases (4). Quality of life has become an important index to evaluate the long-term prognosis of patients with SLE (7).

The findings of this study suggest that socio-demographic factors, such as older age, overweight, occupation, income, payment, marriage, and educational level, are major predictors of poor QoL in patients with SLE. SLE clinical manifestations, such as disease activity, disease duration, and organ damage, are also important factors in QoL (8–10). Studies have shown that psychological factors also affect the quality of life in patients with SLE (11).

Social support was conducive to actively facing the disease, effectively reducing psychological distress, and improving the quality of life (12), and has been found to alleviate the negative impacts of chronic diseases on QOL (13). There is substantial evidence that SLE affects Asian and indigenous populations as well as people of African descent more frequently; it has a more severe course, causes more organ damage, and has a higher mortality rate than whites. Poor social support is common in the non-white population and has a negative impact on the course and outcome of SLE (14). The quality of life in the United States of America, Canada, Asia, and Europe differed by gender. Women with SLE have more social support, but their functional tendencies in physical health and pain-vitality are poor (15). Furthermore, the level of social support was closely related to the quality of life in Chinese patients with SLE (11). However, the role of social support on the quality of life in patients with SLE is unclear.

As a predictor of mental health, the distress disclosure index (DDI) is the choice of emotional concealment and emotional exposure. It is the way an individual deals with emotions; patients may deal with humiliation by concealing their illness (16). It is a fundamental interpersonal process that is influenced by a variety of factors, including the targets of disclosure, the depth or type of information to be conveyed, and the breadth or amount of information (17). According to the findings of functional magnetic resonance imaging, self-disclosure can activate both reward-related and social-cognition-related brain regions, particularly those related to psychological internalization and point of view selection, implying that self-disclosure is a rewarding behavior with intrinsic value to the subject (18). In the field of chronic diseases, several studies have shown that improving quality of life can be achieved by improving self-disclosure (19, 20). A study by Corsetti et al. showed that Tandem-Psychotherapy can improve the level of distress disclosure of autoimmune patients with high levels of pain and related psychiatric comorbidities, reduces psychological distress, and improves the quality of life (21). Therefore, we speculate that the level of pain manifestation may affect the quality of life. In patients with SLE, fatigue, memory or concentration deterioration, activity limitation, and temporary or permanent damage to the appearance cause psychological distress (22, 23). However, the effect of distress disclosure level on the quality of life of patients with SLE has not been reported.

It has been reported that the social support of the rural elderly affected the health-related quality of life through the mediating effect of self-disclosure (24). Meanwhile, the self-disclosure of college students played a mediatory role in social support and subjective wellbeing (25). Brown et al. (26) also pointed out that social support affected HIV disclosure, and HIV-positive status disclosure concerns affected the quality of life (20). In addition, a study by Logie et al. (27) has proved that HIV disclosure mediated the effect of social support on the quality of life through a structural equation model. Therefore, we speculated that social support may affect the quality of life indirectly through disclosure.

Patients with SLE have been found to have greater psychological distress; it has been revealed that anxiety seriously affected the quality of life of patients with SLE (28), Conceio et al. (29) also found that psychological treatment can alleviate patients' anxiety and depression and thus improve their quality of life. But there is also a study showing no relationship between anxiety and quality of life (30). The levels of disclosure and anxiety reflect psychological distress to a certain extent, which may jointly affect or moderate the quality of life (31). However, very limited studies have paid attention to the relationship between distress disclosure and anxiety.

To clarify the association of social support, distress disclosure, anxiety, and quality of life in female patients with SLE, we further explore the following contents: (1) occupation,

SLEDAI, BMI, residence, marital status, disease duration, payment, education, monthly income, and age had significant differences in the quality of life of patients with SLE; (2) social support affected the quality of life; (3) distress disclosure, as a mediator variable, played a mediator role in the path from social support to quality of life; and (4) anxiety, as a moderator variable, played a moderator role in the effect of distress disclosure on quality of life.

Materials and methods

Design and participants

From 13/04/2021 to 24/05/2021, a cross-sectional convenient sampling survey was conducted in three Grade 3A hospitals in Hefei, Anhui province, China. A total of 237 female patients with SLE were recruited. Inclusion criteria: (1) the diagnosis meets the SLE classification criteria revised by the American College of Rheumatology (ACR); (2) voluntarily participates in the research with informed consent; (3) clear consciousness, certain comprehension, and language skills; (4) female; and (5) age $\geq$ 18 years old. Exclusion criteria: (1) severe infection or lupus encephalopathy; and (2) with other malignant tumors or serious life-threatening diseases.

The study participants were mainly 30–60 years old (42.14 and 13.86), with a short duration of disease ($\leq$5 years) and a moderate income ($299–$598). A total of 44.3% of patients were with moderate and severe disease activity of SLE.

Procedure

The inpatients from the Department of Rheumatology and Immunology at the First Affiliated Hospital of Anhui Medical University and Anhui Provincial Hospital were investigated after providing informed consent. R-CG and LW, two trained graduate student majoring in nursing, conducted this study independently and obtained informed consent from department leaders, teachers, and patients before the test. Within the department, we used a convenient sampling method and chose clean, relatively interference-free rooms as survey sites, avoided treatment, dine, and lunch times. The questionnaire was filled in anonymously. The subjects were required to answer the questionnaire truthfully and independently, and the questionnaire was withdrawn on the spot. If the patients could not complete the questionnaire independently, the researchers assisted them to complete it. It will take 5–10 min to complete the questionnaire based on the current situation. The integrity of the questionnaire was checked on the spot and corrected in time. A total of 249 questionnaires were received, the recovery rate of the questionnaire was higher than 95%, and 237 female patients with SLE were finally included.

Measures

Demographic characteristics: A total of 11 demographic variables were included, including age, body mass index (BMI), duration, SLE disease activity index (SLEDAI), residence, payment (medical insurance), education, marital status, monthly income, occupation, and duration of drugs.

Variables and instruments

Lupus Quality of Life (LupusQoL): Lupus QOL is a measure developed by McElhone et al. (32) in 2007 to assess the quality of life of patients with SLE in Great Britain, and it has been also translated into 77 languages for use in 51 countries (33). LupusQoL was used to evaluate the disease-specific quality of life. Its sensitivity was relatively high and increased SLE-specific items and measurement properties are better (34) as compared to the SF36 scale. The difference between the outcomes by the SF-36 and disease-specific health-related quality of life was previously reported (35), although there was comparability between the traditional SF-36 scale and the LupusQoL scale (36). A study has shown that LupusQoL was more suitable for measuring the quality of life of patients with SLE (37). A 5-point scale (score range of 0–4) was applied to assess the disease-related conditions in the last 4 weeks. It contains eight domains with a total of 34 items. Specifically, physical health, planning, pain, intimate relationships, burden to others, emotional health, body image, and fatigue. Each dimension can be converted to 0–100 (original score/number of entries/4) $\times$ 100 (38). The total score of the quality of life was expressed by the sum of the scores of each dimension (after conversion), or the total score was calculated directly by using the above method (39). This study used the original total score for analysis, the total original score range was 0–136. Lu et al. (34) of China formed the Chinese version of LupusQOL after cultural adjustment, with good internal consistency (0.811–0.965), good reliability, and validity. Cronbach's α of the complete scale was 0.919 in this study.

Social Support Rate Scale (SSRS): SSRS was used to assess the level of social support, it contains 10 items with three dimensions: objective support, subjective support, and utilization of support. The higher the score, the higher the perceived social support. It has high reliability and validity. SSRS has shown good psychometric properties, with Cronbach's coefficients ranging from 0.89 to 0.94 in each dimension (40). In this study, Cronbach's α was 0.692.

The Distress Disclosure Index (DDI): The DDI was described by Kahn and Hessling (41), they found that the average score of female college students was 42.21 and the standard deviation was 9.16. This study applied the revised version of DDI by Li et al. Cronbach's α coefficient is 0.866. It is used to evaluate the degree of self-disclosure of patients. The scale consists of 12 items, each item is 1–5 points, and the total score range from 12 to 60. The higher the score, the higher the degree of disclosure, suggesting negative emotional handling with good psychometric properties (42). Cronbach's α coefficient range from 0.89 to 0.95 (43), and it was 0.965 in this study, indicating that the internal consistency of the scale was excellent.

Self-Rating Anxiety Scale (SAS): SAS is a self-reporting tool for assessing anxiety levels. It consists of 20 entries, each with a score of 1–4. SAS has demonstrated good psychometric properties (44). Wang et al. (45) tested localization and validity; Cronbach's α coefficient was 0.931. A total score of 40 is the critical point, the higher the score, the more serious the anxiety. Cronbach's α was 0.715.

Ethic approval and consent to participate

The oral informed consent of all patients was approved by the Ethics Research Committee of the Second Affiliated Hospital of Anhui Medical University (reference number: YX2021-088).

Statistical analysis

EpiData 3.1 software was applied for data input. SPSS 23.0 was used for data analysis. Quantitative variables were represented by the mean and standard deviation (SD), and categorical variables were expressed as counts and percentages. A Pearson correlation analysis was carried out among variables, including LupusQoL, age, duration, SSRS, DDI, and SAS. We conducted a prior hierarchical regression analysis to examine the influencing factors of SLE patients' quality of life, taking into account that demographic variables may interfere with the model. Age, BMI, disease duration, residence, marital status, monthly income, payment, education, occupation, and SLEDAI were incorporated into the model as control variables. To test the moderated mediation effect among SSRS, DDI/SAS, and LupusQoL, we performed a multiple regression analysis. To further clarify whether SAS played a moderating role, it was verified by PROCESS model 5, model 7, and model 14, respectively. When model 14 was used in SPSS macro, the moderated mediator effect model was verified. Simple slope analysis showed the interaction effect among SAS and DDI on quality of life, the path coefficient of moderated mediation model was given. The number of bootstrap samples for percentile bootstrap confidence intervals was 5,000. The statistical results were tested by a two-tailed test ($p < 0.05$).

Results

Demographic characteristics and main variables of all female patients with systemic lupus erythematosus

The average DDI of female patients with SLE was lower than the normal for college students, 73 patients (30.8%) were higher than the normal for female college students. Compared with college students, DDI levels in patients with SLE were as follows: low level: 100 (42.2%), medium level: 78 (32.9%), and high level: 59 (24.9%).

The scores (mean and standard deviation) of lupus quality of life in eight dimensions were as follows: physical health: 75.4 and 16.94; pain: 75.46 and 18.97; planning: 68.53 and 17.22; intimate relationships: 84.39 and 18.84; burden to others: 49.68 and 23.87; emotional health: 75.04 and 16.23; body image: 73.76 and 21.24; and fatigue: 56.17 and 17.02. The score of intimate relationships was the highest, and burden to others was the lowest. The original total score of lupus quality of life was 95.86 and 16.05. **Table 1** shows that LupusQoL had statistical significance in occupation.

Correlation analysis of the distress disclosure index, self-rating anxiety scale, social support rate scale, and lupus quality of life in female patients with systemic lupus erythematosus

As shown in **Table 2**, LupusQoL had a strong correlation with age, SLEDAI, SSRS, DDI, and SAS. The quality of life was positively correlated with social support, while other variables were negatively associated with social support. There was no significant correlation between SAS and SSRS, but it was significantly related to DDI and quality of life. The correlation between the quality of life and the duration of the disease was not statistically significant.

The hierarchical regression analysis on lupus quality of life

Demographic variables affect the SLE quality of life ($F = 3.18$, $p = 0$); age, SLEDAI, and payment affect SLE patients' quality of life and have a disturbing effect on the model. After controlling age, SLEDAI, and payment, SSRS has a positive effect on the quality of life ($\beta = 0.61$, $p = 0$). DDI, SAS, and

DDI*SAS had a negative impact on the quality of life (β = −3.31, $p = 0.02$; β = −1.12, $p = 0$; β = −0.01, $p = 0.02$), as shown in Table 3.

TABLE 1 Demographic characteristics of LupusQoL ($N = 237$).

Variables	n (%)	LupusQoL		t/F	p
		Mean	SD		
		95.86	16.05		
Lupus nephritis				0.40	0.69
No	167 (70.5%)	96.13	16.49		
Yes	70 (29.5)	95.24	15.07		
Residence				−1.57	0.12
Rural	124 (52.3%)	94.33	18.01		
Town	113 (47.7%)	97.55	13.47		
Payment (medical insurance)				1.98	0.14
Self-supporting	39 (16.5%)	99.05	13.54		
Residents	157 (66.2%)	94.39	16.60		
Staff	41 (17.3%)	98.46	15.69		
Education				1.92	0.13
Primary or below	85 (35.9%)	93.54	14		
Middle school	97 (40.9%)	95.65	18.49		
Technical degree	34 (14.3%)	98.59	15.08		
College or above	21 (8.9%)	101.86	11.32		
Marital status				1.20	0.31
Unmarried	37 (15.6%)	96.89	18.99		
Married	194 (81.9%)	95.88	15.54		
Divorced	3 (1.3%)	99.00	3.		
Widowed	3 (1.3%)	79.00	11.79		
Monthly income ($)				1.68	0.17
≤299	68 (28.7%)	93	18.43		
299–598	113 (47.7%)	95.81	15.42		
598–897	51 (21.5%)	99.57	12.68		
≥897	5 (2.1%)	98.20	22.91		
Occupation				3.99	0.01*
On-the-job	74 (31.2%)	99	16.68		
Students	15 (6.3%)	92.60	21.09		
Farmer/ self-employed	52 (21.9%)	99.44	11.96		
Unemployed/ retired	96 (40.5%)	92.02	15.90		
Duration of disease				0.70	0.62
≤2	72 (30.4%)	96.90	16.29		
3–5	41 (17.3%)	99.17	14.80		
6–10	68 (28.7%)	94.10	15.43		
11–15	25 (10.5%)	94.76	13.48		
16–20	12 (5.1%)	94.67	15.26		
>20	19 (8.0%)	93.32	22.89		

*$p < 0.05$.
SD, Standard deviation; BMI, Body Mass Index; SLEDAI, Systemic Lupus Erythematosus Disease Activity Index.

The test of moderated mediation effect

Age and disease activity index were used as control variables. Regression analysis detected the moderated mediating effect model. SSRS had a positive predictive effect on the lupus quality of life, while SLEDAI and DDI had the opposite effect. In addition, SAS had a negative predictive effect on the quality of life. The DDI and SLEQOL had a significant negative correlation (β = −0.14, $p = 0.05$). Although the coefficient of social support and quality of life decreased after adding DDI, it remained positively significant (β = 0.14, $p = 0.05$), indicating that DDI plays a partial mediating role between social support and quality of life. Quality of life was influenced by the interaction between DDI and SAS (β = −0.19, $p < 0.01$). SAS acts as a moderator, moderates the effect of DDI on quality of life, as shown in Table 4.

To further clarify the moderation effect of SAS in this mediation model, we applied Model 14 (a moderated mediator) in PROCESS macro to do the Bootstrap test. Figure 1 shows the model regression coefficients. In the mediator effect model of SSRS-DDI-LupusQoL, DDI was selected as the mediator variable; social support directly affected lupus quality of life. The direct effect was significant, DDI played a partial mediator role in the mediation model. The total effect was 0.57, the mediation effect was 0.19, and the mediation effect ratio was 33.3%. In the mediating effect model, when SAS was used as a moderating variable of the DDI-LupusQoL pathway, SAS had a moderating effect. Furthermore, a simple slope test found that compared with individuals with high anxiety level, individuals with low anxiety level had a more significant positive predictive effect of self-disclosure on the quality of life, indicating that with the increase in anxiety level, the positive predictive effect of self-disclosure on the quality of life gradually decreased, as shown in Figure 2.

Therefore, social support affected the lupus quality of life; some of them were directly affected, followed by distress disclosure as a mediator, and finally moderated the effects of distress disclosure on the quality of life through anxiety.

Discussion

The quality of life of patients with SLE could not be well-controlled even in remission (46), however, the quality of life should be improved pertinently. Occupation, payment age, and disease activity may influence the quality of life of patients with SLE. The disease burden of lupus patients can affect their quality of life, but working or having a certain income can help (3, 47). Elera et al. also contend that sociodemographic factors, such as older age, poverty, and a low education level, are the primary predictors of poor quality of life in patients with SLE (48). According to this study, quality of life was negatively correlated with disease activity, which was consistent with

TABLE 2 Correlation analysis among variables in female patients with SLE.

Variables	Mean	SD	LupusQoL	Age	Duration	SLEDAI	SSRS	DDI	SAS
LupusQoL	95.86	16.05	1						
Age	42.14	13.86	−0.22**	1					
Duration	8.16	7.37	−0.10	0.29**	1				
SLEDAI	9.25	4.95	−0.22**	0.05	0.12	1			
SSRS	40.33	5.85	0.26**	−0.10	−0.12	−0.02	1		
DDI	34.30	13.18	−0.29**	0.27**	0.09	−0.01	−0.46**	1	
SAS	34.53	5.68	−0.46**	0.21**	0.02	0.13*	−0.10	0.18**	1

*$p < 0.05$; **$p < 0.01$.
LupusQoL, Lupus Quality of Life; SLEDAI, Systemic Lupus Erythematosus Disease Activity Index; SSRS, Social Support Rate Scale; DDI, The Distress Disclosure Index; SAS, Self-Rating Anxiety Scale.

previous research; the higher the disease activity, the worse the quality of life (38, 49). Furthermore, a previous study found that the quality of life was positively correlated with the duration of the disease; however, this was not found in this study. Therefore, the influence of disease duration on lupus quality of life needs to be demonstrated further (50).

This study indicated that social support, distress disclosure, and anxiety, were predictors of the lupus quality of life. After eliminating the interference of the age and disease activity index, social support has a positive influence on quality of life; and distress disclosure, and anxiety have a negative influence on the quality of life. Social support may be one of the direct factors affecting the quality of life of patients with lupus. Self-disclosure partially mediated the relationship between social support and quality of life. Anxiety moderated the latter half of the impact of social support on quality of life.

TABLE 3 Hierarchical regression analysis on LupusQoL.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
(constant)	103.09	81.56	90.40	125.94	123.62
BMI	0.41	0.32	0.306	0.36	0.34
Age	−0.24*	−0.20*	−0.17	−0.08	−0.09
Duration of disease	−0.06	−0.02	−0.04	−0.10	−0.09
Residence	3.14	2.58	2.56	1.91	2.24
Education	−0.11	0.36	0.45	0.61	0.30
Marital status	1.40	0.76	1.22	0.88	0.92
Monthly income	0.02	−0.58	−0.43	−0.31	−0.36
Payment	−1.66	−2.13	−2.96	−3.48*	−3.40
Occupation	−1.21	−1.16	−1.08	−0.84	−0.75
SLEDAI	−0.67***	−0.67***	−0.68***	−0.51**	−0.51**
SSRS		0.61***	0.44*	0.39*	0.30
DDI			−3.31*	−2.65*	3.71
SAS				−1.12***	−0.65*
DDI*SAS					−0.01*
R^2	0.12	0.17	0.19	0.33	0.35
ΔR^2	0.12	0.05	0.02	0.14	0.02
F	3.18	4.19	4.38	8.54	8.51

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
SLEDAI, Systemic Lupus Erythematosus Disease Activity Index; SSRS, Social Support Rate Scale; DDI, The Distress Disclosure Index; SAS, Self-Rating Anxiety Scale.

The social support of patients with SLE is correlated with their quality of life, which may be because higher social support means patients get more subjective and objective help and utilization of support, which increases patients' confidence in facing difficulties, improves treatment compliance and is conducive to the improvement of their quality of life, which is consistent with the results of previous studies (51). In this study, self-disclosure was negatively correlated with quality of life, which may be due to the fact that patients with SLE suffer great pain in many aspects, including physiology, disease, treatment methods, and psychosocial function, which has a great impact on the quality of life, patients with higher levels of self-disclosure may suffer more pain and have a greater impact on the quality of life and are more willing to disclose. Currently, there is still no cure for SLE, which is prone to depression, anxiety, and other emotions of varying degrees during the disease (52); negative emotions are not conducive to the remission of disease and may reduce the quality of life. Although research has confirmed the impact of age on quality of life (53), a study by Khanna et al. (54) showed that the quality of life of patients with SLE was not affected by age and duration of disease. In this study, the third step of the multiple regression analysis found that age did not affect the quality of life, which was different from the results of the first test; so the effect of age on the quality of life of female patients with SLE needs to be further studied. Also, literature displayed that the quality of life was positively correlated with the duration of the disease (48), but it was not found in this study, which is consistent with Khanna et al.'s (54) findings.

At present, scholars generally agree on the role of social support in promoting the quality of life (55); social support was the only positive predictor in this study. The level of DDI can reflect patients' willingness to disclose, investigating the level of DDI was conducive to a more comprehensive evaluation of psychological status. This study pointed out the significance of DDI in female patients with SLE. On the one hand, SSRS directly

TABLE 4 The multiple regression analysis on LupusQoL.

Variables	LupusQoL			DDI			LupusQoL		
	B (95%CI)	β	t	B (95%CI)	β	t	B (95%CI)	β	t
Age	−0.21 (−0.35, −0.07)	−0.18	2.98**	0.21 (0.11, 0.32)	0.22	3.92**	−0.10 (−0.023, 0.03)	−0.09	1.54
SLEDAI	−0.66 (−1.05, −0.27)	−0.20	3.36**	−0.08 (-0.38, 0.22)	−0.03	0.54	−0.44 (−0.79, −0.09)	−0.14	2.50*
SSRS	0.65 (0.32, 0.98)	0.24	3.91**	−0.99 (−1.24, −0.74)	−0.44	7.75**	0.38 (0.05, 0.70)	0.14	2.26*
DDI							−0.17 (−0.32, −0.02)	−0.14	2.19*
SAS							−1.05 (−1.36, −0.74)	−0.37	6.63**
DDI*SAS							−0.04 (−0.07, −0.02)	−0.19	3.45**
F	13.22***			27.55***			19.75***		
R^2	0.13			0.25			0.32		
ΔR^2	0.15			0.26			0.34		

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
LupusQoL, Lupus Quality of Life; SLEDAI, Systemic Lupus Erythematosus Disease Activity Index; SSRS, Social Support Rate Scale; DDI, The Distress Disclosure Index; SAS, Self-Rating Anxiety Scale.

affected the quality of life; on the other hand, SSRS indirectly affected the lupus quality of life through the mediator role of DDI. DDI played a negative role in predicting the quality of life in female patients with SLE. Currently, the scope of application of DDI in various diseases was limited, there are few studies on the distress disclosure and the moderator effects of DDI in patients with SLE, which provided many possibilities for the study of it.

In the moderated mediating effect model, SAS was significantly correlated with DDI and quality of life, but not with SSRS, these results suggested that SAS may be involved in the effect of DDI on quality of life, but excluded the connection with SSRS, it confirmed the moderated mediator model. In addition, SAS played a moderating role in the pathway of DDI on quality of life, the moderator effect as a whole was a negative predictor of quality of life. Anxiety was also common in the study of various disease, it was a significant predictor of the quality of life (56).

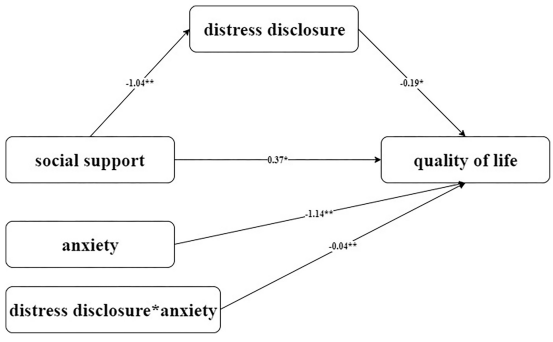


FIGURE 1
Hypothetical model of moderated mediator mediated by DDI and moderated by SAS. *$p < 0.05$; **$p < 0.01$. LupusQoL, Lupus Quality of Life; DDI, The Distress Disclosure Index; SSRS, Social Support Rate Scale; SAS, Self-Rating Anxiety Scale.

A study (57) suggested that social anxiety played a moderator role in the expectation of being liked and self-disclosure. The study of SAS as a moderator variable is still at an initial stage.

There was no clear conclusion about the internal relationship among SSRS, SAS, DDI, and quality of life. A study by Rotheram-Borus et al. (58) has shown the relationship among social support, quality of life, disclosure, and depression through the structural equation model, there was also a link among social support, physical and mental health, disclosure, and psychological resilience (27). A survey (59) showed the correlation between self-disclosure and social support, anxiety, and quality of life, but the relevant contents, especially the four variables, were still immature. This study focused on the relationship between the psychosocial status and quality of life of female patients with SLE, it can effectively supplement this relevant part and provide important reference value. Of course, male patients can be included in the future to demonstrate and elaborate on this direction in the longer term.

Limitations

First, the survey methods adopted in this study are all in the form of self-reports, thus there may be subjective assumptions that have an impact on the results. There are many forms of self-disclosure and differences in expression, and patients were unable to pour out their emotions in a short period of time to test the predictive value of disclosure to mental health. A high level of disclosure may be an important event stimulation, or it may be a positive coping style, which is closer to expressing desire or demand and cannot fully reflect the mental health status of patients. Second, this study cannot determine causality due to its cross-sectional design. Third, this study did not make a detailed study of the eight dimensions of the quality of life, and only used the original score to study; its rigor remains

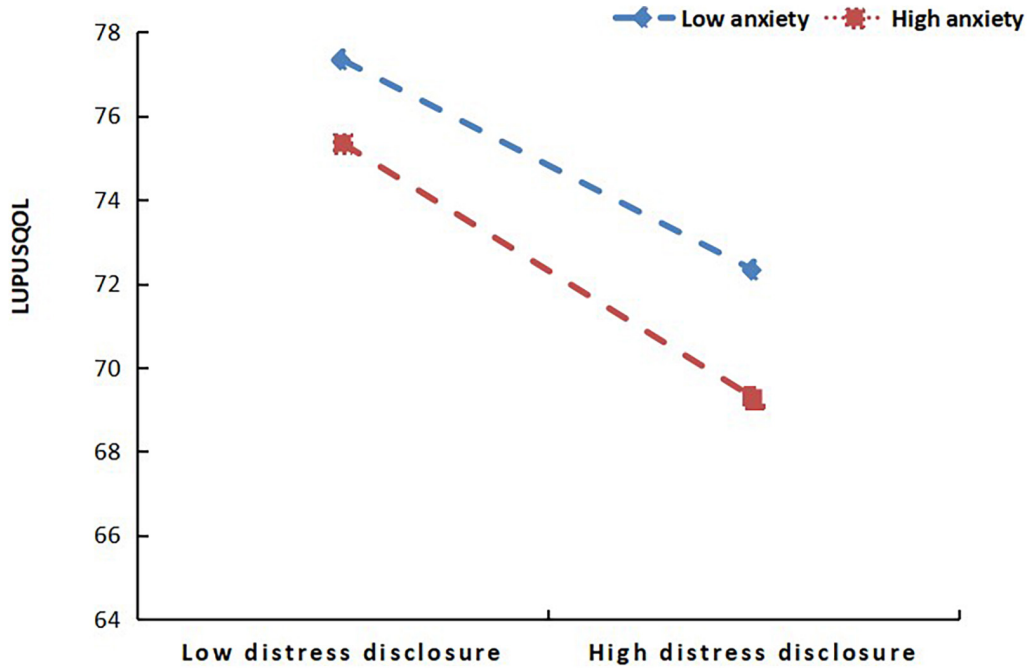


FIGURE 2
Moderating effect of self-rating anxiety scale (SAS) on the pathway from the distress disclosure index (DDI) to lupus quality of life (LupusQoL).

to be confirmed, and there was a lot of room for research on its internal relationship, which can be discussed in depth in the future. To improve the quality of life in patients with SLE, interventions should focus on psychosocial factors such as social support, self-disclosure, and anxiety.

Conclusion

The key finding of this study is that distress disclosure has a partial mediator effect between social support and quality of life in female patients with SLE, while anxiety has a moderator effect between distress disclosure and quality of life. When distress disclosure is increased, the positive impact of social support on quality of life may be diminished. At low anxiety level, the slope was relatively small, and the quality of life of lupus was higher with the decrease in DDI score. With the increase in anxiety level, the positive predictive effect of self-disclosure on quality of life decreased gradually. In future studies, our goal is to improve the quality of life of patients with SLE by improving the level of social support. In addition, we will focus on the mediating role of distress disclosure and the moderating role of anxiety. This could be an important development in the field.

In a theoretical sense, our study explores a new understanding of the impact of social support on the quality of life in patients with SLE. Furthermore, using distress disclosure as the mediating variable, we discovered that social support decreased distress disclosure in patients with SLE, and that distress disclosure ultimately had a negative impact on quality of life, whereas anxiety had a moderating effect on self-disclosure and quality of life.

Clinical and practical implications for practice, this study describes the relationships between the four variables proposed in this study, which may aid researchers in better understanding the mechanisms that influence the quality of life. Positive psychological and lifestyle interventions for patients with SLE and their families can therefore mitigate the negative effects of poor quality of life in patients with SLE. This theory will also have implications for policy in terms of social support and anxiety. Effective measures for improving the quality of life of patients with SLE include raising their awareness of the need for assistance, increasing social support, and avoiding excessive disclosure of distress. Medical institutions should also take a multidisciplinary approach to provide comprehensive care, including psychological care, to patients with SLE who are anxious. This intervention can help patients rebuild their perception of the disease, allowing them to actively receive treatment, control disease activities on time, and avoid a decline in the quality of life. Nursing plans should include SLE self-care health education.

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 oral informed consent of all patients was approved by the Ethics Research Committee of the Second Affiliated Hospital of Anhui Medical University (reference number: YX2021-088). The patients/participants provided their written informed consent to participate in this study.

Author contributions

R-CG and G-CW designed the study. R-CG, LW, P-LS, NS, and MH gathered the data. R-CG and LW run and described the statistical analyses. R-CG, LW, and G-CW interpreted the data and wrote the manuscript. All authors approved the final version of the manuscript and edited the manuscript.

Funding

This study was supported by the Young Seedling Training Project of the School of Nursing, Anhui Medical University, and the project involved the construction of a sleep disorder prediction model for patients with SLE based on clinical, psychological, social, and inflammatory factors (hlqm2021010).

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.

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frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 08 September 2022
DOI 10.3389/fpubh.2022.899322

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

RECEIVED 18 March 2022
ACCEPTED 22 August 2022
PUBLISHED 08 September 2022

CITATION
Tang B, Mamubieke M, Jilili M, Liu L and Yang B (2022) Amelioration and deterioration: Social network typologies and mental health among female domestic workers in China. *Front. Public Health* 10:899322. doi: 10.3389/fpubh.2022.899322

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Amelioration and deterioration: Social network typologies and mental health among female domestic workers in China

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Previous quantitative studies on the effects of social network types on mental health have obtained inconsistent or conflicting results, due to problems such as sample selection bias or crude measurement of variables. In this study, we avoided these problems by using appropriate statistical methodology to examine the effect of various forms of social network on the mental health of a sample of 987 Chinese female domestic workers. Thus, we measured social network types in terms of both network attributes (friend networks and family networks) and interaction channels (face-to-face, telephone, and WeChat/QQ channels, where the latter are two popular online messaging platforms in China), and used the coarsened exact matching method to obtain a balanced sample. The results showed that social network typologies had positive and negative effects on the mental health of this sample of domestic workers, as evidenced by (1) In terms of network attributes, family networks were associated with improved mental health and friend networks were associated with worsened mental health; (2) In terms of interaction channels, the significant amelioration in mental health from family networks came from face-to-face interactions, the significant deterioration in mental health from friends networks came from telephone interactions, and in terms of other interaction channels, family networks and friends networks had no significant effect on mental health. Robustness tests indicated that these conclusions are reliable. We discuss the possible mechanisms of which different types of social networks influence mental health.

KEYWORDS

mental health, family network, friend network, face-to-face, domestic workers, coarsened exact matching, network types

Introduction

Domestic workers are a large and vulnerable group in the global informal labor market, but their mental health has not received due attention (1, 2). Some studies have posited that mental health problems are prevalent among domestic workers (3), and that their psychological status is much worse than that of the general adult population (4), with this primarily manifested as high levels of anxiety and depression (5). Poor

psychological health has serious consequences for domestic workers, as it can lead to suicidal thoughts or render them unable to perform their duties (5, 6). Moreover, in recent years in China, there have been several cases of elderly people or children being maltreated by mentally ill domestic workers[1]. These cases have shocked Chinese society, and serve as a warning of the urgent need to support domestic workers' mental health.

Many studies have examined the types of social networks of domestic workers and their mental health implications (4, 7–14). These studies provide us with rich insights and reveal the complexity of the impact of social networks on the mental health of domestic workers. However, this existing body of research has various limitations. First, although these studies classified social networks in terms of netwok attributes into two types of family networks and friend networks, they have neglected to examine the effects of social network in terms of interaction channels. This has generated a research gap, as the rapid development of communication technology means that people now communicate *via* an increasingly diverse array of online interaction channels, such as Facebook and WeChat/QQ (two popular online messaging platforms in China), rather than only *via* offline interaction channels (e.g., face-to-face communication); the impact of different social network types on mental health *via* these interaction channels may vary. Second, most studies have used qualitative research methods, whose conclusions are only suggestive, and the few studies that have used quantitative research methods have been based on small-scale convenience sampling methods (e.g., snowball sampling) These sampling methods may have generated selection bias, which means that the studies' conclusions may be incorrect. Thus, appropriate statistical methods must be used to solve such sampling problems and obtain valid conclusions.

To address the above-mentioned limitations of previous studies, we used a respondent-driven sampling method to collect representative sample data, a coarsened exact matching method to obtain a balanced sample, and measured social networks in terms of both its network attributes and interaction channels. This enabled us to systematically examine the relationship between various types of social network and the mental health of a sample of Chinese domestic workers.

1 Red Star News, 2020, "67-year-old nanny who suffocated 83-year-old was informal hospital nurse, and her husband said she had suffered from mental illness," May 13, 2020. URL: https://baijiahao.baidu.com/s?id=1666580543214174211&wfr=spider&for=pc%20 (in Chinese) [Accessed June 4, 2022]. Beiqing.com, 2021, " 'Mentally abnormal' nanny abuses the elderly, a home care company is sentenced to liability," August 5, 2021. URL: https://t.ynet.cn/baijia/31225673.html%20 (in Chinese) [Accessed June 5, 2022]. China.com, 2017, "A nanny and a employer fight for a child, the woman once suffererd from mental illness and the housekeeping company also know", July 5, 2017. Available at: https://news.china.com/socialgd/10000169/20170705/30917540.html%20 (in Chinese) [Accessed June 5, 2022].

Literature review

Research indicates that social relations have a powerful impact on mental health (15–17), but most of these studies has examined the effects of isolated aspects of social relations, such as total network size (18, 19). Fiori et al. (20) argue that it may be more informative to examine types of social networks and their mental health implications, and according to Adams and Blieszner (21), there is likely to be considerable variation in patterns of social relations and their adaptiveness for human groups, and it should be preferable to consider this adaptiveness in terms of network typologies.

Different attributes of social network and mental health

Research on how social networks aids the mental health of domestic workers has identified several mechanisms linking family networks and/or friend networks to these workers' mental health. First, although they had limited survey data, some studies have found that family networks (22) or friend networks (7) are important for maintaining and improving their mental health. Second, the family and friend networks has a positive impact on the mental health of domestic workers, but that the extent and conditions under which these effects occur vary. For example, Holroyd et al. (8) studied the mental health and family networks of 290 Filipino domestic workers in Hong Kong collected *via* a snowball sampling method, and found that these workers' level of contact with their relatives was inversely proportional to their probability of suffering from depression. As would be expected, in the absence of family members, social networks of friends is crucial to support mental health. Ye and Feinian (14) investigated the effects of family networks and friend networks on the self-rated health (including mental health) of 1,017 Filipino domestic workers in Hong Kong, whom they recruited *via* a multi-stage cluster sampling method. Their results showed that family networks invariably and significantly improved the mental health of these domestic workers, whereas Hong Kong-based friend networks only sometimes improved the mental health of these domestic workers, while non-Hong Kong-based friend networks had no effect. Moreover, there was an interdependence between the effects of a family networks and a friend networks. Similarly, Iyer et al. (3) interviewed 30 foreign domestic workers in Singapore, and van der Ham et al. (23) studied 500 domestic workers in the Philippines who were recruited *via* snowball sampling, and both found that family contact was particularly beneficial for the mental health of domestic workers, whereas friend contact was either beneficial or had no effect. In contrast, in an empirical study of 261 female Filipino domestic workers in Macau, which was conducted using a snowball sampling method, Mendoza et al.

(10) found that from both family and friend networks did not have a significantly positive impact on domestic workers' mental health, and in some cases worsened their mental health.

The reason for the inconsistent and contradictory results described above has not been determined, but a possible explanation is that these studies have largely failed to distinguish how the impacts of social network types on domestic workers' mental health vary with the channels of interaction. For example, Ye and Feinian (14) used a measure of family and friends networks that consisted of three interaction channels: face-to-face, telephone, and Internet. However, despite the fact that the impact of social network types on mental health may vary between different interaction channels, the authors (in common with other studies) combined social network types from all three interaction channels into a homogeneous result, which may have led to erroneous interpretations. Therefore, it is necessary to explore the relationship between social network types and mental health in each interaction channel separately.

Different interaction channels of social network and mental health

The development of communication technology means that people now interact in range of ways, such as *via* face-to-face interaction, which is constrained by geographical location, and telephone and Internet social network interaction, which are unconstrained by geographical location. Most studies have suggested that face-to-face communication is the primary method of interpersonal interaction, and that this is supplemented by telephone and Internet-based social networking (24, 25). However, several studies have posited that telephone communication is more important than face-to-face communication, in that as a person's interpersonal relationships mature and increase, these are maintained by distance-independent telephone interaction rather than by distance-dependent face-to-face interaction (26, 27). Overall, it is clear that offline and online communication modes—from face-to-face to telephone and Internet social media modes—encompass diverse channels of interaction that maintain, strengthen, and develop social networks.

Studies examining the relationship between social network types *via* various interaction channels and mental health have suggested that only face-to-face network can diminish depression (25) and loneliness (28, 29), because of the uniquely pleasurable and relaxing nature of face-to-face communication. However, it was also argued that the instantaneity of telephone communication provides rapid social connection and thus emotional benefits (26). Other studies have found that the impact on mental health of social network established *via* Internet interactions is complex, and may be negative (30, 31) or positive (32, 33).

However, the above studies were based on surveys of college students, and thus may not be generalizable to domestic workers. Specifically, unlike college students, domestic workers have a mobile and isolated working environment, in which they may have few face-to-face interactions with family and friends. Thus, domestic workers may find telephone and social media to be more convenient ways to interact with family and friends. Moreover, two studies on female domestic workers in Singapore have shown that compared with not using mobile phones and Internet social media to interact with family and friends, using such methods was associated with these workers having more social contact and significantly improved mental health (9, 34). However, these studies have not compared the effects on mental health of social network types received through different interaction channels.

It is clear that there is a dearth of quality research on the effects of social network types on the mental health of domestic workers. First, research on the relationship between social network typologies and mental health has used imprecise methods, and few studies have compared the effects of social network types *via* different interaction channels on mental health. Thus, more research is needed to determine the validity of previous studies' findings. Second, domestic workers do not randomly decide whether to interact offline (i.e., face-to-face) and/or online (*via*, for example, Facebook or WeChat/QQ) with family and friends; their decision is guided by constraints. These include the barrier of geographical distance and the "digital divide" of communication technology, and imply that the frequency of interactions *via* offline and/or online modes is biased by domestic workers' circumstances or technological skills, which leads to non-randomness in the way and frequency of interactions across different social network types of domestic workers. Consequently, without the careful balancing of a study sample, there is a high risk of bias in sample selection and thus also in study findings. This underscores the need for the balanced matching of samples to obtain unbiased estimates, which we have addressed in this study.

Methods

Data

We used data from a domestic workers survey conducted in four cities in China (Nanjing, Wuxi, Guangzhou, and Foshan) in 2019, which employed respondent-driven sampling to obtain a total of 1,007 valid samples (35) The questionnaire collected information on domestic workers' basic situation, employment relationship, job attitudes, job training, and mental health. We excluded male domestic workers as the domestic service industry is dominated by women, and our final valid sample comprised 987 female domestic workers. Domestic workers as those who perform paid domestic work in private households,

excluding part-time workers who occasionally perform domestic work (36).

Measurements

Dependent variable

Our dependent variable is the depressive symptoms of domestic workers, measured by the 10-item Center for Epidemiological Studies Depression Scale developed by Radloff (37). This scale shows good reliability and validity in assessing the mental health of specific groups, such as the elderly and adolescents, and the general population (38, 39). In each item of the scale, respondents are asked to note how often they have experienced a negative mental state in the previous week. The options are "never or very infrequently (< 1 day)," "not much (1–2 days)," "sometimes or half of the time (3–4 days)," and "most of the time (5–7 days)." We allocated a response of "never or very infrequently (< 1 day)" a score of 0, a response of "not much (1–2 days)" a score of 1, a response of "sometimes or half of the time (3–4 days)" a score of 2, and a response of "most of the time (5–7 days)" a score of 3. As the positive emotion items "hopeful about the future" and "feeling very happy" are reverse questions, we also reversed the values. The reliability of the scale is 0.782 (Cronbach's α), indicating higher internal consistency. We used factor analysis to extract a common factor (Kaiser–Meyer–Olkin = 0.839) and standardized the results to obtain a depressive tendency score from 0 to 100, where a higher score indicates worse mental health.

Independent variables

The core independent variable is the respondent's social network. Domestic workers communicate and interact with family members and friends through various channels to obtain encouragement, comfort, love, empathy, and care (40), which are especially important for domestic workers in bad working conditions. We used a questionnaire that asks respondents how often they interacted with their family and friends in 2018 *via* face-to-face meetings, phone calls, and WeChat/QQ. The options are "every day," "several times a week," "once a week," "at least once a month," "at least once every 6 months," and "once a year." We first classified social networks into family networks and friends networks by network attributes, followed by further subdivide family networks and friends networks into face-to-face interaction networks, telephone interaction networks, and WeChat/QQ interaction networks by different interaction channels. Where the interaction strength of different network types is measured by contact frequency.

Accordingly, we allocated a response of "every day" a score of 6, a response of "several times a week" a score of 5, a response of "once a week" a score of 4, a response of "at least once a month" a score of 3, a response of "at least once every 6 months" a score of 2, a response of "once a year" a score of 1, and a response of "no contact at all" a score of 0, so a higher score indicated that the respindent interacts more frequently with family members or friends. As the questionnaire asks about the frequency of interaction between a respondent and multiple family members (e.g., the interaction between a respondent and her parents, spouse, or children), this was regarded as an indicator of the comprehensive interaction frequency between a respondent and their family members, according to the following equation:

$$E_i = \left(\sum S_{ij}\right)/N \quad (1)$$

Where E_i is the comprehensive interaction frequency between respondent i and her family j (her parents, spouse, first child, second child, and youngest child); S_{ij} is the frequency of interaction between respondent i and family j, scored from 0 to 6; and N is the number of people in her family. This afforded a comprehensive frequency of interaction between respondents and their families, which ranged from 0 to 6.

We also controlled for three categories of variables that affect mental health: demographic variables, employment-related variables, and other variables. The demographic variables are age, education level, marriage, and hukou (household registration); the employment-related variables are the nature of the job, work years, weekly rest days, monthly income, employer-installed monitoring equipment, job injury, and chronic disease; and the other variables are religious belief and whether a respondent seeks help when experiencing problems. These variables are also described below in Table 1.

Research methods

Coarsened exact matching

Domestic workers choose to interact with family and friends face-to-face or phone calls and Wechat/QQ, which are not random choices. The "digital divide" in communication technology mean that the frequency of different interaction modes is biased, which leads to the self-selection in the frequency of interactions across different social network types. If we do not deal with the problem of sample balance, there is a high probability that there will be sample selectivity deviation, the conclusion may be biased. So, It is necessary to balance the samples to obtain unbiased estimation. Sample matching is one of the important methods to reduce selectivity bias. Based on the idea of covariate matching, Iacus et al. (41) proposed the CEM method, which attempts to solve the self-selection problem by selecting similar samples from survey data to simulate the effect of randomization experiments. Compared with traditional matching methods, such as propensity score and Mahalanobis matching, the advantages of the CEM method include: (1) it does

TABLE 1 Description of model variables ($N = 987$).

Variables	Category/indicator	Percentage/value	Min	Max
Dependent variable				
Depressive tendency score	Mean (standard deviation)	16.60 (16.74)	0	100
Core independent variable				
Social network of different attributes				
Frequency of contact with family members	Mean (standard deviation)	4.52 (1.03)	0	6
Frequency of contact with friends	Mean (standard deviation)	4.29 (1.61)	0	6
Social network through different channels				
Face-to-face with family	Mean (standard deviation)	3.98 (1.47)	0	6
Call your family	Mean (standard deviation)	4.66 (1.35)	0	6
Contact your family on WeChat /QQ	Mean(standard deviation)	4.78 (1.89)	0	6
Face-to-face with friends	Mean (standard deviation)	4.16 (2.07)	0	6
Call your friends	Mean (standard deviation)	3.63 (1.91)	0	6
Contact your friends on WeChat /QQ	Mean (standard deviation)	4.48 (2.07)	0	6
Control variables				
Work years	Mean (standard deviation)	8.20 (6.82)	0.10	38.60
Age	Under the age of 50	42.45%	0	1
	Age 50 and above	57.55%		
Education Level	Primary and below	35.16%	1	3
	Junior high school	49.65%		
	High school	15.20%		
Marriage	In the wedding	88.75%	0	1
	Not in marriage	11.25%		
Hukou	Rural registered permanent residence	73.86%	0	1
	Urban hukou	26.14%		
Monthly income	3,000 yuan or less	19.25%	0	1
	More than 3,000 yuan	80.75%		
Nature of work	Care work	60.89%	0	1
	Non-care work	39.11%		
Weekly rest days	Don't rest	28.57%	1	3
	Only 1 day off	59.98%		
	2 days off	11.45%		
Employer installs camera	The installation	25.84%	1	3
	Not to install	63.63%		
	Don't know	10.54%		
Job injury	Yes	11.04%	0	1
	No	88.96%		
Ask for help in the past 12 months	Yes	25.53%	0	1
	No	74.47%		
Religious beliefs	Yes	12.77%	0	1
	No	87.23%		
Chronic diseases	Yes	47.11%	0	1
	No	52.89%		

not require high prior sample size requirements for the observed data; (2) the matching process is simpler, with the researcher selecting the matching level based on specific, intuitive and substantive information; (3) the equilibrium constraint of a covariate can be studied and improved individually. Therefore, CEM is considered a line of defense to protect causal inferences from threats to validity.

According to the data, 6 percent of domestic workers do not have smartphones and 10 percent do not know how to use Wechat /QQ, popular social software, which provides more convenience and possibility for the interpersonal interaction between respondents and their family and friends. However, the ability to own a smartphone and use of smartphone applications such as WeChat/QQ is a non-random event which is affected by

a series of social and economic factors such as age, income and educational level etc.

Moreover, our other data obtained from our sample revealed that the respondents' average age was 50 years (with the oldest being 71 years); the average monthly income is RMB 4,905, with a minimum monthly wage of RMB 300 and a maximum monthly wage of RMB 17,800; nearly 20% had an average monthly income of <3,000 RMB, more than 73% had a rural hukou, and 80% had a junior high school education or below. These data show that compared with employees in other sectors, these domestic workers were older, and had lower living standards and education levels; such a subset of society has significantly less ability to use new communication technologies than others in society. Therefore, we applied the CEM method developed by Iacus et al. (41, 42) to match the covariables affecting the use of WeChat/QQ, and used the resulting matched and balanced data for regression analyses, to eliminate the deviations caused by the raw data.

The basic operation of the CEM method consists of three steps: the first is to coarse-code variables; the second is to apply an exact matching algorithm to the coarse data to generate weighted variables and matching units; and the third is to retain the successfully matched data, discard the unmatched data, and make use of the weights for subsequent regression analysis. Thus, the ideality of the data matching can be determined by the multivariate imbalance index indicator (L_1) (42). The value of L_1 is calculated based on the data and the selected covariables, and ranges from 0 (completely balanced) to 1 (completely unbalanced); thus, a larger value indicates a greater imbalance between the groups under comparison. Well-matched data result in a significant reduction in L_1, which is calculated as follows:

$$L_{1(f.g)} = \frac{1}{2}\sum \varepsilon_1 \ldots\ldots \varepsilon_k \left| f_{\varepsilon_1 \ldots\ldots \varepsilon_k} - g_{\varepsilon_1 \ldots\ldots \varepsilon_k} \right| \quad (2)$$

Equation (2) indicates that the covariables after coarsening are first cross-tabulated as $X_1 \times \ldots\ldots \times X_k$ for the treated and the control groups, respectively. Then, the k-dimensional relative frequency for the treated group is recorded in $f_{\varepsilon 1 \ldots\ldots \varepsilon k}$ units and that for the control groups is recorded in $g_{\varepsilon 1 \ldots\ldots \varepsilon k}$ units. The absolute difference between all unit values is the L_1 value (43). If the two groups of data are completely separated, then $L_1 = 1$, whereas if the two groups of data are completely overlapping, then L_1 Equals = 0.

Results

Matching result analysis

Table 2 reports the balance distribution of covariables affecting WeChat/QQ usage before and after matching. Model 1 shows that before matching, age, education level, and marital status significantly affected the probability of WeChat/QQ usage. That is, compared with domestic workers who were aged 50 or older, did not have a junior high school education or above, and were not married, domestic workers who were aged younger than 50, had a junior high school education or above, and were married were more likely to know how to operate social media software such as WeChat/QQ. Model 2 shows that the CEM method largely preserved the data sample size (i.e., removed only 103 samples) and improved the balance distribution of covariables affecting WeChat/QQ usage ($p > 0.05$). Thus, matching afforded a well-balanced random sample.

TABLE 2 Covariable balance results of WeChat /QQ usage before and after matching.

	Before matching (Model 1)	After matching (Model 2)
Age (0 = under 50)	−2.177*** (0.403)	0.0063 (0.237)
Education level (0 = primary school and below)		
Junior high school	1.239*** (0.260)	−0.053 (0.239)
High school and above	2.416*** (0.631)	−0.091 (0.462)
Marriage (0 = not married)	0.661* (0.307)	0.031 (0.478)
Monthly income (0 = 3,000 yuan and below)	0.315 (0.262)	0.335 (0.259)
Household Registration (0 = Urban)	−0.155 (0.304)	0.209 (0.293)
Constant term	2.115** (0.666)	1.469* (0.705)
Sample size	987	884
R2	0.19	0.01

Robust standard error in parentheses.
*P < 0.05, **P < 0.01, ***P < 0.001.

Table 3 reports the results for L_1 based on CEM. Before matching, age, education level, and marital status were the variables that significantly influenced WeChat/QQ use, with L_1 values of 0.4, 0.4, and 0.1, respectively, and thus the comprehensive multivariate imbalance index L_1 was almost equal to 0.45. After matching, the L_1 values of a single-variable index and those of a multivariate index after synthesis were almost equal to 0. This indicates that the data were significantly less imbalanced after matching, showing that excellent matching was achieved.

Regression analysis

We next used the matched samples for regression analysis. As the dependent variable—the depressive symptoms of

TABLE 3 Imbalance index L_1 before and after CEM.

	Before matching: L_1 (average)	After matching: L_1 (average)
Age (0 = under 50)	0.398 (−0.389)	1.0 e-15 e-15 (1.3e-15)
Fixed number of year of the education	0.361 (0.494)	1.1 e-15 (4.4 e-16)
In marriage (0= not in marriage)	0.095 (0.095)	1.1 e-16 (−1.1 e-16)
Multivariate L_1	0.441	9.281 e-16
Sample size	987	884

The mean difference of L_1 in parentheses.

domestic workers, as a marker of their mental health—is a continuous variable, a multiple linear regression model was applied to investigate the effects of social network types from different attributes and *via* different interaction channels on the mental health of domestic workers. Table 4 below reports the regression results for a set of nested regression models.

Model 3 in Table 4 is the basic model, which reports the influence of a series of control variables on the mental health of domestic workers. The model shows that the mental health of domestic workers with a higher education level and higher monthly income was significantly better than that of domestic workers with a lower education level and lower monthly income, under the assumption that other control variables were unchanged. Domestic workers who suffered from chronic diseases or had been injured physically or psychologically at work (due to, for example, assault, abuse, harassment, or complaints) had significantly worse mental health than those who did not suffer from chronic diseases or had not been injured physically or psychologically at work. These findings are consistent with common expectations, and the fact that the mental health of domestic workers who had sought help was worse than that of those who had not.

Models 4 and 5 include social network variables. Model 4 includes family network variables, based on Model 3, and the regression results for Model 4 show that contact with family had a significantly positive effect on the mental health of domestic workers, at significance level of 0.05. This means that the more frequently domestic workers are in contact with their families, the better was their mental health. Model 5 includes friend network variables, based on Model 4. The results for Model 5 clearly demonstrates that frequent contact with friends significantly worsened the mental health of domestic workers, and that after controlling for family contact. These findings are consistent with the mainstream view in previous studies: that family networks invariably improves a person's mental health, and the relationship between the two variables is relatively stable, whereas friend networks may worsen a person's mental health (3, 14, 23).

As the effects of social network on mental health vary with the attributes of a network, the regression model in Table 5 examines the interactive channels *via* which social network affects domestic workers' mental health.

Model 6 reports the effect of face-to-face social network types on the mental health of domestic workers. The regression results show that when control variables were included, face-to-face contact with family members significantly improved the mental health of domestic workers (at a significance level of 0.05). That is, the more that domestic workers interacted face-to-face with family members, the better was the domestic workers' mental health. In contrast, face-to-face interaction with friends had a negative effect on domestic workers' mental health, but this result was not statistically significant ($p > 0.05$). Model 7 reports the effect of the type of social network through telephone interactions on the mental health of domestic workers. The regression results show that telephone interaction with family members somewhat improved domestic workers' mental health, but this result was not statistically significant ($p > 0.05$). In contrast, telephone interaction with friends consistently significantly worsened domestic workers' mental health ($p < 0.01$), with the frequency of domestic workers' telephone interactions with friends being inversely proportional to these workers' mental health. Model 8 examines the effect of the type of social network through WeChat/QQ interactions with family members and friends on the mental health of domestic workers. The regression results show that domestic workers' mental health was improved by WeChat/QQ interactions with family members but worsened by WeChat/QQ interactions with friends. Both of these effects were significant ($p < 0.05$).

However, domestic workers may also interact with family networks and friend networks through three channels simultaneously: face-to-face, by telephone, and by WeChat/QQ. This is explored by a comparison of the results from Model 9 with those for Models 6, 7, and 8, which indicates that face-to-face interactions with family members consistently and significantly improved the mental health of domestic workers ($p < 0.05$); face-to-face interactions with friends also improved the mental health of domestic workers, but this effect was not significant ($p > 0.05$). In addition, there was no change in the direction of the effect of telephone interactions with family networks or friend networks on domestic workers' mental health, and telephone interactions with friends invariably significantly worsened domestic workers' mental health ($p < 0.05$). In addition, family networks or friend networks *via* WeChat/QQ interactions no longer had a significant effect on the mental health of domestic workers ($p > 0.05$).

TABLE 4 Regression results of social network with different network attributes on mental health of domestic workers.

	Model 3	Model 4	Model 5
Age (0 = under 50)	−0.673 (1.197)	−0.895 (1.196)	−1.198 (1.200)
Education level (ref = Primary school and below)			
Junior high school	−2.734* (1.191)	−2.633* (1.188)	−2.652* (1.185)
High school and above	−3.041 (2.278)	−2.628 (2.276)	−2.399 (2.272)
Married	−1.927 (2.338)	−1.137 (2.349)	−1.270 (2.344)
Monthly income (0 = 3,000 yuan and below)	−3.260* (1.412)	−3.490* (1.410)	−3.258* (1.409)
Hukou (ref = Urban)	0.00711 (1.407)	0.367 (1.409)	0.591 (1.409)
Religious belief (0 = none)	0.813 (1.688)	1.358 (1.695)	1.354 (1.691)
Chronic diseases (0 = none)	6.449*** (1.116)	6.602*** (1.113)	6.698*** (1.111)
Job injury (0 = none)	7.113*** (1.763)	6.522*** (1.772)	6.490*** (1.767)
Ask for help when encountering a problem (0 = none)	4.428*** (1.284)	4.207** (1.282)	4.122** (1.279)
Working fixed number of year	−0.0288 (0.0789)	−0.0190 (0.0787)	−0.0286 (0.0786)
Caregiving work (0 = non-caregiving)	0.868 (1.167)	0.540 (1.170)	0.768 (1.171)
Weekly rest days (0 = no rest)			
Only 1 day off	−0.847 (1.205)	−0.478 (1.209)	−0.550 (1.206)
2 days off	−0.557 (1.914)	0.171 (1.927)	−0.0794 (1.925)
Employer installs camera (0 = Install)			
Not to install	−2.027 (1.241)	−2.257 (1.240)	−2.410 (1.238)
Don't know	−0.114 (1.994)	−0.0837 (1.988)	0.0462 (1.983)
Frequency of contact with family members		−1.479** (0.563)	−1.802** (0.578)
Frequency of contact with friends			0.824* (0.347)
Constant term	19.76*** (3.173)	25.77*** (3.903)	23.84*** (3.976)
Sample size	884	884	884
R2	0.112	0.119	0.125

Robust standard error in parentheses.
*P < 0.05, **P < 0.01, ***P < 0.001.

Robustness analysis

We adopted two methods for testing the robustness of the identified relationships between domestic workers' social network typologies and their mental health. The first method requires the construction of a new dependent variable. Radloff (37) stated that the 95th percentile corresponding to the total score of the 10-item Center for Epidemiological Studies Depression Scale can be used as the threshold of depression. Accordingly, we constructed a dependent variable of depressive symptoms, which when scoring <13 (indicating the absence of depressive symptoms) is allocated a value of 0 and when scoring ≥13 (indicating the presence of depressive symptoms) is allocated a value of 1. The second method is to perform testing with the original (i.e., non-matched and thus unbalanced) sample. These test results are shown in Table 6, and indicate that irrespective of whether the test model uses a new dependent variable (the first method) or a new sample (the second method) for regression analysis, the test results of Model 1 and Model 3 are consistent with those for Model 5 in Table 4, and the test results of Model 2 and Model 4 are also substantially consistent with those for Model 9 in Table 5. These robustness tests therefore confirm the reliability of the results of our regression analysis.

Discussion

This study explored the relationship between social network typologies and the mental health of domestic workers, after effectively solving the sample balance problem using the CEM method. The results showed that different types of social network had distinct and important effects on the mental health of domestic workers in our sample. For example, the mental health of domestic workers was consistently improved by family networks but consistently worsened by friend networks. We also found that when other forms of interpersonal interaction were not controlled for, the mental health of domestic

TABLE 5 Regression results of social network in different interactive channels on mental health of domestic workers.

	Model 6	Model 7	Model 8	Model 9
Age (0 = under 50)	−0.953 (1.204)	−0.977 (1.197)	−0.856 (1.200)	−1.182 (1.208)
Education level (1 = Primary school and below)				
Junior high school	−2.807* (1.190)	−2.687* (1.189)	−2.750* (1.188)	−2.803* (1.189)
High school and above	−2.933 (2.275)	−2.683 (2.274)	−2.846 (2.275)	−2.596 (2.273)
Marriage (0 = not married)	−1.505 (2.355)	−1.742 (2.335)	−1.799 (2.333)	−1.096 (2.352)
Monthly income (0 = 3,000 yuan and below)	−3.339* (1.419)	−3.209* (1.407)	−3.103* (1.410)	−3.358* (1.417)
Hukou (0 = Urban)	0.761 (1.446)	0.0970 (1.403)	−0.0949 (1.404)	0.676 (1.446)
Religious belief (0 = none)	1.054 (1.692)	0.813 (1.685)	1.002 (1.697)	1.258 (1.696)
Chronic diseases (0 = none)	6.574*** (1.116)	6.743*** (1.116)	6.640*** (1.116)	6.988*** (1.120)
Job injury (0 = none)	6.739*** (1.775)	7.081*** (1.758)	6.816*** (1.763)	6.447*** (1.773)
Ask for help when encountering a problem (0 = none)	4.286*** (1.283)	4.307*** (1.283)	4.477*** (1.281)	4.237*** (1.283)
Working fixed number of year	−0.0248 (0.0788)	−0.0466 (0.0788)	−0.0341 (0.0791)	−0.0391 (0.0790)
Caregiving work (0 = non-caregiving)	0.598 (1.182)	1.101 (1.170)	1.023 (1.166)	0.824 (1.187)
Weekly rest days (0 = no rest)				
Only 1 day off	−0.419 (1.226)	−1.085 (1.204)	−0.824 (1.216)	−0.522 (1.232)
2 days off	0.553 (2.014)	−1.042 (1.914)	−0.600 (1.918)	0.304 (2.011)
Employer installs camera (0 = Install)				
Not to install	−2.267 (1.244)	−2.184 (1.239)	−2.261 (1.246)	−2.563* (1.249)
Don't know	−0.174 (1.993)	−0.148 (1.987)	−0.0722 (1.990)	−0.285 (1.988)
Frequency of face-to-face with family	−0.839* (0.412)			−0.814* (0.421)
Frequency of face-to-face with friends	0.292 (0.263)			−0.079 (0.300)
Frequency of call your family		−0.713 (0.417)		−0.559 (0.425)
Frequency of call your friends		0.872** (0.303)		0.805* (0.344)
Frequency of contact your family on WeChat /QQ			−0.790* (0.344)	−0.546 (0.359)
Frequency of contact your friends on WeChat /QQ			0.641* (0.305)	0.394 (0.348)
Intercept	21.43*** (3.567)	20.04*** (3.637)	20.54*** (3.389)	23.29*** (3.944)
Sample size	884	884	884	884
R2	0.118	0.121	0.119	0.128

Robust standard error in parentheses.
*P < 0.05, **P < 0.01, ***P < 0.001.

workers was significantly improved by face-to-face interaction and WeChat/QQ interaction with family members, whereas it was significantly worsened by telephone interaction and WeChat/QQ interaction with friends.

However, with control for other types of interpersonal interaction, the intermediary effect of WeChat/QQ on the mental health status of domestic workers was found to be complicated. Thus, although it was again revealed that domestic workers' mental health was improved by telephone and WeChat/QQ interaction with their family network, this effect was not significant ($p > 0.05$). Similarly, although domestic workers' mental health was again worsened by telephone and WeChat/QQ interaction with their friend network, the WeChat/QQ interaction was not significant ($p > 0.05$). Finally, we found that social network *via* the most elementary form of interaction—face-to-face interaction, with either a family network or a friend network—was highly effective in improving the mental health of domestic workers, although this result was not significant at the level of 0.05 for the friend network. The results of robustness tests confirmed the validity of these results.

It is intriguing that domestic workers' mental health was improved by family networks and yet worsened by friend networks. This may be attributable to a woman's family network being a more intimate core network

TABLE 6 Robustness test results.

Test method 1 (Dependent variable: depressive tendency)		Test method 2 (Dependent variable: mental health)	
Test model 1 ($N = 884$)	**Regression coefficient**	**Test model 3 ($N = 987$)**	**Regression coefficient**
Frequency of contact with family members	−0.014^{+} (0.008)	Frequency of contact with family members	−1.542** (0.543)
Frequency of contact with friends	0.013** (0.005)	Frequency of contact with friends	0.738* (0.331)
Test model 2 ($N = 884$)		**Test model 4 ($N = 987$)**	
Frequency of face-to-face with family	−0.012* (0.006)	Frequency of face-to-face with family	−0.936* (0.399)
Frequency of face-to-face with friends	0.004 (0.004)	Frequency of face-to-face with friends	−0.037 (0.285)
Frequency of call your family	0.002 (0.005)	Frequency of call your family	−0.185 (0.417)
Frequency of call your friends	0.011* (0.005)	Frequency of call your friends	0.621^{+} (0.327)
Frequency of contact your family on WeChat /QQ	−0.003 (0.005)	Frequency of contact your family on WeChat /QQ	−0.563 (0.344)
Frequency of contact your friends on WeChat /QQ	0.001 (0.005)	Frequency of contact your friends on WeChat /QQ	0.331 (0.330)

The significance level: + p < 0.1, *p < 0.05, **p < 0.01, ***p < 0.001.
Standard error in brackets.
Original control variables are included.
The dependent variables of test model 1 and Model 2 were dummy variables of depression tendency, and the sample size was 884 after matching with balance problems.
The dependent variable of test model 3 and model 4 was the continuous variable of depressive tendency score, and the sample was the pre-matching sample without dealing with the balance problem, with a sample size of 987.

than her friend network, leading to the former network having more natural and stable social ties than the latter network. Moreover, compared with a friend network, there may be no competition and conflict in a family network and thus a more reasonable allocation of resources. Furthermore, domestic workers primarily work, day after day and year after year, to earn money to support their families, and are supported by their families during employment-related periods of isolation *via* reverse remittance, emotional feedback, and the provision of a virtual family resource.

A family network is also an interdependent network of intimate relationships, and the support supplied to domestic workers by their family network is invariably selfless and helpful. In contrast, a friend network consists of unstable social tie-based networks, its availability is affected by the addition of new friends and the departure of old friends, and the relationship intimacy it supplies to domestic workers depends on the number of relevant resources it contains. As a consequence, the value of a friend network to a domestic worker varies with the network's level of relationship intimacy, and there is always a limit to the friend network-based support that domestic workers can obtain. Thus, friend networks do not necessarily improve and can even worsen the mental health of domestic workers, especially if such a network contains conflict.

In addition, it is clear that the impact on domestic workers' mental health of face-to-face, telephone, and WeChat/QQ interactions with family networks or friend networks varies with the attributes of these networks. Previous studies comparing these three channels of interaction have found that face-to-face interaction generates stronger and more effective ties within social networks than telephone or WeChat/QQ interactions, thus leading to the greatest improvements in mental health. In addition, from the perspective of media richness theory, face-to-face interaction is one of the richest communication media: it is a "real presence" that enables real-time interactive feedback, multi-threading, and spoken language performance, and thus enables more focus on individual capture than other interaction methods. Face-to-face interaction also effectively reduces the uncertainty and ambiguity in communication, and thus develops the best interactive relationships. In contrast, due to the "absence" or "unreal presence" of telephone and WeChat/QQ interactions, factual information is used to effectively reduce the uncertainty in communication, which is more suitable for task-oriented communication than emotion-oriented communication (44). Thus, compared with intermediary interaction *via* a telephone or WeChat/QQ, direct (i.e., face-to-face) interaction is the most efficient way for domestic workers to build and maintain close relationships. In sum, meeting with family and friends develops and maintains domestic workers' close relationships, and having a close social network invariably has positive effects on domestic workers, such as improving their mental health.

We also noticed that family networks and friend networks had differing effects on the mental health of domestic workers. We believe that that this can be accounted

for by the concept of "network privatism" proposed by Campbell (45). This concept holds that social networks are diverse, with both strong and weak connections, and that a mediating interaction is more beneficial for strong-relationship networks than for weak-relationship networks. This alters the balance between strong and weak relationships, and thus when intimate relationships are important, individuals' social networks converge with strong networks (comprising strong ties) rather than with broad networks (comprising weak ties). Thus, this mediating interaction has positive consequences for strong networks and negative consequences for weak networks. For domestic workers, family networks are strong relational networks compared to friend networks.

Conclusion

This study shows that it is crucial for Chinese domestic workers to maintain their mental health by fostering a good social network consisting of intimate relationships. First, our findings indicate that when constructing social networks to improve their mental health, domestic workers should focus on the development of a family ties-based network. Such a network consists of natural intimate relationships that can effectively alleviate domestic workers' mental health problems, regardless of how they interact with family members. Second, our findings show that face-to-face interactions are an effective channel *via* which domestic workers can improve their mental health, either from a family network or a friend network.

The two other key contributions of this study are as follows. First, we overcome the previously intractable or neglected problem of obtaining a balanced sample by judiciously employing statistical methods. Second, we enrich the literature by determining that social network both ameliorates and deteriorates domestic workers' mental health, as shown by exploratory analysis and a comparison of the effects of various types of social network, *via* different channels, on domestic workers' mental health. However, due to limitations, these conclusions are based on cross-sectional data, and thus must be validated in future work on larger samples. We therefore expect that future studies will enrich this research area by using more sophisticated measurements and longitudinal analyses.

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 corresponding author upon reasonable request. Requests to access these datasets should be directed to linpingl@163.com.

Author contributions

BT and MM undertook completing the main draft, including conceived and proposing research methods, data analysis, and manuscripts writing. MJ and BY completed editing manuscript and draft review. LL is the primary investigator and lead researcher on this study. All authors are accountable for the content of the work. All authors contributed to the article and approved the submitted version.

Funding

This study was funded by the Key Project of National Social Science Fund of China (Grant-No. 18ASH007) and the Program B for Outstanding Ph.D. Candidate of Nanjing University (Project No. 201902B058).

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.

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frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 09 September 2022
DOI 10.3389/fpubh.2022.893518

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OPEN ACCESS

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

RECEIVED 10 March 2022
ACCEPTED 22 August 2022
PUBLISHED 09 September 2022

CITATION
Li H, Ning W, Zhang N, Zhang J, He R, Mao Y and Zhu B (2022) Association between maternal depression and neonatal outcomes: Evidence from a survey of nationally representative longitudinal studies.
Front. Public Health 10:893518.
doi: 10.3389/fpubh.2022.893518

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Association between maternal depression and neonatal outcomes: Evidence from a survey of nationally representative longitudinal studies

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Background and aims: Maternal depression before and after delivery has dramatically increased in China. Therefore, this study aimed to examine the association between antepartum and postpartum depression and neonatal outcomes.

Design: A population-based retrospective cohort study.

Setting: China.

Participants: Data were obtained from China Family Panel Studies (CFPS). Different mother-child/infant samples were included in this study. Mother in CFPS2012 and CFPS2016 were linked with 1–2-year-old children in CFPS2014 and CFPS2018, respectively. Besides, and mothers in CFPS2012, CFPS2016, and CFPS2018 were linked with 0–1-year-old infants in CFPS2012, CFPS2016, and CFPS2018, respectively.

Methods: Maternal depression was measured using the Center for Epidemiologic Studies Depression Scale. The neonatal outcomes included duration of gestational days, preterm birth, birth weight, birth weight z-score, weight, weight z-score, illness in the past month, and hospitalization in the past year. Propensity score matching was used to balance maternal, family, and infant/child characteristics between the maternal depression and non-maternal depression groups.

Results: Multivariable regression analysis of matched samples estimated that antepartum depression was associated with a shorter duration of gestation by 3.99 days (95% confidence interval [CI] = −7.21, −0.78). The association between antepartum depression and preterm birth, birth weight and birth weight z-score were not statistically significant. Postpartum depression was associated with more episodes of illness in the last month by 0.23 times (95% CI = 0.11, 0.36) and a higher odd of hospitalization in the previous year (OR = 1.59, 95% CI = 1.15, 2.20). The association between postpartum depression and weight or the weight z-score was not significant.

Conclusion: Maternal depression appears to be associated with worse neonatal outcomes.

KEYWORDS

birth quality, cohort study, maternal depression, neonatal outcomes, propensity score matching

Introduction

The quality of the newborn population is an important indicator of a country's social economy and level of medical service. Improving the quality of the newborn population is of great significance for individuals, families, and society (1). Birth quality refers to the quality of the babies before and after they are born. Negative outcomes mainly include sub-healthy births, such as preterm birth, asphyxia, overdue delivery, and low birth weight, which often result in the death of babies or serious diseases and long-term disabilities in children. These factors closely correlate with newborn survival and lifelong health and may bring heavy medical burden to families and society (2, 3). Globally, the preterm birth rate in 2014 was 10.6%, equating to an estimated 14.84 million live preterm births in 2014 (4). The preterm birth rate has increased over the past two decades in almost every country where data are available; 1.1 million babies die from prematurity, and many survivors are disabled or illness like asthma every year (5, 6). Meanwhile, 20.5 million neonates were born with a low birth weight in 2015, and the survivors have a higher risk of stunting, lower intelligence quotient, andd cardiovascular disease later in life than their counterparts (3).

Recently, the proportion of newborns born with sub-health problems in China has increased alarmingly from 25% in 1980 to 65% in 2009. The average number of newborns born with sub-health in China is approximately 1 million every year, which is the main cause of death or disability in newborns in China (7). Monitoring of the quality of the birth population in China started late with small coverage, and the work is also focused on birth defects; thus, few data about sub-healthy births can be collected (2). If the quality of the birth population cannot be fundamentally improved, the number of defective and sub-healthy children will continue to accumulate, and the negative impact will continue to spread among the population, becoming an obstacle to the sustainable development of China in this new situation.

Maternal depression could be considered a potential factor for sub-healthy births. The symptoms of depressed pregnant women are not significantly different from other depressed patients, who may experience loss of appetite, difficulty sleeping, lack of energy, weight loss, and other symptoms (8–10). Moreover, they may smoke and drink more frequently but rarely in China because Chinese culture believes that drug abuse, smoking, and drinking can cause great harm to vulnerable fetuses (11). Chinese scholars surveyed 1,899 pregnant women in 2015 and found that the overall prevalence of prenatal depression was 33.6% (12). Fearful of the effects of antidepressants on their children, women are also less likely to seek medical help or follow medical advice; consequently, they become preoccupied with depressive thoughts, doubt their ability to be a parent, and, more seriously, may self-harm or even commit suicide (8–11). Some studies have demonstrated that depressed pregnant women may have a shorter birth duration (13), a greater risk of preterm birth, delayed fetal development, and a greater risk of low birth weight than non-depressed women (11, 14). Also, some studies showed that depression in pregnant women is not associated with preterm birth, low birth weight, or developmental delay (15, 16).

Postpartum depression has complicated effects on infants or children (17–24), especially in the field of cognitive development; speech and language; visual, motor, emotional/behavioral, and hormonal systems; and infant growth (i.e., body mass index, birth weight, length, and height) (25), and it was also considered as the most significant mental health risk for women during the perinatal period (26, 27). In the published literature in China from 2014 to 2019, the incidence of postpartum depression ranged from 1.66% to 34.8% (28). In terms of infant growth, research has successfully demonstrated the negative effects of postpartum depression in the first 12 months of infant development (25). In both high- and low-income countries, mothers with postpartum depression may have underweight and stunted children (29, 30), especially in infants < 12 months, with a continuous linear growth deficit for up to 5 years (25, 31, 32). However, babies may also gain weight because of early bottle feeding and solid food feeding by depressed mothers (33). Other studies have shown that postpartum depression was not associated with infant growth (34). Additionally, postpartum depression is associated with more episodes of diarrhea and a high risk of infectious and atopic diseases in infants (35).

In summary, according to existing studies, there is no general conclusion regarding the relationship between maternal depression and neonatal outcomes, (15, 16, 34) and this issue deserves further investigation. Because of the lack of attention

in China, neither issue has been sufficiently studied. Therefore, in this study, we explored the relationship between antepartum and postpartum depression in mothers of infants in China to compensate for this research gap. Specifically, we aimed to answer two questions. First, does antepartum depression affect neonatal outcomes? Second, does postpartum depression affect neonatal outcomes? Therefore, we proposed the following hypotheses: 1) antepartum depression would have a negative effect on neonatal outcomes and 2) postpartum depression would have a negative effect on neonatal outcomes.

Methods

Data and sample

This study was based on Chinese mother–infant pairs, which were divided into intertemporal and contemporaneous groups. Data from the China Family Panel Studies (CFPS) from 2012, 2016, and 2018 were used in this study. The CFPS, which is a nationally representative sample covering China's 25 provinces/regions and 95% of the population, (36) is implemented by the Chinese Center for Social Science Surveys (ISSS) at Peking University. The CFPS used the Center for Epidemiologic Studies Depression Scale (CESD) to measure depression in adults. Figure 1 illustrates the matching principle. The intertemporal group included mothers in 2012 and 2016 linked with 1–2-year-old children in 2014 and 2018, respectively. So the intertemporal group consisted of 1487 mother-child pairs. The contemporaneous group, including the mothers in 2012, 2016, and 2018, was linked with 0–1-year-old infants in 2012, 2016, and 2018, respectively. So the contemporaneous group consisted of 2293 mother-infant pairs. We further excluded 771 mother-child pairs and 829 mother-infant pairs with missing information on the outcomes and/or covariates required in this study. In total, 716 mother–child pairs and 1464 mother–infant pairs were included in the statistical analysis. Figure 2 presents the detailed selection process.

Measures

Antepartum depression and postpartum depression

The CFPS survey used the Epidemiologic Studies Depression Scale developed by Radloff, which measures the self-rated mental health of respondents using 20 questions (37). Radloff proposed that a score of 16–28 on this scale indicates depressive symptoms, while a score of more than 28 indicates severe depressive symptoms (37). Accordingly, adults who scored more than 28 on the CESD scale of the CFPS2012 and 2016 were defined as "depressed." In addition, mothers' depression was defined as "antepartum depression" and "postpartum depression" in the intertemporal and contemporaneous groups, respectively.

Neonatal outcomes

In the intertemporal group, neonatal outcomes included the duration of gestation (number of days), birth weight (grams), preterm birth (binary indicator for <37 weeks), birth weight z-score (binary indicator for <-2 or >2, calculated using gestational-age-specific birth weight medians and standard deviations by sex). In the contemporaneous group, neonatal outcomes included weight (grams), weight z-score (binary indicator for <-2 or >2, calculated using gestational-age-specific birth weight medians and standard deviations by sex), illness in the past month (number), and hospitalization in the past year (binary indicator).

Covariates

The following variables were considered as potential confounding factors in previous studies and were controlled for in this study. The mothers' demographics included age, educational attainment, employment status, and health insurance. Families' characteristics included urban households, region, health expenditure, the Engel coefficient, and poor households. Child demographics included sex.

Statistical analysis

We used propensity score matching (PSM), a common method used in observational studies, to reduce selection bias. This allowed us to mimic some of the characteristics of a randomized controlled trial by balancing the distribution of observed covariates in the treated and control groups (38–40). First, we used all the covariates described in the Covariates subsection to calculate the propensity score of depression for each pair. Second, children with depressed mothers were matched at a 1:2 ratio to children with normal mothers using nearest-neighbor matching with replacement, the most common implementation of PSM that minimizes bias in subsequent estimations (41). Lastly, we computed standardized differences in covariates between the treated and control groups before and after matching to assess the improvement of balance in the covariates (Supplemental Technical Note 1) (42). If the standardized difference was < 10%, it was considered an indicator of balance (42).

Following PSM, generalized linear mixed regression analyses (Gaussian family model for continuous outcomes and binomial family model for binary outcomes) were used to examine the effect of mothers' antepartum depression and postpartum depression on neonatal outcomes respectively, accounting for the pairing between the treated and control

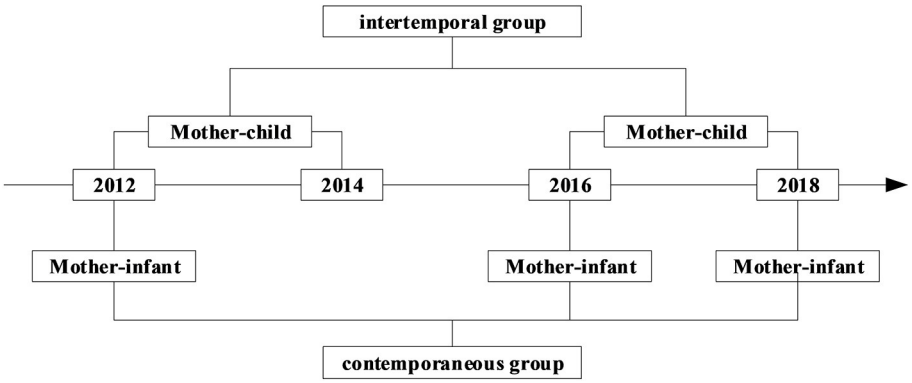


FIGURE 1
Flow chart of the study groups. The intertemporal group consisted of mothers from 2012 and 2016 who were matched with children from 2014 and 2018, respectively. The contemporaneous group consisted of mother–infant pairs from 2012, 2016, and 2018.

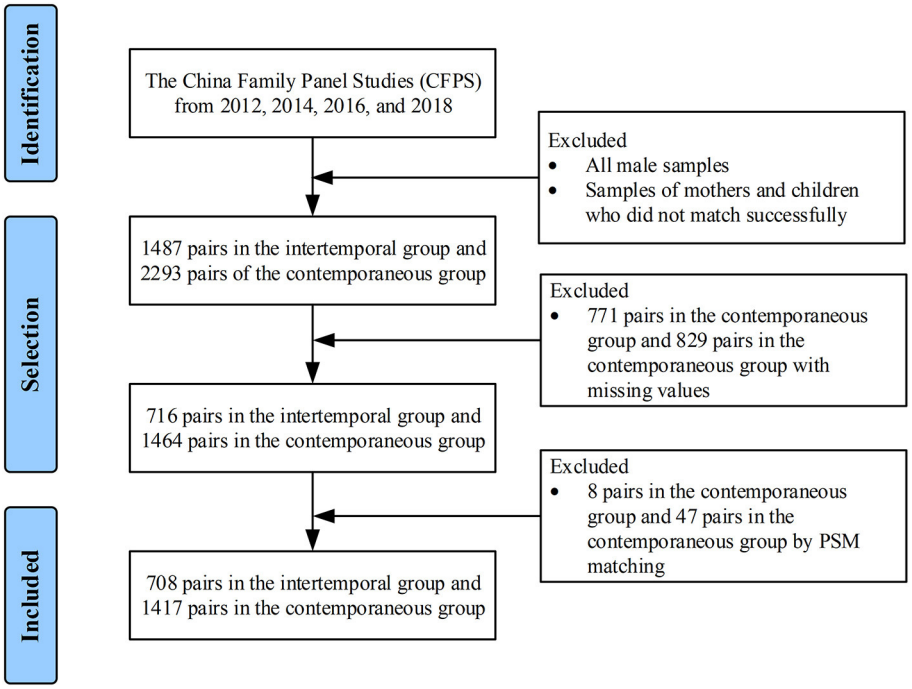


FIGURE 2
Flow chart of the study participants. Data from the China Family Panel Studies (CFPS) from 2012, 2016, and 2018 were applied.

groups in the intertemporal and contemporaneous groups. All the covariates described in the Covariates subsection were adjusted for in the regression analyses. The final sample sizes for the regression analyses following PSM were 708 and 1,417 in the intertemporal and contemporaneous groups, respectively.

In the sensitivity analysis, we used different PSM methods to determine the robustness of the results. In addition to 1:2 nearest-neighbor matching with replacement in the main analysis, we used 1:2 nearest-neighbor matching with replacement and a caliper of 0.001, and 1:4 nearest-neighbor matching with replacement, kernel matching, radius matching, and a caliper of 0.01. In addition, Meanwhile, we divided the samples into subgroups by sex and urban households of infants or children to test for heterogeneity in each group.

All statistical analyses were performed using Stata 15.1 (Stata Corp., LLC). A p-value < 0.05 was considered statistically significant.

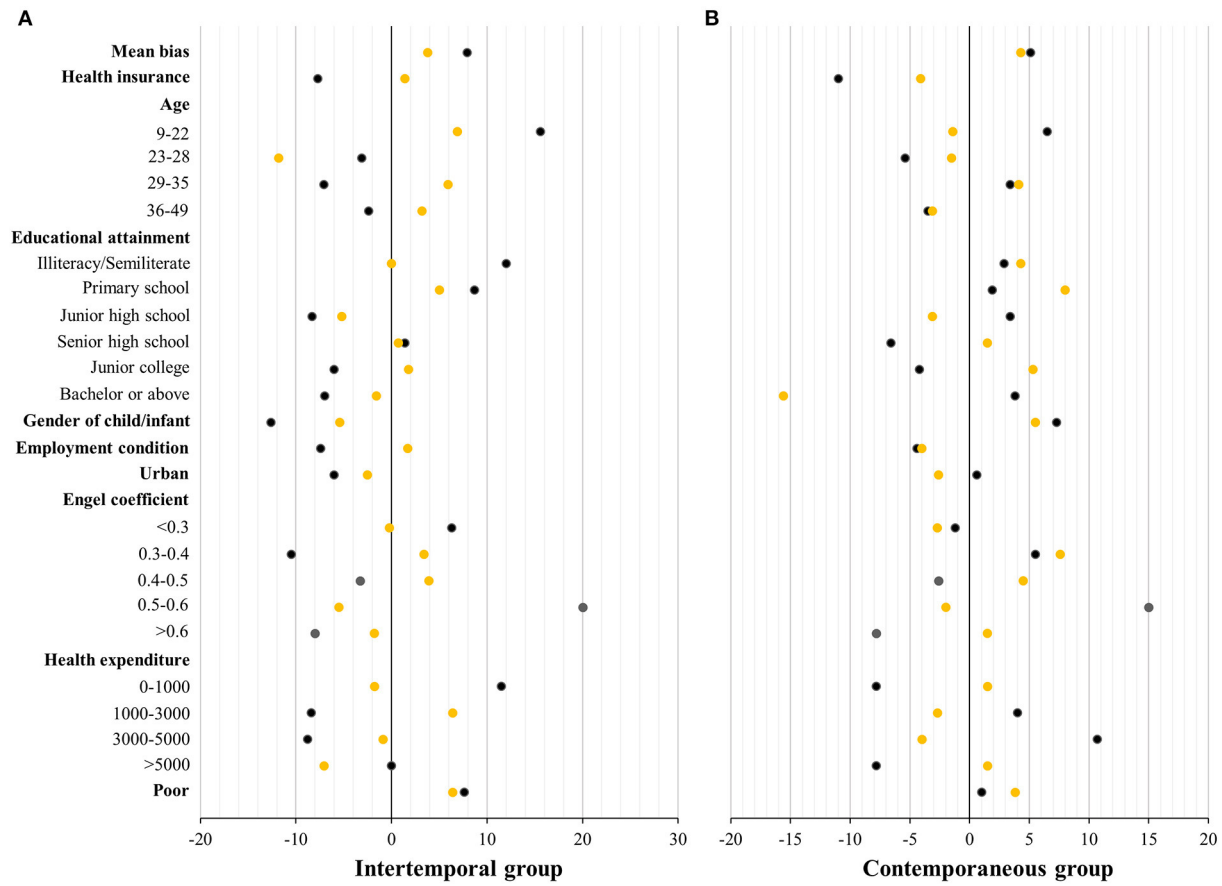


FIGURE 3
Standardized differences between the treated and control groups before and after propensity score matching. The results of intertemporal group **(A)** and contemporaneous group **(B)** are displayed. The black dots represent standardized differences before matching, and the yellow dots represent standardized differences after matching. The 1:2 nearest-neighbor matching with replacement was used. Details are provided in Supplementary Tables 3, 4.

TABLE 1 Neonatal outcomes between the treated and matched control groups after propensity score matching in the intertemporal group.

Outcome	Treated ($n = 523$)		Matched control ($n = 185$)		T test results of the between-group difference		
	Mean or %	95% CI	Mean or %	95% CI	Mean or %	95% CI	*P*-value
Duration of gestation, continuous	281.05	279.39, 282.72	285.41	282.80, 288.01	4.35	1.16, 7.54	0.0076
Preterm birth, binary	6.50%	4.38%, 8.62%	3.78%	1.01%, 6.56%	−2.72%	−6.20%, −0.77%	0.1261
Birth weight	3257.46	3211.11, 3303.81	3311.62	3234.53, 3388.72	54.16	−36.10, 144.43	0.2392
Birth weight z-score, continuous	80.31%	76.89%, 83.73%	78.38%	72.39%, 84.37%	−1.93%	−8.68%, −4.82%	0.5753

CI, confidence interval.

Ethics approval

We only used secondary data from the CFPS database which is open for the public. So we did not collect data from the respondents and thus exempted by the Institutional Review Board (IRB) of our university.

Results

Propensity score matching

Using PSM, we matched 523 mother–child pairs with antepartum depression and 1,044 mother–child pairs with

TABLE 2 Neonatal outcomes between the treated and matched control groups after propensity score matching in the contemporaneous group.

Outcome	Treated ($n = 1044$)		Matched control ($n = 373$)		*T*-test results of the between–group difference		
	Mean or %	95% CI	Mean or %	95% CI	Mean or %	95% CI	*P*–value
Weight, continuous	8975.05	8821.55, 9128.54	8892.55	8615.91, 9168.54	−82.82	−387.86, 222.21	0.5944
Weight z–score, binary	4.02%	2.83%, 5.21%	5.90%	3.50%, 8.30%	1.88%	−0.80%, 4.56%	0.1700
Illness in the last month, continuous	0.72	0.65, 0.78	0.48	0.40, 0.56	−0.24	−0.35, −0.13	0.0000
Hospitalization, binary	23.95%	21.35%, 26.53%	16.09%	12.34%, 19.83%	−7.86%	−12.41%, −3.31%	0.0007

CI, confidence interval.

TABLE 3 Descriptive statistics of the covariates for study samples in the intertemporal group.

Characteristics	Treated ($N = 523$)		Unmatched Control ($N = 193$)		Matched Control ($N = 185$)	
	N	%	*N*	%	*N*	%
Maternal characteristics						
Age						
16–22	88	16.83	22	11.40	22	11.89
23–28	252	48.18	96	49.74	93	50.27
29–35	143	27.43	59	30.57	54	29.19
36–49	40	7.65	16	8.29	16	8.65
Medical insurance	444	84.89	169	87.56	161	87.03
Education						
Illiteracy/Semiliterate	59	11.33	15	7.77	15	8.11
Primary school	116	22.18	36	18.65	34	18.38
Junior high school	169	32.31	70	36.27	67	36.22
Senior high school	95	18.16	34	17.62	33	17.84
Junior college	55	10.52	24	12.44	22	11.89
Bachelor or above	29	5.54	14	7.25	14	7.57
Employment	268	51.24	106	54.92	101	54.59
Family characteristics						
Urban	231	44.17	91	47.15	85	45.95
Poor	58	11.09	17	8.81	16	8.65
Health expenditure						
0–1000	413	78.97	143	74.09	137	74.05
1000–3000	71	13.58	32	16.58	31	16.76
3000–5000	20	3.82	11	5.70	10	5.41
Above 5000	19	3.63	7	3.63	7	3.78
Engel coefficient						
Above 0.6	175	33.46	72	37.31	70	37.84
0.5–0.6	66	12.62	13	6.74	13	7.03
0.4–0.5	83	15.87	33	17.10	33	17.84
0.3–0.4	60	11.47	29	15.03	27	14.59
Below 0.3	139	26.58	46	23.83	42	22.70
Child characteristics						
Female	233	44.55	74	38.34	74	40.00

Treated group included all mother–infant pairs with antepartum depression. Unmatched control group included all mother–infant pairs without antepartum depression. Matched control group included propensity–score–matched mother–infant pairs without antepartum depression.

TABLE 4 Descriptive statistics of the covariates for study samples in the contemporaneous group.

Characteristics	Treated ($N = 1044$)		Unmatched control ($N = 420$)		Matched control ($N = 373$)	
	N	%	*N*	%	*N*	%
Maternal characteristics						
Age						
9–22	115	11.02	38	9.05	37	9.92
23–28	501	47.99	213	50.71	186	49.87
29–35	365	34.96	140	33.33	125	33.51
36–49	63	6.03	29	6.90	25	6.70
Medical insurance	946	90.61	393	93.57	348	93.30
Education						
Illiteracy/Semiliterate	59	5.65	21	5.00	19	5.09
Primary school	156	14.94	60	14.29	51	13.67
Junior high school	380	36.40	146	34.76	128	34.32
Senior high school	201	19.25	92	21.90	85	22.79
Junior college	134	12.84	60	14.29	51	13.67
Bachelor or above	114	10.92	41	9.76	39	10.46
Employment	467	44.73	197	46.90	175	46.92
Family characteristics						
Urban	478	45.79	191	45.48	175	46.92
Poor	90	8.62	35	8.33	30	8.04
Health expenditure						
0–1000	647	61.97	276	65.71	239	64.08
1000–3000	259	24.81	97	23.10	91	24.40
3000–5000	64	6.13	16	3.81	16	4.29
Above 5000	74	7.09	31	7.38	27	7.27
Engel coefficient						
Above 0.6	408	39.08	181	43.10	153	41.02
0.5–0.6	82	7.85	18	4.29	18	4.83
0.4–0.5	147	14.08	63	15.00	56	15.01
0.3–0.4	154	14.75	54	12.86	51	13.67
Below 0.3	253	24.23	104	24.76	95	25.47
Infant characteristics						
Female	474	45.40	206	49.05	185	49.60

Treated group included all mother–infant pairs with postpartum depression. Unmatched control group included all mother–infant pairs without postpartum depression. Matched control group included propensity–score–matched mother–infant pairs without postpartum depression.

postpartum depression, which constituted the treated group, with mother–child pairs in the intertemporal group and mother–child pairs in the contemporaneous group, which constituted the matched control group. Supplementary Tables 1, 2 show the descriptive statistics.

Figure 3 presents the standardized differences between the treated and control groups before and after 1:2 matching (details are provided in Supplementary Tables 3, 4). In the intertemporal group, some covariates had standardized differences >10% and even up to 20% before matching, but the standardized differences were considerably reduced after matching except for one covariate (age between 23 and 28), which still had a difference >10% and the mean standardized differences reduced from 7.9 to 3.8%, and some covariates had differences reduced to 5% or less. In the contemporaneous group, three covariates had standardized differences >10% before matching, and the standardized differences were reduced to <10% after matching, except for one covariate (junior college), and most standardized differences were reduced to <5%. The mean standardized differences decreased from 5.1 to 4.3%. Therefore, the mean standardized differences were reduced to <5% in both intertemporal and contemporaneous groups. PSM considerably improved comparability between the treated and control groups.

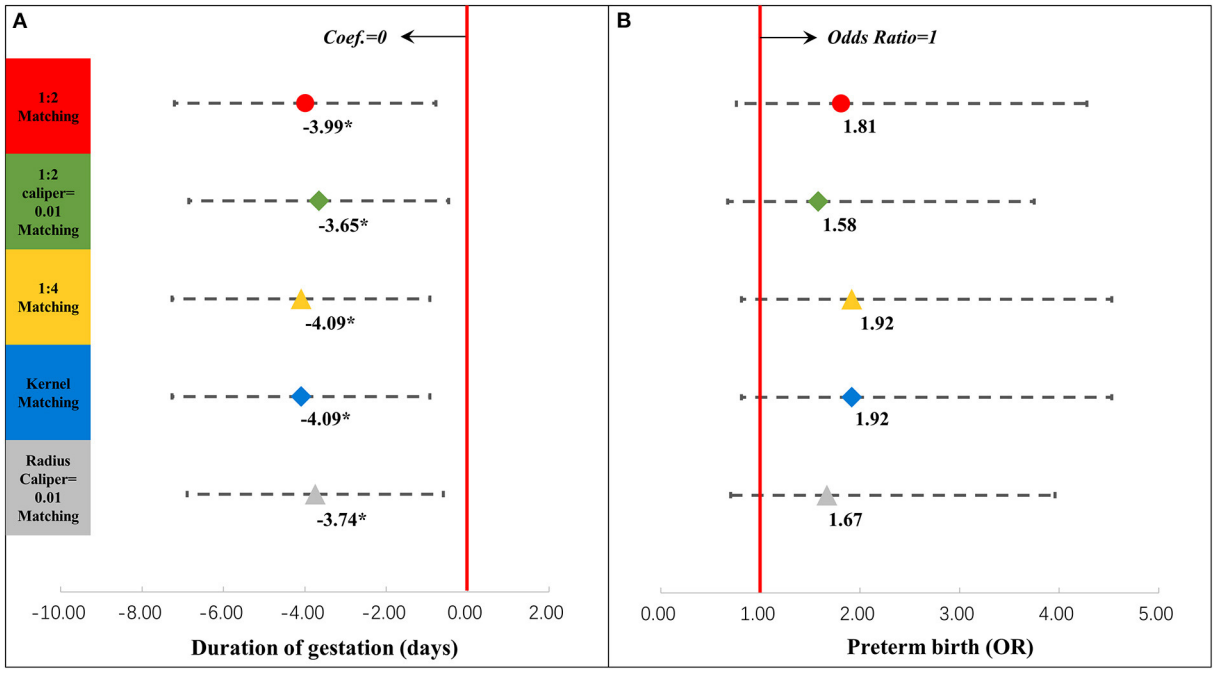


FIGURE 4
Results of regression analysis of the duration of gestation **(A)** and preterm birth **(B)** after propensity score matching. $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$. The results of different propensity score matching analyses are reported too. Dots and lines represent means and 95% confidence intervals for Coef. or ORs estimated from generalized linear mixed regression analyses. Maternal, family, and infant characteristics were also included in the regression analyses but are not reported. Details are provided in Supplementary Table 5. Coef, coefficient; OR, odds ratio.

Association estimation after matching

We first performed descriptive statistics on neonatal outcomes and covariates. Tables 1, 2 show the descriptive statistics of the neonatal outcomes in the intertemporal and contemporaneous groups without regression adjustments. Tables 3, 4 show the descriptive statistics of the descriptive statistics of the covariates for the study sample in the intertemporal and contemporaneous groups.

We then examined the association between antepartum depression and neonatal outcomes in the intertemporal groups. Figure 4 displays the associations between antepartum depression and neonatal outcomes, which were related to gestational age (details are shown in Supplementary Table 5). Antepartum depression was associated with a shorter duration of gestation by 3.99 days (95% confidence interval [CI] = −7.21, −0.78). But the association between antepartum depression and preterm birth was not significant. Figure 5 presents the associations between antepartum depression and neonatal outcomes, which were related to birth weight (details are shown in Supplementary Table 5). The association between antepartum depression and birth weight and birth weight z-score was not significant.

Meanwhile, we examined the association between postpartum depression and neonatal outcomes in the contemporaneous group. Figure 6 shows the associations between postpartum depression and neonatal outcomes, which were related to weight (details are shown in Supplementary Table 6). The association between postpartum depression and weight or the weight z-score was not significant. Figure 7 displays the associations between postpartum depression and neonatal outcomes, which were related to illness (details are shown Supplementary Table 6). Postpartum depression was associated with more episodes of illness in the last month by 0.23 times (95% CI = 0.11, 0.36) and a higher odd of hospitalization in the last year (OR = 1.59, 95% CI = 1.15, 2.20).

We also demonstrated the after-matching results of subgroups by sex and urban households of infants or children in the appendix (details are shown in Supplementary Tables 7–10).

Discussion

Using a large retrospective cohort in China, this study examined the effects of maternal depression on newborns, which may seriously affect the quality of the birth population. Unlike most previous studies focusing on the effect of antepartum depression or postpartum depression, this study focused on both antepartum depression and postpartum depression. Our

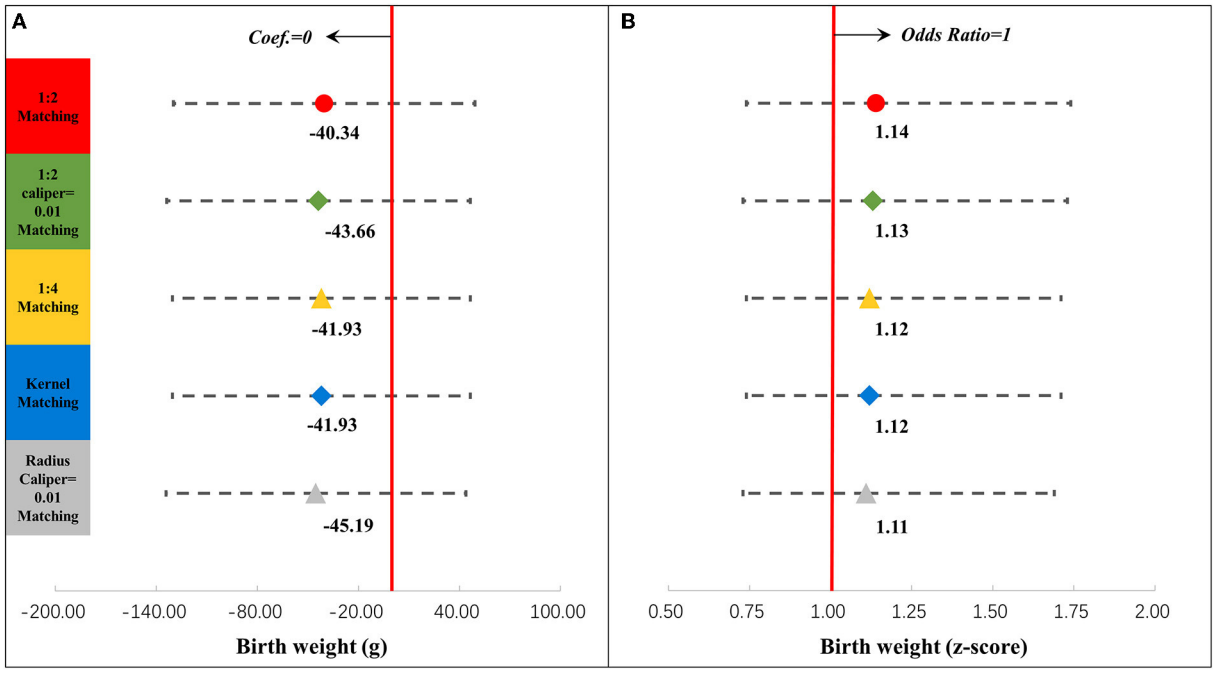


FIGURE 5
Results of regression analysis of the birth weight **(A)** and birth weight z-score **(B)** after propensity score matching. $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$. The results of different propensity score matching analyses are reported too. Dots and lines represent means and 95% confidence intervals for Coef. or ORs estimated from generalized linear mixed regression analyses. Maternal, family, and infant characteristics were also included in the regression analyses but are not reported. Details are shown in Supplementary Table 5. Coef, coefficient; OR, odds ratio.

PSM analysis revealed that both antepartum and postpartum depression affect newborn health in some ways. Based on the CFPS data, we made several important findings that partially validated our hypotheses.

First, our results showed that antepartum depression was associated with a shorter duration of gestation, but we did not find a significant association between antepartum depression and preterm birth. Larsson et al. found an association between antepartum depressive symptoms and a shorter gestational period of 1 week (13) and other studies have reported no significant association between antepartum depression and preterm birth (14, 16). These studies confirmed our conclusions. But in a previous study from China, Huang et al. reported no link between antepartum depression and preterm birth (43). Furthermore, different from other studies in China (44, 45), the association between antepartum depression and birth weight and birth weight z-scores in our study was not significant. Studies in other countries also suggested no evidence that antepartum depressive symptoms are associated with birth weight (15) or a higher odds of delivering a low-birth-weight infant (16), which was consistent with our conclusion.

It is possible that women with depression may suffer from loss of appetite, difficulty sleeping, lack of energy, weight loss, and other symptoms (8–10), which could biologically affect the fetus. Pregnant women with prenatal depression were also more likely to have pregnancy complications, such as back pain and premature contractions, and were more likely to have mental disorders and fear of childbirth than those without prenatal depression (13). Additionally, mothers with depression are more likely to obtain inadequate medical care or seek medical help than non-depressed mothers (8). But based on our results, all of these potential negative effects of antepartum depression may lead to a shorter duration of gestation, but not so severe as to increase the probability of preterm birth. Meanwhile, our study also proved that antepartum depression was not associated with birth weight.

Second, our study demonstrated that postpartum depression had no significant association with weight or the weight z-score of infants, but postpartum depression was associated with more illnesses in the last month and a higher risk of hospitalization in the previous year. Unlike what we found in our study, evidence from developing countries showed that postpartum depression was associated with early childhood growth, such as being underweight or stunted (30, 35), which was also verified to be true in low-income countries (29). A study on Chinese infants also showed that postpartum depression had a negative effect on the physical development of the baby (46). At the same time, the effect may be persistent, affecting a child's weight gain up to the age of 2 years (32). However, Tomlinson et al. found the

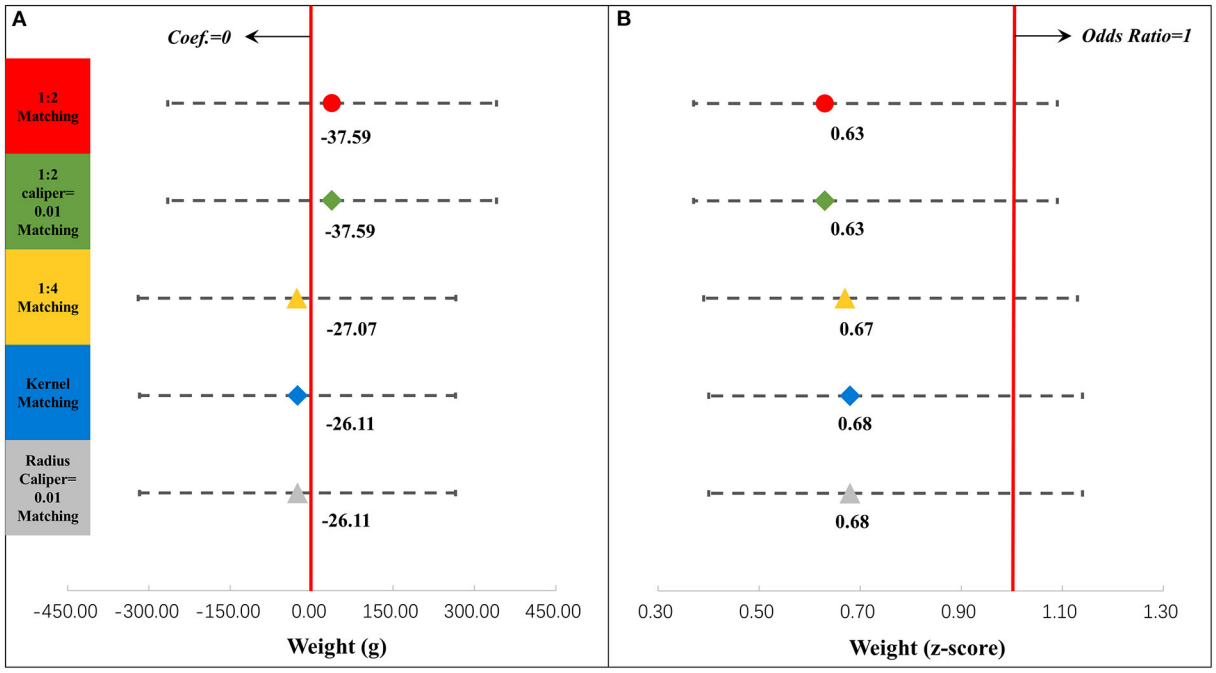


FIGURE 6
Results of regression analysis of weight **(A)** and the weight z-score **(B)** after propensity score matching. $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$. The results of different propensity score matching analyses are reported too. Dots and lines represent means and 95% confidence intervals for Coef. or ORs estimated from generalized linear mixed regression analyses. Maternal, family, and infant characteristics were also included in the regression analyses but are not shown. Details are reported in Supplementary Table 6.

same results with us that the association between postpartum and child growth is not significant (34). In addition, many literatures that confirmed that postnatal depressive symptoms can harm a baby's health. A cross-sectional feasibility study in Zambia showed that postpartum depression is associated with more episodes of diarrhea in children. Children with depressed mothers also had more physical problems, such as allergies, asthma, frequent colds, coughs, headaches, and indigestion, than those without non-depressed mothers (47).

Depressive symptoms could also affect maternal care behaviors, such as breastfeeding practices, preparation of appropriate weaning foods, uptake of immunizations, and care-seeking behaviors when children are directly ill (10). Depressed mothers doubt their ability to be a parent (8, 10) and are less likely to provide stimulation and response to their infants than non-depressed mothers (48–50). Consequently, the level of care provided by mothers with depression may put their infants at a higher risk of infection and impaired growth (10). Our findings revealed that maternal depression is a risk factor for the health of newborns and demonstrated the importance of paying attention to women with antepartum depression or postpartum depression in China.

This study has several limitations. First, constrained by the CFPS data, we had to exclude some potential covariates that had too many missing values to keep the sample size as large as possible. We were unable to derive detailed living conditions or childbearing information about mothers, both of which could have potential impacts on neonatal outcomes. Regarding smoking and drinking, as we discussed above, Chinese mothers are less exposed to tobacco and alcohol, but these two factors may have a huge impact on neonatal outcomes (51). Second, we were unable to control for bias from unobserved confounding factors and selection on unobservable confounding factors can still introduce "hidden bias", although PSM analysis with a range of covariates could balance the measured confounding factors, a limitation common to almost all previous epidemiological studies (52). Third, owing to the nature of the CFPS data, the inability to confirm the exact time of pregnancy and birth could be an issue. However, because of the lack of birth month data, we were able to make a rough intertemporal match between the mother and child to infer when the mother was pregnant, which may have affected our measurements. Lastly, similar to previous findings (25, 31, 32), we found that the effects of postpartum depression on babies can be long-lasting or gradual; some effects do not appear even 5 years later. Because our study only examined 0–1 years old infants after birth, we did not perform a long enough follow-up, so the effects of postpartum depression on a child's growth and development have not been accurately measured. Therefore, it would be worthwhile to investigate and study the long-term effects of maternal prenatal or postnatal depression on children. Future researches are suggested to obtain this.

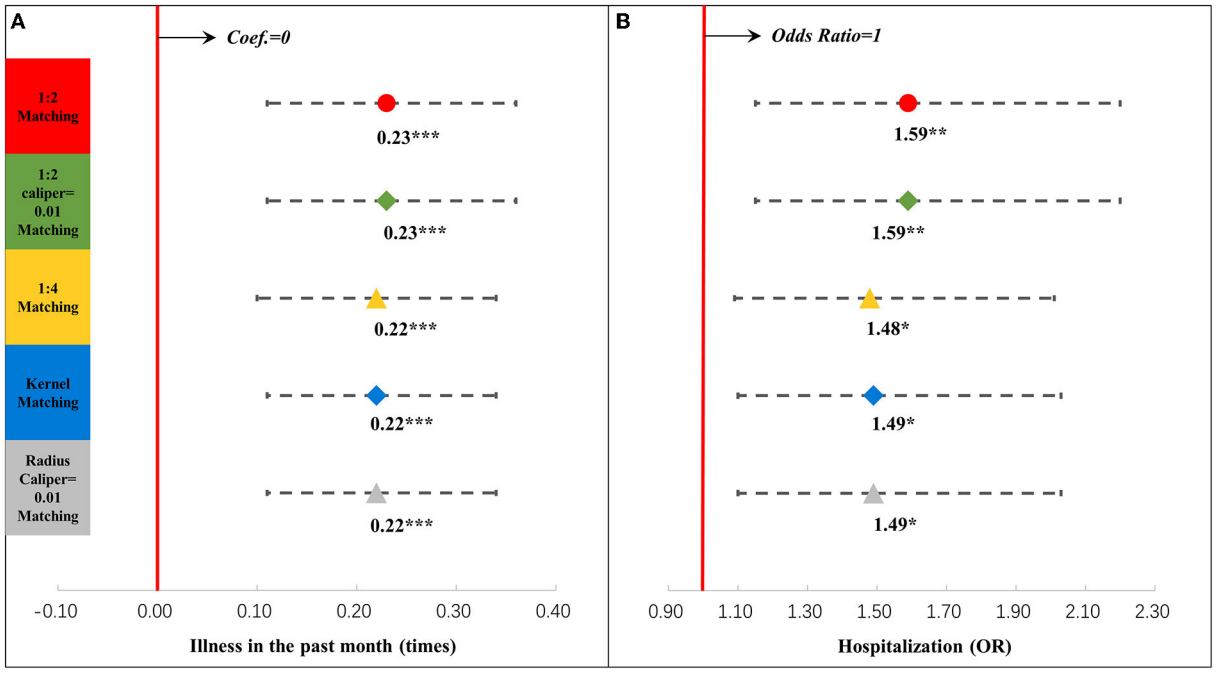


FIGURE 7
Results of regression analysis of illness in the last month **(A)** and hospitalization **(B)** after propensity score matching. $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$. The results of different propensity score matching analyses are shown too. Dots and lines represent means and 95% confidence intervals for Coef. or ORs estimated from generalized linear mixed regression analyses. Maternal, family, and infant characteristics were also included in the regression analyses but are not reported. Details are reported in Supplementary Table 6.

Despite these limitations, our study has three major strengths. First, we used PSM analysis to improve the validity of comparisons, which have rarely been referred to in previous studies. Second, we used a cohort with CFPS data to verify the influence of maternal depression on newborn health, which compensates for the research gap in China. And the CFPS database allowed us to successfully leverage nationwide, more representative data and reach different conclusions than previous studies. Third, unlike previous studies concentrating only on antepartum depression or postpartum depression, this study verified both.

Conclusions

This study used CFPS data to determine the effect of antepartum and postpartum depression on neonatal outcomes in China. We found that antepartum depression was associated with a shorter duration of gestation. Postpartum depression was also associated with more frequent illnesses and a higher risk of hospitalization. Our study indicated that maternal depression before and after delivery should be addressed in China. Policies aimed at paying attention to antepartum depression and postpartum depression can not only improve the plight of mothers, but it is also an effective way to improve the quality of birth population. With the various neonatal outcomes, more studies are needed to understand their association with maternal depression in the future.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: http://www.isss.pku.edu.cn/cfps.

Author contributions

HL: conceptualization, formal analysis, methodology, formal analysis, and visualization. WN and NZ: formal analysis and visualization. JZ and YM: resources and supervision. RH: supervision. BZ: conceptualization, methodology, visualization, and funding acquisition. All authors contributed to the article and approved the submitted version.

Funding

This study was funded by the Project of Natural Science Foundation of Guangdong Province (2021A1515110617, PI: Zhu).

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.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.893518/full#supplementary-material

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frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 10 October 2022
DOI 10.3389/fpubh.2022.951544

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OPEN ACCESS

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

RECEIVED 24 May 2022
ACCEPTED 22 September 2022
PUBLISHED 10 October 2022

CITATION
Sun Y, Tong J, Feng Y, Fang H, Jiang T, Zhao L, Wang Q and Yang Y (2022) Attitude and influencing factors of patients with schizophrenia toward long-acting injections: A community-based cross-sectional investigation in China.
Front. Public Health 10:951544.
doi: 10.3389/fpubh.2022.951544

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Attitude and influencing factors of patients with schizophrenia toward long-acting injections: A community-based cross-sectional investigation in China

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Background: Low prescription rates of antipsychotic long-acting injections (LAIs) may be a major challenge in the prevention and treatment of schizophrenia. However, there are few studies on the usage and attitude toward LAIs among community-based patients with schizophrenia.

Methods: A large community-based cross-sectional investigation was conducted among 6,336 patients with schizophrenia from Shanghai, China from March 1 to June 30, 2021. The structured Attitude and Status toward Treatment of Community Patients with Schizophrenia Questionnaire (AST-CSQ) was used to investigate the attitude and influencing factors of community-dwelling patients with schizophrenia toward LAIs.

Results: Among the 6,336 participants, the average age was 49.28 ± 11.23. The rate of agreement to LAI antipsychotics among participants was 3.16% (n = 200). The family financial resources, care ability, and disease course of the LAIs group were less than those of the non-LAIs group. However, the LAIs group had higher immediate family guardianship, social activity, previous hospitalization, number of hospitalization, outpatient adherence, previous antipsychotic use, antipsychotic adherence, and attitude toward oral antipsychotics than the non-LAIs group, with significant differences between the two groups ($p < 0.05$). Furthermore, age (β = −0.036, OR 0.964, 95% CI 0.947–0.982), marital status (β = 0.237, OR 1.267, 95% CI 1.002–1.602), care ability (β = 0.709, OR 2.032, 95% CI 1.437–2.875), outpatient adherence (β = −0.674, OR 0.510, 95% CI 0.358–0.725), antipsychotic adherence (β = 0.920, OR 2.509, 95% CI 1.092–5.764), and attitude toward oral antipsychotics (β = −1.357, OR 0.258, 95% CI 0.103–0.646) were significant predictors of attitude toward LAI antipsychotics ($p < 0.05$).

Conclusions: The community-dwelling patients with schizophrenia in China had a low willingness to use LAIs. Patients of a younger age, more

hospitalizations, and a shorter course of disease were prone to be more willing to accept LAIs. The patients' age, marital status, care ability, outpatient adherence, antipsychotic adherence, and attitude toward oral antipsychotics were important predictor of patients' attitudes toward LAIs. Under the global deinstitutionalized management model of mental disorders, these results highlight an urgent problems for public mental health service providers and policy-makers and provide more solutions for them.

KEYWORDS

long-acting injections, LAIs, schizophrenia, community, China

Background

The prevention of relapse and hospitalization in individuals with schizophrenia is a major public mental health challenge (1). To date, the problems of multiple relapses in the course of schizophrenia are difficult to solve and have attracted extensive attention worldwide (2, 3). According to a WHO report in 2018, the number of patients with schizophrenia in the world reached 24 million, with a prevalence of 3.8 to 8.4 ‰ and a 10-year recurrence rate of 75% (4). In Europe, estimates of the excess costs of relapse in schizophrenia range from $8665 to 18,676 over periods of 6–12 months, while in the US, it can reach $16,000 to 33,000 over a period of 6–15 months (5). Most studies have shown that poor treatment adherence has become an important factor in multiple relapses of schizophrenia (6, 7).

Long-acting injectable (LAI) antipsychotics have been shown to improve treatment adherence in patients with schizophrenia and decrease the rate of relapse and hospitalization, which makes them superior to their oral counterparts in this regard (8). LAIs are a new medical controlled-release technology that can reduce the number of times patients take medicine, so they can effectively improve medication adherence (9). Subotnik et al. (10) showed that the relapse rate and/or psychotic exacerbation of first episode of schizophrenia was lower for the LAIs group than for the oral group, and the relative risk was reduced by 84.7%. A meta-analysis of 147 studies suggests that LAIs are more beneficial than oral antipsychotics in terms of insight, efficacy, effectiveness, safety and quality of life (11).

However, the clinical use rate of LAIs has not reached expectations, especially for community-dwelling patients with schizophrenia, which puts forward new problems for public mental health (12). In European countries, the second-generation antipsychotic LAI prescription rate is lower than 30%, while that in the United States is only 10% (13). The limited use of LAIs appears to be related to the negative attitudes of clinicians and inpatients toward this treatment (14). A total of 17.6% of physicians declared feeling more pressure to offer LAI antipsychotics than oral antipsychotics (15). Most patients believed that LAIs were less effective, more expensive and had more serious side effects than oral antipsychotics (16).

At present, there are few studies on the usage of and attitude toward LAIs among community-dwelling patients with schizophrenia. We do not know the factors related to the low use of LAIs in community-dwelling patients. According to the data of the mental health center of the Chinese Center for Disease Control and Prevention, the number of patients with schizophrenia in China has exceeded 6.4 million (17). In the future, the rehabilitation of schizophrenia will be gradually deinstitutionalized and the community rehabilitation model will be realized (18). This large community-based cross-sectional investigation explored the attitude and influencing factors of Chinese community-dwelling patients with schizophrenia toward LAIs.

Methods

Study design

This study was conceptualized as a community-based cross-sectional investigation. It was conducted by the Mental Health subcentre of Shanghai Pudong New Area Center for Disease Control and Prevention, Shanghai Pudong New Area Mental Health Center, Tongji University School of Medicine, which has been dedicated to fully functioning community mental health prevention and research since 2010. The sample size of the study was calculated using the PASS version 21.0.3 (NCSS LLC, Utah, USA), a sample size and power analysis software. Taking the significance level (α) was 0.05, the confidence level ($1-\alpha$) was 0.95, the allowable error (δ) was 0.03, and the proportion (p) was 0.5, and the calculated sample size was 1,098. Considering the special population, the loss rate was set at 40%, the calculated sample size was at least 1,830. A total of 10,305 paper informed consent forms and questionnaires were distributed to patients with schizophrenia in 23 residential districts and 32 community health service centers in Pudong New Area, Shanghai. A total of 6,336 individuals agreed to participate in and complete the

questionnaires from March 1 to June 30, 2021. The attrition rate of participants was 38.52%. This study was ethically reviewed by the Research Ethics Committee of the Shanghai Pudong New Area Mental Health Center and Tongji University Mental Health Center.

Participants

All participants were community-based psychiatric patients from Pudong New Area, Shanghai from March 1 to June 30, 2021. The following inclusion criteria were employed: (1) patients meeting the DSM-5 (19) diagnostic criteria for schizophrenia; (2) age $\leq$ 65 years old; (3) certain visual and auditory resolution without cognitive disorders; (4) currently living in the community and not hospitalized; and (5) both the participants and guardians agreed to participate in the investigation and signed the informed consent. The following exclusion criteria were employed: (1) severe visual or hearing impairment, physical disability, extracranial trauma or history of surgery; (2) obvious excitement impulse, serious negativity, self-harm or suicidal ideation; (3) dementia or developmental delay diagnosed as behavioral disorder; and (4) participants or guardians who did not sign the informed consent form, or withdrew halfway.

Outcomes

Attitude and status toward treatment of community patients with schizophrenia questionnaire

This investigation was conducted using the self-made AST-CSQ. To ensure the quality and rationality of the survey, three measures were taken to finalize the questionnaire. First, referring to the Medication Adherence Rating Scale (MARS) (20, 21), Drug Attitude Inventory (DAI) (22), and Multidimensional Scale of Perceived Social Support (MSPSS) (23), the expert consultation determined the questionnaire items. Second, after three rounds of expert committee argumentation, the first version of the questionnaire is determined. Third, the revised version of the questionnaire were determined according to the pre- survey problems. The expert committee consisted of four psychiatrists, four public health experts, two psychopharmacologists, one health economists, and one health statistician.

The structured AST-CSQ was used to investigate the attitude and status toward treatment of community patients with schizophrenia. The questionnaire consists of four sections and twenty questions (Table 1). The first part is demographic characteristics, including age, gender, marriage, residence, education, and occupation. The second part deals with the social support of the respondents, including economic status, medical expenses, guardians, care ability, and social activities. The third part is related to the treatment experience, including course of disease, number of episodes, inpatient or outpatient experience. The last part focuses on attitude toward oral and long-acting injectable antipsychotics (24). In addition, attitudes toward antipsychotics refer to agreement or disagreement to receive oral or long-acting injectable antipsychotics. The questionnaire was completed by 32 community psychiatric public health physicians through face-to-face interviews with respondents. All investigators were trained for consistency.

TABLE 1 Attitude and status toward treatment of community patients with schizophrenia questionnaire (AST-CSQ).

Section 1 (Demographic characteristics)
1. How old are you?
2. What is your gender?
3. What is your marital status?
4. Are you a registered residence in Shanghai?
5. What is your education?
6. What is your occupation?
Section 2 (Social support)
7. How is your family's financial resources?
8. Where does your medical expenses come from?
9. What is your relationship with guardians?
10. How about the guardian's care ability?
11. Do you often involve in social activities or housework?
Section 3 (Treatment experience)
12. How many years is your course of disease?
13. How many times are the accidents caused by illness?
14. Have you ever been hospitalized?
15. How many times have you been hospitalized?
16. Do you have regular outpatient visits?
Section 4 (Attitude toward antipsychotics)
17. Have you ever taken antipsychotics?
18. Could you take your medicine on time according to the doctor's advice every day?
19. Would you like to take oral antipsychotics?
20. Would you like to take long-acting injectable antipsychotics?

Data analysis

Data were analyzed using SPSS version 25.0 statistical software (SPSS, Inc., Chicago, IL, USA). We first identified the patients' attitude acceptance rate of LAIs and divided them into an LAIs group and a non-LAIs group. Descriptive analysis was performed for sociodemographic data. All continuous variables are first tested for normality, and the variables with normal distribution were described by the mean mean $\pm$ standard deviation. The continuous variables were compared between groups using the independent samples t test. For

TABLE 2 Demographic characteristics, social support, treatment experience, and attitude toward antipsychotics of participants.

Variable	Overall (n = 6,336)	LAIs group (n = 200)	non-LAIs group (n = 6,136)	t / x_2	p
Section 1 (Demographic characteristics)					
Age in years (mean ± SD)	49.28 ± 11.23	44.65 ± 11.09	49.43 ± 11.20	5.945	<0.001**
Gender, *n* (%)				0.340	0.560
Male	3,008 (47.47%)	99 (49.50%)	2,909 (47.41%)		
Female	3,328 (52.53%)	101 (50.50%)	3,227 (52.59%)		
Marital status, *n* (%)				3.258	0.354
Unmarried	3,197 (50.45%)	106 (53.00%)	3,091 (50.40%)		
Married	2,619 (41.34%)	74 (37.00%)	2,545 (41.50%)		
Divorce	456 (7.20%)	19 (9.50%)	437 (7.10%)		
Widowed	64 (1.01%)	1 (0.50%)	63 (1.00%)		
Residence, *n* (%)				3.181	0.204
Registered residence	6,124 (96.65%)	189 (94.50%)	5,935 (96.72%)		
Non-registered residence	212 (3.35%)	11 (5.50%)	201(3.28%)		
Education, *n* (%)				11.519	0.074
Primary school and below	442 (6.98%)	13 (6.50%)	429 (6.99%)		
Junior high school	2,761 (43.58%)	93 (46.50%)	2,668 (43.48%)		
Senior high school	2,049 (32.34%)	49 (24.50%)	2,000 (32.59%)		
Junior college or above	1,084 (17.10%)	45 (22.50%)	1,039 (16.94%)		
Occupation, *n* (%)				21.789	<0.001**
Student	80 (1.26%)	4 (2.00%)	76 (1.24%)		
Employed	1,597 (25.21%)	49 (24.50%)	1,548 (25.23%)		
Retire	1,358 (21.43%)	25 (12.50%)	1,333 (21.72%)		
Unemployed	3,301 (52.10%)	122 (61.00%)	3,179 (51.81%)		
Section 2 (Social support)				4.932	0.026*
Family financial resources, *n* (%)					
Poor	976 (15.40%)	42 (21.00%)	934 (15.22%)		
Good	5,360 (84.60%)	158 (79.00%)	5,202 (84.78%)		
Source of medical expenses, *n* (%)				3.913	0.141
Own expense	928 (14.65%)	36 (18.00%)	892 (14.54%)		
Medical insurance	5,222 (82.42%)	155 (77.50%)	5,067 (82.58%)		
Others	186 (2.93%)	9 (4.50%)	177 (2.88%)		
Guardian relationship, *n* (%)				8.089	0.044*
Parents or children	3,455 (54.53%)	126 (63.00%)	3,329 (54.25%)		
Spouse	1,839 (29.02%)	51 (25.50%)	1,788 (29.14%)		
Others	1,042 (16.45%)	23 (11.50%)	1,019 (16.61%)		
Care ability, *n* (%)				22.778	<0.001**
Poor	730 (11.52%)	44 (22.00%)	686 (11.18%)		
Good	5,585 (88.14%)	156 (78.00%)	5,429 (88.48%)		
None	21 (0.34%)	0 (0.00%)	21 (0.34%)		
Social activities, *n* (%)				15.681	<0.001**
Involve in community activities	891 (14.06%)	29 (14.50%)	862 (14.05%)		
Only involve in housework	4,515 (71.26%)	161 (80.50%)	4,354 (70.96%)		
Not involve in any activities	930 (85.32%)	10 (5.00%)	920 (14.99%)		
Section 3 (Treatment experience)	18.05 ± 12.11	14.30 ± 10.06	18.17 ± 12.15	5.320	<0.001**
Course of disease (mean ± SD)					

(Continued)

TABLE 2 (Continued)

Variable	Overall (n = 6,336)	LAIs group (n = 200)	non-LAIs group (n = 6,136)	t / x_2	p
Number of accidents (mean ± SD)	0.03 ± 0.46	0.06 ± 0.40	0.03 ± 0.46	0.675	0.500
Hospitalization, n (%)				42.218	<0.001**
Yes	815 (12.86%)	56 (28.00%)	759 (12.37%)		
No	5,521 (87.14%)	144 (72.00%)	5,377 (87.63%)		
Number of hospitalizations (mean ± SD)	0.67 ± 1.51	1.15 ± 1.91	0.66 ± 1.49	3.674	<0.001**
Outpatient adherence, n (%)				51.851	<0.001**
Regular	4,233 (66.80%)	177 (88.50%)	4,056 (66.10%)		
Irregular	492 (7.77%)	15 (7.50%)	477 (7.77%)		
Never	1,611 (25.43%)	8 (4.00%)	1,603 (26.13%)		
Section 4 (Attitude toward antipsychotics)				5.491	0.019*
History of antipsychotic use					
Yes	6,172 (97.4 %)	200 (100.00%)	5,972 (97.32%)		
No	164 (2.6%)	0 (0.00%)	164 (2.68%)		
Antipsychotics adherence, n (%)				27.434	<0.001**
Regular	5,173 (81.64%)	185 (92.50%)	4,988 (81.29%)		
Irregular	274 (4.32%)	12 (6.00%)	262 (4.27%)		
Never	917 (14.04%)	31 (15.50%)	886 (14.44%)		
Attitude toward oral antipsychotics, n (%)				29.858	<0.001**
Agree	5,104 (80.56%)	190 (95.00%)	4,914 (80.08%)		
Disagree	889 (14.03%)	3 (1.50%)	886 (14.44%)		
Uncertain	343 (5.41%)	7 (3.5%)	336 (5.48%)		
Attitude toward LAI antipsychotics, n (%)				14.37	<0.001**
Agree	200 (3.16 %)	200 (100.00%)	0 (0.00%)		
Disagree	6,136 (96.84%)	0 (0.00%)	6,136 (100.00%)		

LAIs, Long-Acting Injections. *p < 0.05. **p < 0.01.

classified data, the frequency (percentage) was used for statistical description, and the chi-square (χ^2) test was used for intergroup comparison. Binary logistic regression analysis was used to explore the predictors of influencing factors for attitude toward LAI antipsychotics. The difference was statistically significant at $p < 0.05$.

Results

Demographic characteristics

The demographic characteristics of community-based patients with schizophrenia, including age, gender, marital status, residence, education and occupation, are shown in Section Demographic characteristics of Table 2. Among the 6,336 participants, the average age was 49.28±11.23 years, and the proportion of females was higher (52.53%). In addition, most of the respondents were unmarried (50.45%), registered a residence in the city (96.65%), had a junior high school education (43.58%), and were unemployment (52.10%). Respondents of the LAIs group were younger and less employed than those of the non-LAIs group, and there were significant difference between the two groups ($p < 0.001$). But there was no significant difference in other control variables of demographic characteristics ($p > 0.05$).

Attitude toward LAIs

The social support, treatment experience, and attitude toward antipsychotics among participants from the overall and the two groups in this study are reported in Section Social support to Attitude toward antipsychotics of Table 2. The rate of agreement to LAI antipsychotics among participants was 3.16% ($n = 200$), and there was a significant difference between the two groups ($\chi^2 = 14.37$, $p < 0.001$). The family financial resources, care ability, and disease course of the LAIs group were less than those of the non-LAIs group, and there were significant differences between the two groups ($p < 0.05$). However, the LAIs group had higher immediate family guardianship, social activity, previous hospitalization, number of hospitalization, outpatient adherence, previous antipsychotic use, antipsychotic

TABLE 3 Binary logistic regression analysis of different influencing factors on attitude toward LAIs.

Variable	β	Std. Error	Wald	*P*	OR (95% CI)
Age in years	−0.036	0.009	15.296	<0.001**	0.964 (0.947∼0.982)
Gender	−0.132	0.153	0.745	0.388	0.876 (0.650∼1.182)
Marital status	0.237	0.120	3.893	0.048*	1.267 (1.002∼1.602)
Residence	−0.048	0.160	0.092	0.761	0.953 (0.697∼1.302)
Education	−0.106	0.073	2.112	0.146	0.899 (0.779∼1.038)
Occupation	−0.120	0.074	2.599	0.107	0.887 (0.767∼1.026)
Family financial resources	−0.301	0.189	2.536	0.111	0.740 (0.510∼1.072)
Source of medical expense	0.131	0.146	0.809	0.368	1.140 (0.857∼1.516)
Guardian relationship	0.003	0.092	0.001	0.973	1.003 (0.837∼1.202)
Care ability	0.709	0.177	16.050	<0.001**	2.032 (1.437∼2.875)
Social activities	−0.077	0.184	0.176	0.675	0.926 (0.644∼1.327)
Course of disease	−0.014	0.009	2.483	0.115	0.986 (0.970∼1.003)
Number of accidents	0.024	0.133	0.032	0.857	1.024 (0.789∼1.329)
Hospitalization	−0.229	0.190	1.451	0.228	0.795 (0.548∼1.154)
Number of hospitalizations	0.085	0.045	3.496	0.062	1.088 (0.996∼1.189)
Outpatient adherence	−0.674	0.180	14.059	<0.001**	0.510 (0.358∼0.725)
Antipsychotics adherence	0.920	0.424	4.701	0.030*	2.509 (1.092∼5.764)
Attitude toward oral antipsychotics	−1.357	0.470	8.348	0.004**	0.258 (0.103∼0.646)

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

adherence, and attitude toward oral antipsychotics than the non-LAIs group, with significant differences between the two groups ($p < 0.05$). There was no significant difference in the source of medical expenses and the number of accidents ($p > 0.05$).

Regression analysis

The independent variables were different influencing factors of treatment attitude among community-based patients with schizophrenia; attitude toward LAI antipsychotics was the dependent variable for binary logistic regression analysis (Table 3). Age (β = −0.036, OR 0.964, 95% CI 0.947–0.982), marital status (β = 0.237, OR 1.267, 95% CI 1.002–1.602), care ability (β = 0.709, OR 2.032, 95% CI 1.437–2.875), outpatient adherence (β = −0.674, OR 0.510, 95% CI 0.358–0.725), antipsychotic adherence (β = 0.920, OR 2.509, 95% CI 1.092–5.764), and attitude toward oral antipsychotics (β = −1.357, OR 0.258, 95% CI 0.103–0.646) were significant predictors of attitude toward LAI antipsychotics ($p < 0.05$).

Discussion

We examined the attitude and influencing factors of community-based patients with schizophrenia toward LAIs by the AST-CSQ, which is based on a large community-based cross-sectional investigation. To date, our study is the largest survey of community patients-dwelling with schizophrenia, and it can address the relevant factors of patients' attitudes toward LAIs more comprehensively, which is an original research direction. We found that Chinese community-based patients with schizophrenia had a low willingness to use LAIs, only 3.16%. There is a huge gap, with a 30% prescription rate of LAIs in the clinical setting of European countries and an 18.2% utilization rate for outpatients in Japan (13, 25). Regarding attitudes toward oral antipsychotics, 80.56% of the participants agreed with their use. This is also similar to the results of a study conducted by Grover et al. (26), 78.8% of patients in India are still willing to choose oral tablets.

On the other hand, this study also found that there were significant differences in age, hospitalization, and course of disease between the LAIs group and the non-LAIs group, that is, patients of a younger age, more hospitalizations, and a shorter course of disease were prone to be more willing to accept LAIs. This may be related to the high demand for social function recovery of patients or guardians of a younger age, more hospitalizations, or a short course of disease and their obvious desire to reduce recurrence (27). In contrary, older patients with schizophrenia suffer from long-term disease, and their social function and insight are greatly damaged, which seriously affects their expectation of the efficacy of LAIs. These results were consistent with the study of Xiao et al. (28). Perhaps this suggests that it is necessary to develop a personalized intervention plan for the population of this age and disease course structure and carry out targeted medication guidance (29).

Furthermore, the attitude toward and willingness to use LAIs of community-based patients with schizophrenia will also be affected by the characteristics of family monitoring and the coexistence of disease outcome (30, 31). Our study showed that patients' age, marital status, care ability, outpatient adherence, antipsychotic adherence, and attitude toward oral antipsychotics were important predictor of patients' attitudes toward LAI antipsychotics. Consistent with the results of this study, Grover et al. found that patients with low antipsychotic adherence were less willing to accept LAI treatment (26). Interestingly, most studies have found that patients with poor care ability were more likely to choose LAI treatment (32). These patients hope to reduce the cost of monitoring by reducing the number of oral antipsychotics used (33, 34). The antipsychotic adherence of patients with antipsychotics directly affects their motivation and understanding in choosing LAIs (35, 36).

Understanding the attitudes and influencing factors of real-world community-dwelling patients toward LAIs and formulating targeted drug publicity plans may be an effective method for mental health control and prevention of schizophrenia in the future (37). Most previous studies were based on inpatients or outpatients with clinical schizophrenia. In contrast, our study was on a natural sample population of community-based patients (38). Because patients' attitudes toward LAIs are easily influenced by psychiatrists, this may lead to study bias (39). Grover et al. (40) suggested that psychiatrists' attitudes toward LAIs play an important role in the prescription rate of LAIs. Communicating and explaining according to the characteristics of different patients can effectively change their attitudes toward LAIs (41). In the context of deinstitutionalization of global mental disorder management, mental health managers and psychiatrists should participate together to optimize mental health management techniques and strengthen health education for patients with mental disorders in the community (42). This could form a more open relationship and stronger mutual trust to improve patients' support for long-term drugs and reduce the risk of disease recurrence.

Limitations

We also note several limitations. First, we were unable to conduct a nationwide multicentre study because of the COVID-19 pandemic. Second, we did not expand the use of measurement tools to measure psychiatric symptoms or social support systems. Future studies should explore the final outcome of community-based patients with schizophrenia using oral antipsychotics and LAIs by a long-term longitudinal study. This could provide more treatment options for clinical psychiatrists or public health practitioners to prevent the recurrence of mental diseases.

Conclusion

In this study, community-dwelling patients with schizophrenia in China had a low willingness to use LAIs. Patients of a younger age, more hospitalizations, and a shorter course of disease were prone to be more willing to accept LAIs. The patients' age, marital status, care ability, outpatient adherence, antipsychotic adherence, and attitude toward oral antipsychotics were important predictor of patients' attitudes toward LAIs. Under the global deinstitutionalized management model of mental disorders, these results highlight an urgent problems for public mental health service providers and policy-makers and provide more solutions for them.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Research Ethics Committee of the Shanghai Pudong New Area Mental Health Center and Tongji University Mental Health Center (No. PDJWLL2019008). The patients/participants provided their written informed consent to participate in this study.

Author contributions

YF, HF, TJ, and LZ recruited participants and collected the data. QW recommended the scales used in the study. YS, JT, and YY completed the scales data entry, analyzed the data of scales, and wrote the manuscript. YY and QW designed the study and revised the paper. All authors have read and approved the manuscript.

Funding

This study was supported by grants from the following institutions: Shanghai Pudong New Area Science and Technology Development Fund (No. PKJ2021-Y78), Construction of characteristic disciplines of Public

Mental Health of Shanghai Pudong New Area (No. PWYgts2021-01), and the Outstanding Clinical Discipline Project of Shanghai Pudong (No. PWYgy2021-02).

Acknowledgments

The authors would like to thank the Shanghai Pudong Municipal Commission of Health and Family Planning, the Outstanding Clinical Discipline Project of Shanghai Pudong for funding support. We would also like to thank Xudong Zhao, Chengping Hu, and Xirong Sun for their teaching and insight. The authors would also like to thank the participants that took part in this study.

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.

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 09 January 2023
DOI 10.3389/fpsyt.2022.955577

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OPEN ACCESS

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

RECEIVED 28 May 2022
ACCEPTED 16 December 2022
PUBLISHED 09 January 2023

CITATION
Uyar B, Yucel I, Uyar E, Ateş Budak E, Kelle I and Bulbuloglu S (2023) A case-control study on depression, anxiety, and belief in sexual myths in trans women.
Front. Psychiatry 13:955577.
doi: 10.3389/fpsyt.2022.955577

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A case-control study on depression, anxiety, and belief in sexual myths in trans women

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Objective: The purpose of our study was to investigate depression, anxiety, and belief in sexual myths in trans women.

Methods: This is a prospective case-control study. The case group included 60 trans women who were referred to the Medical Biology and Genetics Department from various clinics of the research and training hospital where this study was conducted. The control group consisted of 60 healthy male individuals who presented to the same hospital for routine health follow-ups and collecting documents showing their health. In data collection, we used a Personal Information Form, the Sexual Myths Scale, and the Beck Depression and Anxiety Inventories. The IBM Statistical Package for the Social Sciences 25.0 was used to analyze the data.

Results: In the case group, 26.7% of the participants were sex workers, and all were single. While 46.7% of the participants in the case group were living with their families, 66.7% were smokers, and 13.3% were receiving hormone treatment. All 60 participants in the control group were also single. The participants in the control group had higher levels of believing sexual myths and lower levels of anxiety and depression than those in the case group ($p = 0.000$). The mean scores of the participants in the control group in the Sexual Orientation and Sexual Violence subscales of the Sexual Myths Scale were higher than the mean scores of those in the case group ($p < 0.05$).

Conclusion: The trans women who participated in this study had higher levels of anxiety and depression and lower levels of believing sexual myths than the control group. The mental health of trans women can be disrupted due to various treatments they are exposed to in society such as stigma, discrimination, and violence. Their higher anxiety and depression levels in this study could be explained by this exposure. This exposure could also have led to their lower total scores in the Sexual Myths Scale, as well as lower scores in the Sexual Violence and Sexual Orientation subscales.

KEYWORDS

anxiety, belief in sexual myths, depression, gender dysphoria, sexual myths, trans women

Introduction

Gender incongruence is described as "an individual experiences a marked and persistent mismatch between the gender they experience and their assigned gender" (1, 2). People with gender incongruence experience a mismatch between their assigned gender and gender identity. Based on this mismatch, the person may want to have surgical interventions and hormone treatments. They wish to change their name in social life, have the social status of the opposite sex, behave like the opposite sex, and change their outer appearance. The ICD-11 diagnostic system defines these individuals as "transgender" (3). DSM-5 reported the prevalence of being gender dysphoria as 0.005–0.014% in male-to-female individuals and 0.002–0.003% in female-to-male individuals. In the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), Gender incongruence is defined as the presence of a significant discrepancy between one's existing gender identity and their assigned gender for at least 6 months (4).

In Türkiye, according to the Turkish Civil Code 4721, Part Two and 40th Item, a person who wants to change their sex can officially demand sex change by applying to a court in person. For this application, the court considers the requirements for approval as that the person making the application is over the age of 18 years, they are not married, and they can document with an official health committee report to be obtained from a research and training hospital that they are transsexual, their sex change is imperative for their mental health (5).

The term trans woman refers to individuals who are born with male biology but identify as the female sex (6). It is not possible to argue that a complete sexual transition occurs even for trans women who have undergone surgical interventions and hormone treatments. In Türkiye, trans women are often exposed to physical and verbal violence, experience unemployment and lack of money, and are abandoned by a heterosexual partner when they start the gender transition process (7). Trans women are excluded from society. This situation paves the way for the development of anxiety and depression in trans women (8–10). Anxiety is one of the most frequently encountered disorders worldwide (11), it interrupts activities of daily living and reduces quality of life to a substantial degree (12). Anxiety disorders may result in the avoidance of social life and many social disorders (13). It is believed that by 2030, depression will be the leading cause of disease burden in developed countries (14). It was reported that as the severity of depression increases, the prevalence of individual dysfunctions also increases (15).

Sexuality is a complex and dynamic process that exists in life from childhood to old age (16). Sexual health is associated with both physical and mental well-being (17). The meaning attributed to sexuality and the concept of sexual health is significantly influenced by religious rules, prejudices, taboos, traditions, and customs. Beliefs that do not have a scientific foundation, are related to the inaccurate beliefs and thoughts of individuals, connected to superstitions that have existed in society since ancient times, and accepted as true, while not having any scientific connection with sexuality are defined as "sexual myths" (18, 19). Sexual myths may lead to sexual dysfunctions, gender identity disorder, and lowered quality of sexual life (20, 21).

Stigma, discrimination, violence, and mistreatment in childhood may play an effective role in the deterioration of the mental health of trans women. Many trans women may experience discrimination at varying degrees in terms of access to housing support, healthcare, employment, education, social assistance, and many other social services (22). It was reported that the stress of stigma and trying to cope with this stress cause barriers to the acceptance of the gender identity of trans women and their increased vulnerability in this process (23). This situation may lead trans individuals toward depression and anxiety. The literature review that was carried out for this study did not reveal any previous study that examined whether beliefs in sexual myths are higher among individuals who live in conformity with society and are traditionalists or trans women. Sexual myths may be an obstacle for trans women to freely experience their gender preference. The hypothesis of this study is that anxiety and depression may be in trans women and this negative mental state is worsened by belief in sexual myths. In our study, we aimed to investigate depression, anxiety, and belief in sexual myths in trans women with a case-control design.

Materials and methods

Design and participants

This is a case-control study and the data of the study were collected prospectively. The population of the study consisted of 76 in trans women who presented to the Endocrinology, Urology, Psychiatry, and Obstetrics clinics of the research and training hospital where this study was conducted for sex change and referred to the Medical Biology and Genetics Department of the same hospital. The sample size was calculated using the G*Power 3.1.9.7 software. According to this program, a total of 120 participants were divided into experimental and control groups with 0.5 effect size, 0.05 margin of error, 0.95 confidence level and 95% confidence interval, and thus each group included 60. Researchers could not reach three trans women from their registered phone numbers, five trans women could not participate because they resided outside the city, and eight trans women did not voluntarily participate in the study. A total of 16 trans women were excluded from the study. The control group consisted of 60 healthy male individuals who presented to the same hospital for routine health follow-ups and collecting documents showing their health. The total number

of participants in our study was 120. We used the purposive sampling method to include the participants. The inclusion and exclusion criteria for the study were as follows.

Inclusion criteria

i. Voluntarily agreeing to participate in the study.
ii. The criterion for care at the hospital was to have gender dysphoria.
iii. Individuals who will form both samples must be between the ages of 18 and 65.
iv. Not having a history of or being under treatment for a life-threatening, severe disease.
v. Not having a diagnosis or history of diagnosis of a psychiatric condition that would cause substantial mental infirmity (Schizophrenia, delirium, cognitive problems etc.).

Exclusion criteria

i. Being illiterate
ii. Being unable to speak Turkish
iii. Having a history of or being under treatment for a life-threatening, severe disease
iv. Disorders of sex development
v. Being under 18 or over 65 and not male

In the hospital where the study was conducted, the diagnosis of Gender Dysphoria is determined based on the DSM-5 diagnostic criteria. Processes are initiated to ensure that individuals diagnosed with gender dysphoria according to DSM-5 enter the process of gender transition. Individuals in the control group were individuals who applied to the hospital where the study was conducted to obtain a health report due to work and education. They wanted to go through a routine physician examination for a general medical examination, measurement of blood values, and health check-up. Control group participants who met the study's inclusion criteria were included in the sample after obtaining informed consent.

Data collection

The data of this study were collected by the researchers using the face-to-face interview and survey methods between November 2019 and December 2021. After the case and control groups were formed, the researchers met each participant individually, and all participants provided informed consent. Afterward, the data collection instruments were given to each participant, and each participant was asked to fill them out within approximately 15 min.

Data collection instruments

In data collection, we used a Personal Information Form, the Sexual Myths Scale, and the Beck Depression and Anxiety Inventories.

Personal information form

This form included questions on the sociodemographic characteristics of the participants including age, marital status, income status, and education status.

Sexual myths scale

Gölbaşı et al. developed the Sexual Myths Scale (SMS) and tested its validity and reliability (24). It is a 5-point Likert-type scale consisting of 28 items that is used to identify the levels of belief in sexual myths in individuals. The scale has eight subscales. These subscales are Sexual Orientation: items 1–5, Gender: items 6–11, Age and Sexuality: items 12–15, Sexual Behavior: items 16–18, Masturbation: items 19–20, Sexual Violence: items 21–24, Sexual Intercourse: items 25–26, and Sexual Satisfaction: items 27–28. Each item has the response options of Absolutely Disagree (i), Disagree (ii), Undecided (iii), Agree (iv), and Absolutely Agree (v). The total score of the Sexual Myths Scale is found by summing the scores of all items in the scale, while the score of each subscale is calculated by summing the scores of the items in that subscale. The scale does not have a cutoff point, and higher scores indicate higher levels of belief in sexual myths. The Cronbach's alpha internal consistency coefficient of the scale was reported as 0.91 initially and 0.81 in the repeated reliability test (24). In this study, the Cronbach's alpha coefficient of the scale was found as 0.94.

Beck depression inventory (BDI)

Beck Depression Inventory (BDI) was developed in 1961 by Beck et al. (25) to measure the severity of behavioral symptoms of depression and monitor changes with treatment. In BDI, depression-specific behaviors and symptoms are defined, and each statement is scored in the range of 0–3. It consists of 21 items with response options ordered from the mildest to the most severe. The patient is asked to mark the statements defining their current condition best, and the total score is calculated by summing the scores of all items. The severity of depression is defined based on the scores as 0–9 = minimal, 10–16 = mild, 17–29 = moderate, and 30–63 = severe. The subscale scores are calculated using the cognitive-affective factor and the somatic performance factor. The scale was translated into Turkish and tested for validity and reliability in Turkish by Hisli

(26). In this study, the Cronbach's alpha coefficient of the scale was calculated as 0.91.

Beck anxiety inventory (BAI)

BAI measures the frequency of anxiety symptoms experienced by the individual. It is a 4-point Likert-type self-assessment scale, and each item is scored in the range of 0–3. Higher total scores indicate higher severity of anxiety experienced by the individual. It was developed by Beck et al. (27) and tested for validity and reliability in Türkiye by Ulusoy et al. (28). The severity of anxiety is defined based on the scores as 8–15 = mild anxiety, 16–25 = moderate anxiety, and 26–63 = severe anxiety. In this study, the Cronbach's alpha coefficient of the scale was calculated as 0.89.

Statistical analysis

The data were coded by the researchers and analyzed using the IBM Statistical Package for the Social Sciences (SPSS) 25.0. Descriptive statistics were calculated. The homogeneity test between the case and control groups was conducted using Chi-squared test and analysis of variance (ANOVA). The normality of the distribution of the data was tested using Kolmogorov-Smirnov test before starting the statistical analyses and the groups did not show a normal distribution within themselves. Independent-samples *t*-test was used to determine the relationships between the scales. The results were interpreted in a 95% confidence interval and a statistical significance level of $p < 0.05$.

Ethical aspect of the study

Before our study, approval was obtained from Dicle University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee (Date: 02/10/2019, Number: 123). In line with the principles of the Declaration of Helsinki, the participants in the case and control groups were informed about the study, and the participants signed the Informed Consent Form. The individuals who voluntarily agreed to participate were included after they provided verbal and written consent.

Results

Table 1 presents the descriptive characteristics of the case and control groups, and the homogeneity test results. All 60 trans women in the case group were single. While 23.3% of the participants in the case group were university students, laborers had the same rate, and 26.7% were sex workers. In the case group, 46.7% of the participants were living with their families, 66.7% were smokers, and 13.3% were receiving hormone treatment. All 60 men in the control group were also single. While 53.3% of the participants in the control group were high school graduates, 26.7% were laborers. The tests in our study showed that the groups were homogeneously distributed.

The mean SMS, BDI, and BAI scores of the participants in the case and control groups are presented in Table 2.

As seen in Table 2, the mean SMS score of the case group was 68.9 ± 13.8 (min: 39, max: 97), while the mean SMS score of the control group was 82.6 ± 18.29 (min: 45, max: 110). The mean BDI scores were 12.97 ± 6.65 (min: 0, max: 22) in the case group and 10.93 ± 4.15 (min: 5, max: 20) in the control group. Moreover, the mean BAI scores were 15.4 ± 7.04 (min: 0, max: 51) in the case group and 10.13 ± 4.82 (min: 4, max: 21) in the control group.

Table 3 shows the results of the comparisons of the levels of depression, anxiety, and believing sexual myths in the case and control groups.

As shown in Table 3, the control group had higher levels of believing sexual myths and lower levels of depression and anxiety in comparison to the case group ($p = 0.000$). The control group had higher mean scores in all subscales of SMS, while these differences were statistically significant for the Sexual Orientation and Sexual Violence subscales ($p < 0.05$).

Figure 1 clearly demonstrates the higher anxiety and depression levels and lower levels of believing sexual myths in the case group. Moreover, the lower anxiety and depression levels and higher levels of believing sexual myths in the control group can be seen in the Figure 1.

Discussion

We examined the level of depression, anxiety and belief in sexual myths of trans women in a case and controlled manner in the study. The hypothesis of this study was that in addition to the difficulties of being a trans woman, belief in sexual myths triggered anxiety and depression. In this study, we found that the trans women in the case group had anxiety and depression, whereas the participants in the control group had significantly lower anxiety and depression scores than those in the case group ($p < 0.01$). The identity and behaviors of trans women are usually stigmatized in society, and this leads them to become at risk of negative health outcomes. In many societies, trans women are exposed to high rates of discrimination and violence regarding their sexual identity (29). Studies comparing trans women to their siblings or the general public have reported that trans women are exposed to higher levels of discrimination (30). A study that was conducted in Türkiye revealed that trans women faced stigma and various forms of discrimination in many areas of social life (31). Previous studies have found a higher prevalence of mental disorders, especially

10.3389/fpsyt.2022.955577

TABLE 1 Descriptive characteristics of case and control groups and homogeneity test results (n = 120).

Characteristics	Case group (n = 60)		Control group (n = 60)		Homogeneity test between groups
Age (years, X ± SD)	24.5 ± 3.19 (min: 20, max: 35)		24.6 ± 4.07 (min: 18, max: 33)		F = 0.751 p = 0.744
	n	%	n	%	
Marital status					
Single	60	100	60	100	χ^2 = 1.018 p = 0.903
Married	–	–	–	–	
Education status					
Literate with no formal degree	4	6.7	2	3.3	χ^2 = 0.312 p = 0.515
Primary school	2	3.3	8	13.3	
High school	34	56.7	32	53.3	
University or higher	20	33.3	18	30	
Occupation					
Civil servant	6	10.0	10	16.7	χ^2 = 1.721 p = 0.313
Laborer	14	23.3	16	26.7	
Freelance	10	16.7	10	16.7	
Student	14	23.3	24	40	
Sex worker	16	26.7	–	–	
Income status					
Income < expenses	24	40	18	30	χ^2 = 1.817 p = 0.628
Income = expenses	16	26.7	16	26.7	
Income > expenses	10	16.7	6	10	
Income much higher than expenses	10	16.7	6	10	
Living with					
With family (e.g., mother, father)	28	46.7	46	76.7	χ^2 = 0.813 p = 0.514
Alone	20	33.3	6	10	
With friends	12	20	8	13.3	
Smoker					
Yes	40	66.7	34	56.7	χ^2 = 1.212 p = 0.216
No	20	33.3	26	43.3	
Consumes alcohol					
Yes	24	40	21	35	χ^2 = 1.618 p = 0.416
No	36	60	39	65	
Uses addictive substances such as marijuana and heroin					
Yes	8	13.3	2	3.3	χ2 = 1.148 p = 0.544
No	52	86.7	58	96.7	
Receiving hormone treatment					
Yes	8	13.3	–	–	–
No	52	86.7	60	100	

$\bar{x}$, mean; SD, standard deviation; F, ANOVA, one-way analysis of variance; χ^2, Chi-squared test.

major depression and anxiety, among trans women compared to the general public (32, 33). Major depression and anxiety disorders were encountered at high rates in trans women, and it was determined that 38% of these individuals were diagnosed with mental disorders, and their lifelong prevalence of mental disorders was 70% (34). The lifelong prevalence of mental disorders among trans women in Türkiye has been reported similar to those in the international literature (35, 36). Two different studies reported the rate of depression in trans women as 40% (33) and 51% (37). Anxiety rates in trans women have been found between 26 and 40% (37–39). Previous studies have focused on the prevalence of depression and anxiety. Our study examined the levels of depression and anxiety in individuals, and thus, it is an important source of data.

TABLE 2 Mean sexual myths scale (SMS), Beck depression inventory (BDI), and Beck anxiety inventory (BAI) scores of case and control groups (N = 120).

Scales	Items	Score range	Case group (n = 60)		Control group (n = 60)	
		Min.-Max.	$\bar{x}$ + SD	Min.-Max.	$\bar{x}$ + SD	Min.-Max.
Sexual myths scale	1–28	28–140	68.9 ± 13.8	39–97	82.6 ± 18.29	45–110
Sexual orientation	1–5	5–25	10.7 ± 4.6	6–20	14.3 ± 5.35	6–24
Gender	6–11	6–55	16.06 ± 5.28	6–25	16.8 ± 6.15	6–26
Age and sexuality	12–15	4–20	11.7 ± 3.87	4–17	12.7 ± 3.72	4–17
Sexual behavior	16–18	3–15	9.3 ± 2.39	4–13	10.96 ± 2.23	5–14
Masturbation	19,20	2–10	7.4 ± 1.99	2–9	7.8 ± 1.71	4–10
Sexual violence	21–24	4–20	7.26 ± 1.83	4–11	9.66 ± 3.78	5–17
Sexual intercourse	25,26	2–10	4.03 ± 1.56	2–7	4.96 ± 2.37	2–9
Sexual satisfaction	27,28	2,10	2.4 ± 1.27	2–7	5.46 ± 3.1	2–9
Beck depression inventory	1–21	0–63	12.97 ± 6.65	0–22	10.93 ± 4.15	5–20
Beck anxiety inventory	1–21	0–63	15.4 ± 7.04	0–51	10.13 ± 4.82	4–21

TABLE 3 Comparisons of levels of depression, anxiety, and believing sexual myths in case and control groups (N = 120).

Scales	Case group (n = 60)	Control group (n = 60)	Intergroup comparison
	$\bar{x}$ + SD	$\bar{x}$ + SD	Test and significance
Sexual myths scale	68.9 ± 13.8	82.6 ± 18.29	t = 0.632 **p = 0.000****
Sexual orientation	10.7 ± 4.6	14.3 ± 5.35	t = 1.284 **p = 0.000****
Gender	16.06 ± 5.28	16.8 ± 6.15	t = 1.324
Age and sexuality	11.7 ± 3.87	12.7 ± 3.72	p = 0.413
Sexual behavior	9.3 ± 2.39	10.96 ± 2.23	t = 1.211 p = 0.631
Masturbation	7.4 ± 1.99	7.8 ± 1.71	t = 0.417 p = 0.073
Sexual violence	7.26 ± 1.83	9.66 ± 3.78	t = 1.107 **p = 0.003****
Sexual intercourse	4.03 ± 1.56	4.96 ± 2.37	t = 0.544 p = 0.077
Sexual satisfaction	2.4 ± 1.27	5.46 ± 3.1	t = 3.154 **p = 0.015***
Beck depression inventory	12.97 ± 6.65	10.93 ± 4.15	t = 0.147 **p = 0.004****
Beck anxiety inventory	15.4 ± 7.04	10.13 ± 4.82	t = 1.457 **p = 0.000****

$\bar{x}$, mean; SD, standard deviation; t, Independent-samples t-test. **$p < 0.01$, *$p < 0.05$.

10.3389/fpsyt.2022.955577

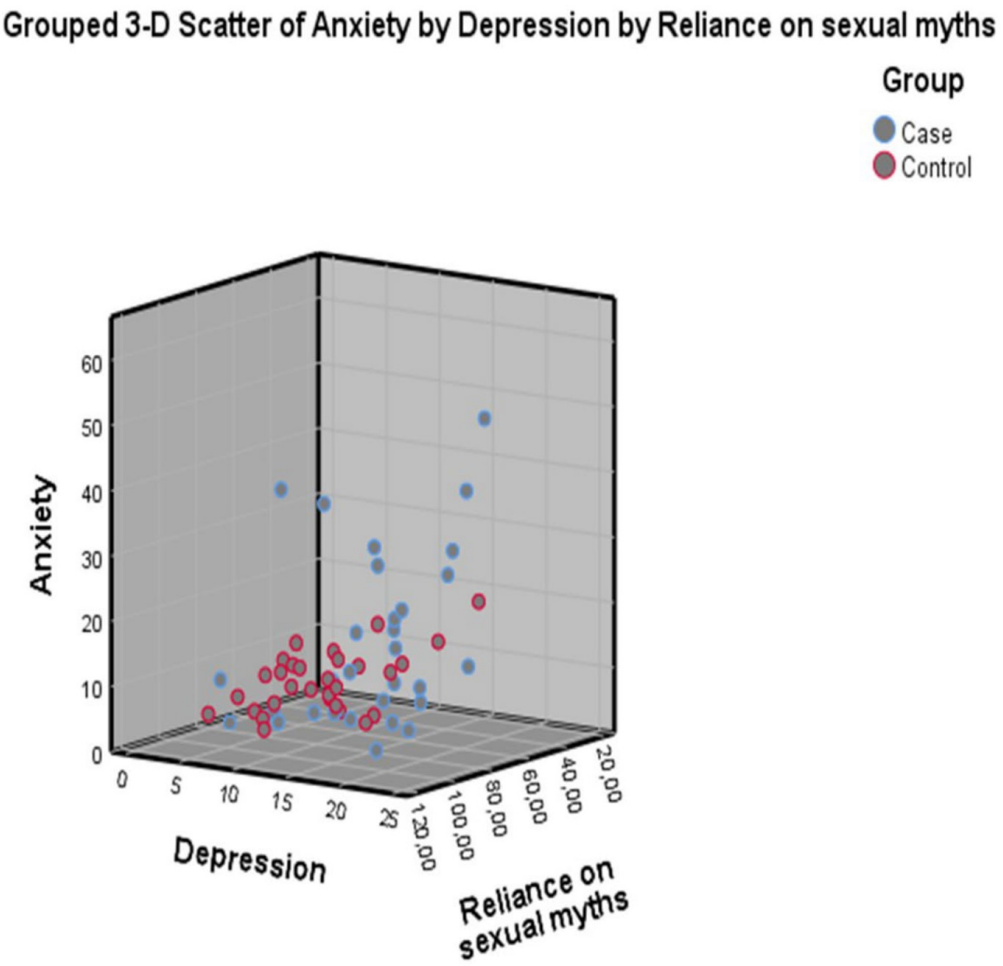


FIGURE 1
Scatter plot of believing sexual myths, depression, and anxiety in case and control groups (N = 120).

In our study, the rates of believing sexual myths in the control group were higher than those in the case group. A study that was carried out in Türkiye with the participation of 167 men revealed a high rate of believing sexual myths (40). It is clear that sexual myths brought about by the social structure of Türkiye that includes patriarchal and traditionalist approaches create pressure on the expression and experience of the sexual identity among trans women. Nevertheless, the results of studies in other countries, including Western societies, have also shown that the areas of freedom enjoyed by trans women are limited, and this situation leads to anxiety and depression, as well as various other mental issues. Incomplete or inaccurate knowledge of sexuality acquired in the psychosexual development stage in childhood and adolescence, and inaccurate and exaggerated expectations about sexuality are reflected in the sexual beliefs and behaviors of the individual in their adulthood, and they pave the way for problems to be experienced in their sexual life. This issue may explain the higher levels of believing sexual myths among the participants in the control group than those in the case group.

The control group in this study had significantly higher total Sexual Myths Scale (SMS) scores and scores in the Sexual Orientation and Sexual Violence subscales of SMS than the case group ($p < 0.05$). This result showed that the levels of belief in sexual myths among the trans women were lower compared to the men without gender dysphoria. To the best of our knowledge, there is no study investigating belief in sexual myths among trans women in the literature. The possibility that trans women may have different sexual experiences or witness such experiences in periods when they are in a search regarding their sexual identity could lead them to become more open-minded about sexuality. Moreover, this possibility may also set a basis for their higher levels of exposure to sexual violence, discrimination, and stigma in comparison to the general population. This exposure may have led to lower levels of believing sexual myths in

trans individuals than in the general population in more traditional societies.

In this study, trans women had low levels of belief in sexual myths in addition to high levels of anxiety and depression. Individuals in the control group had lower levels of anxiety and depression and higher levels of belief in sexual myths than trans women. A previous study conducted with the participation of women and men in the premarital period, the level of belief in sexual myths of individuals who are experienced in sexual intercourse and who have sufficient knowledge about sexuality was found to be lower than those who are inexperienced and less knowledgeable (41). Other studies have reported that as sexual experience dwindles, sexual myths decrease, with men believing more in sexual myths than women (18, 19). Beliefs are influenced by experiences. In our study, we did not examine the sexual experience and knowledge levels of the sample groups. It is not possible for us to comment on which group is more experienced and knowledgeable from our findings. Trans women may have developed a tolerance for different sexual experiences while seeking sexual identity and may therefore tend to be more open-minded about their sexuality. Our results can form the basis for future studies on belief in sexual myths in trans women.

Unfortunately, although we are in the 21st century, Turkish society has not become adequately free about different sexual identities. Individuals who have not accepted that gender is not limited to a binary system, it is a construct that covers a broad spectrum of sexual identities, and the gender of a person can be different than their biological sex cannot be expected to be open-minded about sexuality or any other issue. If society becomes more tolerant and open-minded about these issues, it will be possible to create a more pleasant life for individuals with differences. This way, individuals in society can get over their sexual attitudes and knowledge based on taboos, namely sexual myths. Furthermore, it will be possible to provide everyone with healthier ways of socializing, sexual preferences suitable for their individual identity, and a freer and more respectful social life.

Limitations

This study, in which we investigated trans women's belief in anxiety, depression, and sexual myths, has several limitations. We can list these limitations as cross-sectional design, single-center study, and uncertain generalizability of the results.

Conclusion

The trans women who participated in this study had higher levels of anxiety and depression than the control group, and this result was compatible with those in the literature. Factors such as the exposure of trans women to stigma, discrimination, and violence may be associated with their higher levels of depression and anxiety. On the other hand, they had lower levels of believing sexual myths compared to the control group. This result may be connected to different sexual experiences of trans women or their witnessing of such experiences in periods when they are in a search regarding their sexual identity, and their possibility of being more open-minded about sexuality due to these factors. Additionally, their exposure to mistreatment by society could explain their lower scores in the Sexual Orientation and Sexual Violence subscales of the Sexual Myths Scale. Awareness can be raised in society by educating people about different genders and gender identities. This way, an environment that is mentally healthier, freer, more respectful, and more tolerant can be created for everyone.

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 author.

Ethics statement

The studies involving human participants were reviewed and approved by Dicle University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee (Date: 02/10/2019, Number: 123). The patients/participants provided their written informed consent to participate in this study.

Author contributions

BU, IY, EU, EA, IK, and SB: medical practices, design, and writing. BU, IY, and EU: concept. BU and EU: data collection or processing. BU and IK: analysis or interpretation. SB, BU, and IY: literature search. All authors contributed to the article and approved the submitted version.

Conflict of interest

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

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 20 January 2023
DOI 10.3389/fpsyt.2022.947987

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OPEN ACCESS

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

RECEIVED 19 May 2022
ACCEPTED 30 December 2022
PUBLISHED 20 January 2023

CITATION
Huang Z-H, Wang F, Chen Z-L, Xiao Y-N, Wang Q-W, Wang S-B, He X-Y, Migliorini C, Harvey C and Hou C-L (2023) Risk factors for violent behaviors in patients with schizophrenia: 2-year follow-up study in primary mental health care in China. *Front. Psychiatry* 13:947987. doi: 10.3389/fpsyt.2022.947987

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Risk factors for violent behaviors in patients with schizophrenia: 2-year follow-up study in primary mental health care in China

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Objective: The consequences and impact of violent behavior in schizophrenia are often serious, and identification of risk factors is of great importance to achieve early identification and effective management.

Methods: This follow-up study sampled adult patients with schizophrenia in primary mental health care in a rural area of southern China, in which 491 participants completed a comprehensive questionnaire at baseline and the 2-year follow-up. Sociodemographic, clinical and psychological assessment data were collected from all participants. Paired sample *T*-Tests and the McNemar Test were performed to examine changes over the follow-up period. Generalized Estimating Equations (GEE) were used to analyze the risk factors for violent behavior.

Results: The results showed that about two in five community-dwelling patients with schizophrenia reported violent behavior in the past year. At follow-up, participants were significantly less employed, had more times of hospitalization, more psychotropic medication, and severer depressive symptoms, but had better health-related quality of life than at baseline. Use of clozapine and better insight into medication decreased the possibility of violent behavior, while more severe positive symptoms, insomnia, as well as use of second-generation antipsychotics other than clozapine, antidepressants and mood stabilizers increased the possibility of violent behavior.

Conclusions: Risk evaluation, prevention and management of violence in patients with schizophrenia are demanded in primary mental health care.

KEYWORDS

violence, schizophrenia, risk factor, primary care, Generalized Estimating Equations

1. Introduction

Violent behavior in patients with schizophrenia or other psychosis is a research interest dating back over six decades (1). Violence is a broad concept, including everything from verbal threats and hostility to homicide. Fazel et al. (2) defined violent behavior as homicide, assault, robbery, arson, any sexual offense, or illegal threats and harassment, while Rund's study focused on severe violence (3). The lack of clear operationalized definitions of violent behavior applied in different research has led to mixed results. In general, the causes of violent behavior are multifactorial, including individual as well as social or environmental factors, such as substance abuse, past violent victimization, violence in the surrounding environment and so on (3–5). Violence in psychiatric disorders might be a multidimensional issue which includes

several subtypes with different psychopathological underpinnings, and is often linked to acute psychomotor agitation than a long-lasting state (48, 49).

Despite many inconsistent findings, it is generally agreed that there is a modest association between violence and schizophrenia or other psychosis (6, 7). Meta-analysis has revealed the odds of homicide being committed by individuals with psychosis was almost 20 times that of the general population irrespective of comorbid substance abuse (8). A further meta-analysis also demonstrated that schizophrenia spectrum disorders are associated with a heightened risk of violent offending (9), in which some studies estimated that up to 20% of patients with schizophrenia in the community will behave violently in a 6-month period (34).

The consequences of violent perpetration among people with schizophrenia or other psychosis are often very serious for the victims, the patient themselves and the wider community (3), which leads to serious public health concern and social problems (10). Furthermore, the high disease burden and economic impact associated with violence are also critically important. Senior et al. (11) noted that the estimated annual economic impact of violence perpetrated by people with severe mental illness was £2.5 billion in England and Wales in 2015 to 2016, or 5.3% of the total estimated societal cost of violence. Unfortunately, no relevant Chinese data of economic impact of violence perpetrated by patients with schizophrenia or other severe mental illness.

Therefore, exploration of risk factors for violent behavior in schizophrenia or other psychosis is of great importance, so as to achieve early identification and prevention. A previous review found that severe violence appears particularly associated with poor insight, high impulsivity, psychopathy, poor motor speed and global cognition (3). Fazel et al. (2) reported that the strongest predictors for violent offending within 12 months in patients with severe mental illness were conviction for previous violent crime (adjusted OR = 5.03) and male sex (adjusted OR = 2.32), and meanwhile the decline in probability of violent offending was linearly related to increasing age (adjusted OR = 0.63 per 10 years of age). Similarly, an Italian study showed that patients with severe mental illness with a history of violence had a greater frequency of lifetime domestic violence than those without a violence history (12).

However, many previous studies examining risk factors for violence in psychosis tend to be cross-sectional in design and conducted in well-developed regions (4, 12–14). Therefore, this study aimed to explore the socio-demographic features, clinical characteristics, and medication of patients with schizophrenia using a longitudinal design. We hypothesized that severer psychiatric symptoms, severer depressive symptoms, poorer insight into disease and insomnia will increase the possibility of violent behavior.

In particular, the design will enable the identification of risk factors for their violent behavior in a rural area of the middle-income country of China, thus enhancing the generalizability of the results to similar developing regions. A secondary aim of the study is to strengthen risk evaluation and guide prevention, as well as management, of potentially dangerous behaviors in patients with schizophrenia or other psychoses in this and similar settings.

2. Methods

2.1. Study design and participants

This follow-up study was led by Guangdong Mental Health Center, Guangdong province in China, and The University of Melbourne. Ethical clearances were obtained from the above-mentioned institutions (Z2019-120 and 2021-20740-15415-3, respectively).

Study participants were all administered by, and recruited from Luoding city, which is an underdeveloped and rural area of Guangdong province in southern China, fitting the research interest of the present study. Also, Luoding is a city which can provide relatively good primary mental health services in Guangdong Province. In the present study, 21/63 townships with primary mental health care services in Luoding city were chosen by a random cluster sampling method, for which the randomized digital table was applied. All local patients with schizophrenia who presented to primary mental health care services were registered and managed in the Chinese National Psychiatric Management System (CNPMS). CNPMS was established to provide community follow-up management for severe mental illness, in which individuals with schizophrenia, schizoaffective disorder, paranoid psychosis, bipolar disorder, mental disorder related to epilepsy, and intellectual disability with psychotic symptoms were required to enroll.

First, the sampled schizophrenic patients from CNPMS were contacted by telephone to clarify the details of the research protocol. If they were willing to participate, both participants and their caregivers would took part in a 1-h face-to-face interview, which was conducted by one of three psychiatrists, each with no <3 years clinical and scientific research experience. After the interview, patients were included if they met the inclusion criteria (see below for more details) for the present study. At baseline, a total of 742 patients with schizophrenia were included. The baseline survey was conducted from October 2015 to January 2016 (15). 2 years later, researchers telephoned all the study participants and conducted face-to-face follow-up evaluations from November 2017 to January 2018, in which 491 participants completed the interview, and the remaining 251 participants refused follow-up. We only conducted one follow-up till now, yet there will be on-going follow-ups in the future.

Inclusion criteria for the participants were as follows: (a) aged 18 years or older; (b) diagnosed with schizophrenia (according to ICD-10) based on a review of the medical record and supplemented by clinical interview conducted by one psychiatrist; (c) capable of understanding and completing the interview according to the researchers. Exclusion criteria were having a history of significant head injury, seizures, cerebrovascular diseases and other neurological diseases.

Each eligible potential participant who was deemed competent to participate in an interview was informed of the purpose, significance, content (inclusion criteria, research procedures, etc.), benefit and confidentiality of the study, after which their written informed consent to participate in the study was obtained.

2.2. Sociodemographic and clinical information

Basic sociodemographic information was collected for all study participants, including age, gender, education, marital status (married or unmarried) and occupational status (employed or unemployed); clinical features including first episode or not, age of onset of illness, number of lifetime hospitalizations, and psychotic medication usage were also collected. Additionally, gender, education, first episode or not, age of onset of illness and whether living with others were examined only at baseline, while the rest of the above variables were examined both at baseline and follow-up.

2.3. Violent behavior assessment

All the participants and their caregivers were asked whether the participants had engaged in any violent behavior toward others in the past 12 months. Violent behavior was evaluated by the psychiatrists, using a six-level risk assessment scale according to the National Standards for Basic Public Health Services (the Third Edition), which was issued by the Chinese National Health and Family Planning Commission (http://www.nhc.gov.cn/jws/s3578/201703/d20c37e23e1f4c7db7b8e25f34473e1b.shtml). According to the above regulations, the Chinese psychiatrists must apply this six-level risk assessment scale for the management and treatment in patients with severe mental disorders. Level 0: does not conform to any of the following level 1–5 behaviors; Level 1: verbal threats, shouting, but no beating people or smashing objects; Level 2: beating or smashing behavior against property, restricted to the home, can be persuaded to stop; Level 3: serious beating or smashing behavior against property, regardless of occasion, cannot be persuaded to stop; Level 4: continued beating or smashing behavior against property or people, regardless of occasion, cannot be persuaded to stop, including self-injury or suicidal behavior; Level 5: any act of violence against a person with a controlled dangerous weapon, or acts of arson or explosion, whether at home or in a public place. In this study, Level 0 was classified as no violent behavior, while levels 1–5 were classified as presence of violent behavior.

2.4. Psychiatric symptom assessment and psychological assessment

The Chinese version of the Brief Psychiatric Rating Scale (BPRS) was used to evaluate the severity of clinical symptoms. The results of total and sub-evaluation of BPRS were very consistent ($r = 0.85$–0.99, $P < 0.01$), and there was a high degree of consistency between the checks-recheck total scores within 3 days ($r = 0.52$, $P < 0.01$), which indicated good reliability. Additionally, there was a high positive correlation between the total score of BPRS and the clinician's judgment of the severity of the disease ($r = 0.84$, $P < 0.01$), and the efficacy assessed by BPRS was basically consistent with the clinical efficacy ($r = 0.60$, $P < 0.01$), which indicated good validity (16, 17). BPRS is a 7-point Likert-type clinician-administered scale, rated from no symptoms (1) to extremely severe (7), and higher scores indicate more severe symptoms.

The Chinese version of the Montgomery–Asberg Depression Rating Scale (MADRS) was used to measure depressive symptoms. The inter-rater reliability of Chinese version of MADRS was 0.954, the Cronbach α coefficient was 0.847, and the criterion related validity with HAMD total score and CGI-S were 0.853 and 0.672, respectively (both $P < 0.01$), indicating good reliability and validity (18, 19). MADRS is a 6-point Likert-type clinician-administered scale. The total score ranges from 0 to 60 points, and higher scores represent more severe depressive symptoms. Meanwhile, we employed the Chinese version of the 16-Item Quick Inventory of Depressive Symptomatology, self-report (QIDS-SR16) to enable the participants to rate their own depressive symptoms. The internal consistency (Cronbach's alpha) ranged from 0.73 to 0.82 for QIDS-SR at both the baseline and exit (6 weeks later). The QIDS-SR total scores were highly correlated with the HAMD total score at both baseline ($r = 0.54$, $p < 0.01$) and exit $r = 0.72$, $p < 0.01$, respectively) (20, 21). This scale consists of 16 items, each of them ranges from 0 to 3 points, and a higher total score indicates greater severity of depressive symptoms.

Insight was measured by the Chinese version of the Insight and Treatment Attitude Questionnaire (ITAQ). The retest reliability was 0.869 ($p < 0.001$), the inter-rater reliability was 0.80, the half-score reliability was 0.903, and the validity between clinical experience of the general evaluation results of insight and BPRS was 0.7075 and −0.40, respectively, indicating that ITAQ has good reliability and validity (22, 23). In the scale, five items assessed patients' awareness of illness, while 6 items assessed patients' awareness of the need for treatment. ITAQ is a clinician-administered scale, in which each item ranges from 0 to 2 points, and a higher total score means better insight.

Sleep status was also evaluated as sleep disturbance may also be relevant to violent behavior (24). We used an eight-question self-report scale to assess the sleep status of the participants over the past month, which is widely used in other Chinese studies (25, 26). The scale included four sub-domains: any type of insomnia [e.g., difficulty initiating sleep (Over the past month, have you had trouble falling asleep), difficulty maintaining sleep (Over the past month, have you had difficulty maintaining sleep for a long time or waking up from time to time?) and early morning wakening [For the past month, have you had trouble waking up in the middle of the night or waking up too early to go to sleep again]; whether insomnia requires treatment [Have you been using sleeping pills (medicines) for insomnia for the past 1 month?]; whether bothered by insomnia [Have you been bothered by insomnia for the past 1 month?]; whether insomnia affects life, work and study [Have you suffered from insomnia that affects life, work, and study for the past 1 month?

The Sheehan Disability Scale (SDS) with good reliability and validity (27) was used to evaluate functional impairment. The internal consistency reliability of the SDS is high, with coefficient alpha of 0.89 and the construct validity was substantiated in two ways (28). SDS is a self-report scale, including three sub-domains of functioning: work/school, social life and family life. The total score ranges from 0 to 30 points, and higher scores represent poorer functioning.

We used the Chinese brief version of the World Health Organization Quality of Life instrument (WHOQOL-BREF) to

evaluate health-related quality of life. The scale has good internal consistency, discriminative validity and structural validity. There is a high correlation between the scores in each field of the WHOQOL-BREF and the scores in the corresponding fields of the WHOQOL-100 scale, in which the Pearson correlation coefficient is 0.89 (Social relationships domain) at the lowest and 0.95 (physical health domain) at the highest (29, 30). WHOQOL-BREF consists of 28 items divided into four sub-domains: physical health, psychological health, social relationships and environment. WHOQOL-BREF is a self-report scale, in which each item ranges from 1 to 5 points, and a higher total score means better quality of life.

Treatment satisfaction of the patients, their relatives and doctors were separately measured with a 7-point Likert-type self-report scale, in which the total score ranges from 1 to 7 points, representing the degree of satisfaction from extremely unsatisfactory to extremely satisfactory.

Reliability training was conducted by the three researchers prior to this study, in which 20 patients with schizophrenia were co-rated. The interrater reliability of the rating instruments yielded highly satisfactory agreement (intraclass correlation coefficients and kappa values >0.90).

2.5. Statistical analysis

Data were analyzed by IBM SPSS v26.0. The comparisons between the completed follow-up sample and the lost-to-follow-up sample on sociodemographic and clinical characteristics were performed by Pearson chi-square test and Independent-Samples *T*-Test as appropriate. McNemar Test and Paired-Samples *T*-Test were applied to analyze the differences concerning sociodemographic and clinical characteristics between the baseline group and the follow-up group in the 491 participants who completed the follow-up visit.

Subsequently, Generalized Estimating Equations (GEE) (31) were used to analyze the risk factors for violent behavior. GEE is mainly used for the analysis of repeated measurement data, in which there are more flexible observation time points. We conducted only one follow-up visit so far, yet there will be more follow-up visits in the future. Thus, GEE is more suitable for the statistical analysis in the present study. Risk factors were added as independent variables into the GEE analysis based on previous relevant studies, our clinical experience and the results of the bivariate analyses (see Table 2). More precisely, "Baseline variables" mean the variables which would not change over time, which include "Male, First-episode (or not), Education level at baseline" and so on. Besides, "Time-dependent variables" mean the variables which would change over time, including "Married, Employed, On FGAs" and so on. Additionally, in GEE analysis, variables with large correlations would not be selected as independent variables simultaneously. For example, "BPRS Positive, BPRS Negative and BPRS Affect" were chosen as independent variables, while "BPRS Total" not, as the latter was the sum of the former. The level of significance was established at 0.05 (two-tailed).

Effect size was calculated if the result was statistically significant, so as to consider whether the change was also clinically meaningful. Cohen's d value was calculated as the effect size when comparing two mean values, in which 0.2 represents a small effect size, 0.5 represents a medium effect size, and 0.8 represents a large effect size. Phi coefficient was calculated as the effect size when comparing two rates, in which 0.1 represents a small effect size, 0.3 represents a medium effect size, and 0.5 represents a large effect size.

3. Results

3.1. Sample characteristics and descriptive analyses

There were 491 participants with schizophrenia who took part at both baseline and follow-up 2 years later, giving a response rate of 66.2% at follow-up. Those who dropped out were significantly more likely to be living with others (Phi = 0.07), and significantly less likely to be a current smoker (Phi = 0.08), taking clozapine (Phi = 0.11) and had a smaller number of hospitalizations across their lifetime (Cohen's d = 0.16): however, all four effect sizes were small or very small (see Table 1).

3.2. Changes in sociodemographic and clinical variables between baseline and 2-year follow-up

At follow-up, participants were significantly less likely to be employed (Phi = 0.38) and experienced more hospitalization episodes over their lifetime (Cohen's d = 0.73) than at baseline. Compared with at baseline, participants were more likely to report taking clozapine (Phi = 0.25), second-generation antipsychotics (SGAs) other than clozapine (Phi = 0.44), antidepressants (Phi = 0.09), benzodiazepines (Phi = 0.26), mood stabilizers (Phi = 0.21) and anticholinergics (Phi = 0.13) after 2 years. Concerning medication dosage, participants reported taking significantly larger doses of clozapine (Cohen's d = 0.18) and SGAs other than clozapine (Cohen's d = 0.42) after 2 years in comparison with baseline (see Table 2).

With regard to their mental health, participants scored significantly lower at follow-up in the BPRS Total (Cohen's d = 0.10), BPRS Positive (Cohen's d = 0.08) and BPRS Negative (Cohen's d = 0.18), indicating less general and positive as well as negative symptoms; whilst scoring higher in the BPRS Affect (Cohen's d = 0.18), MADRS Total (Cohen's d = 0.14) and QIDS-SR16 Total (Cohen's d = 0.47) than at baseline, indicating more affective symptoms, especially depressive symptoms. Furthermore, follow-up scores were lower in the ITAQ Illness subscale (Cohen's = 0.15) compared to baseline, indicating poorer insight into illness (see Table 2).

However, better patient satisfaction (Cohen's d = 0.30) and better relative satisfaction (Cohen's d = 0.39) regarding treatment were observed at follow-up. Scores at follow-up were lower in the SDS Family life domain (Cohen's d = 0.32) compared to baseline, indicating better family functioning. In addition, follow-up scores in the WHOQOL-BREF Physical health (Cohen's d = 0.79), WHOQOL-BREF Social relationships (Cohen's d = 0.22) and WHOQOL-BREF Environment (Cohen's d = 0.27) domains were higher in comparison with baseline, indicating better health-related quality of life (see Table 2).

TABLE 1 Comparison of sociodemographic and clinical characteristics between the completed follow-up sample ($n = 491$) and the lost-to-follow-up sample (n=251).

	Completed follow-up sample ($n = 491$)		Lost-to-follow-up sample ($n = 251$)		Statistics		
	n	%	*n*	%	$\chi^{2\$}$	df	*p*
Male	313	63.7	149	59.4	1.35	1	0.244
Married	213	43.4	115	45.8	0.40	1	0.527
Employed	318	64.8	170	67.7	0.64	1	0.421
Living with others	453	92.3	241	96.0	3.87	1	**0.049**
First episode	47	9.6	33	13.1	2.207	1	0.137
Current drinker	20	4.1	8	3.2	0.35	1	0.549
Current smoker	122	24.8	44	17.5	5.12	1	**0.024**
Physical disease	27	5.5	22	8.8	2.87	1	0.090
Family psychiatric history	111	22.6	57	22.7	0.001	1	0.975
Violent behavior in past 1 year	205	41.8	109	43.4	0.19	1	0.662
On FGAs	143	29.1	57	22.7	3.47	1	0.062
On clozapine	104	21.2	31	12.4	8.702	1	**0.003**
On SGAs other than clozapine	226	46.0	120	47.8	0.21	1	0.646
On antidepressant	8	1.6	4	1.6	0.001	1	0.971
On benzodiazepine	22	4.5	11	4.4	0.004	1	0.951
On mood stabilizer	58	11.8	23	9.2	1.19	1	0.274
On anticholinergic	164	33.4	81	32.3	0.09	1	0.757
Insomnia in past 1 month	241	49.1	121	48.2	0.051	1	0.821
	Mean	SD	Mean	SD	T%	df	*p*
Age (years)	40.35	11.907	38.86	13.42	−1.53	740	0.124
Education level (years)	8.27	2.16	8.17	2.303	−0.55	740	0.578
Age of onset (years)	26.20	9.18	25.79	9.24	−0.57	740	0.563
Number of lifetime hospitalizations	2.16	1.92	1.80	1.97	−2.34	740	**0.020**
BPRS total	25.89	8.25	26.34	8.29	0.702	740	0.483
BPRS positive	6.12	2.73	6.08	2.55	−0.19	740	0.845
BPRS negative	5.54	2.76	5.50	2.906	−0.201	740	0.841
BPRS affect	5.13	1.72	5.08	1.57	−0.42	740	0.675
MADRS total	4.69	5.70	5.29	5.96	1.33	740	0.182
QIDS-SR16 total	3.55	3.52	3.72	4.09	0.57	740	0.563
ITAQ total	9.83	7.78	9.68	7.72	−0.24	740	0.809
ITAQ illness	3.97	3.38	3.84	3.43	−0.47	740	0.636
ITAQ medication	5.86	4.604	5.84	4.53	−0.05	740	0.953
SDS work/school	4.03	2.19	4.19	2.35	0.93	740	0.351
SDS social life	4.07	2.203	4.25	2.34	1.03	740	0.303
SDS family life	4.02	2.25	4.29	2.402	1.51	740	0.131
Patient satisfaction	4.25	0.97	4.33	1.06	0.92	740	0.356
Relative satisfaction	4.26	1.01	4.30	1.107	0.51	740	0.604
Doctor satisfaction	4.31	1.05	4.31	1.13	0.11	740	0.912
WHOQOL-BREF physical health	12.26	1.41	12.10	1.53	−1.48	740	0.138

(Continued)

TABLE 1 (Continued)

	Completed follow-up sample ($n = 491$)		Lost-to-follow-up sample ($n = 251$)		Statistics		
	n	%	*n*	%	$\chi^{2\$}$	df	*p*
WHOQOL-BREF psychological health	12.53	1.21	12.44	1.402	−0.87	740	0.380
WHOQOL-BREF social relationships	12.10	2.09	11.81	1.87	−1.82	740	0.068
WHOQOL-BREF environment	11.87	1.29	11.84	1.37	−0.22	740	0.823

Bold values: $P < 0.05$; $^{\$}$ Pearson chi-square test; $^{\%}$Independent-Samples *T*-Test.
BPRS, Brief Psychiatric Rating Scale; FGAs, First-generation antipsychotics; ITAQ, Insight and Treatment Attitude Questionnaire; MADRS, Montgomery–Asberg Depression Rating Scale; QIDS-SR16, The 16-Item Quick Inventory of Depressive Symptomatology, Self-Report; SGAs, second-generation antipsychotics; SDS, Sheehan Disability Scale; WHOQOL-BREF, The World Health Organization Quality of Life- brief version.

3.3. Risk factor for violent behavior (GEE analysis)

GEE analysis suggested that for those on clozapine, the likelihood of violent behavior is decreased by 31% ($OR = 0.69$). Each additional point on ITAQ Medication also decreased the likelihood of violent behavior by 9.3% ($OR = 0.907$). In short, use of clozapine and better insight into the need for medication were the protective factors for violent behavior in participants with schizophrenia (see Table 3).

In contrast, each additional point on BPRS Positive increases the likelihood of violent behavior by 12% ($OR = 1.12$), and for those with insomnia, the likelihood of violent behavior increases by 38% ($OR = 1.38$). Those on SGAs other than clozapine experienced a 45% increase in the odds of violent behavior ($OR = 1.45$), and those on antidepressants were more than three times as likely to report engaging in violent behavior ($OR = 3.12$), while those on mood stabilizers had an 80% increase in the odds of violent behavior ($OR = 1.802$). In short, higher positive symptoms, insomnia, as well as use of SGAs other than clozapine, use of antidepressants and use of mood stabilizers were the risk factors for violent behavior in these participants (see Table 3).

4. Discussion

This study found that about two in five community-dwelling patients with schizophrenia reported violent behavior in the past year. Bivariate analysis showed that at follow-up, participants were significantly less employed, experienced more lifetime hospitalization episodes, reported taking more psychotropic medication, and experienced more depressive symptoms, while having better health-related quality of life (especially in physical health domain) than at baseline. GEE analysis showed that use of clozapine and better insight into medication decreased the possibility of violent behavior, while more severe positive symptoms, insomnia, as well as use of second-generation antipsychotics other than clozapine, antidepressants and mood stabilizers increased the probability of violent behavior.

The drop-out rate of the present study is approximately 33.8%, which is larger than the common acceptable value (<20%) (32). We have tried many efforts to increase the response rate during follow-up period, still the drop-out rate was relatively high. Therefore, we made comparison on variables between the lost-to-follow-up sample and the completed follow-up sample, to find out whether there was large difference between these two samples. Fortunately, those who dropped out were significantly different from participants who completed follow-up in only 4/43 examined variables, and meanwhile the four effect sizes were all small or very small, which suggested those differences may not be clinically meaningful and that the completed follow-up sample may be broadly representative of the whole sample.

We have reported relatively high rates of violent behavior over the past year for the follow-up participants, whether at baseline (41.8%) or 2 years later (40.3%). Reported rates of violent behavior have differed across studies: for instance, a review involving 31 studies showed that outpatients with severe mental illness reported rates of 2%–13% of violent perpetration in the past 6 months to 3 years (33), while other studies reported rates of 14–20% (34–36). The above inconsistent findings may possibly be explained by differences in sample size, the research subjects of interest, the definition and the time period of violent behavior. After a 2-year follow-up period, more participants with schizophrenia were admitted to the hospital and reported taking more, and higher doses of psychotropic drugs, especially SGAs other than clozapine, than at baseline. This suggests worsening of their illness over time, requiring more medical services and medication. Additionally, at follow-up, participants had a higher and probably meaningful rate of unemployment than at baseline, which may be explained by their continuing hospitalizations or accumulated experiences of stigma and/or depression.

Depression is commonly seen in all stages of schizophrenia (37), and is associated with serious consequences in patients with schizophrenia (38). Interestingly, in our study, the scores of BPRS Affect, MADRS Total and QIDS-SR16 Total increased compared with baseline, although only the effect size of QIDS-SR16 Total was close to medium effect size. This might indicate that clinicians should pay more attention to the aggravation of depressive symptoms in patients with schizophrenia, especially considering that the QIDS-SR16 was the only self-report measure. Moreover, health-related quality of life (especially in the subdomains of physical health, social relationships and environment) increased in these participants with schizophrenia after 2 years, although only the effect size of WHOQOL-BREF Physical health is close to a large effect size. Our observed decrease in positive and negative symptoms, especially likely to be associated with increased usage of clozapine, may partly account for this. Similarly, Verma's study found that treatment with clozapine leads to improvement in core symptoms of schizophrenia and is also associated with significant improvement in the quality of life (39).

We applied GEE analysis to identify the risk factors for violent behavior in participants with schizophrenia. Our study indicated that more severe positive symptoms in participants with schizophrenia related to more violent behavior, which was similar to the finding of

10.3389/fpsyt.2022.947987

TABLE 2 Comparison of sociodemographic and clinical characteristics between baseline and 2-year follow-up in 491 patients with schizophrenia.

	Baseline		Follow-up		Statistics		
	n	%	n	%	$\chi 2^{\$}$	df	*p*
Married	213	43.4	220	44.8	0.43	1	0.510
Employed	318	64.8	190	38.7	70.12	1	**<0.001**
Violent behavior in past 1 year	205	41.8	198	40.3	0.17	1	0.677
On FGAs	143	29.1	162	33.0	3.02	1	0.082
On Clozapine	104	21.2	164	33.4	29.50	1	**<0.001**
On SGAs other than clozapine	153	31.2	288	58.7	94.01	1	**<0.001**
On Antidepressant	8	1.6	19	3.9	4.00	1	**0.043**
On benzodiazepine	22	4.5	75	15.3	34.22	1	**<0.001**
On mood stabilizer	58	11.8	109	22.2	22.12	1	**<0.001**
On anticholinergic	164	33.4	203	41.3	7.89	1	**0.005**
Insomnia in past 1 month	241	49.1	232	47.3	0.28	1	0.595
	Mean	SD	Mean	SD	$T^{\%}$	df	*p*
Number of lifetime hospitalizations	2.16	1.92	3.06	2.57	−16.23	490	**<0.001**
PDD/DDD FGAs	0.15	0.35	0.17	0.44	−0.35	490	0.720
PDD/DDD Clozapine	0.09	0.22	0.14	0.26	−4.03	490	**<0.001**
PDD/DDD SGAs other than clozapine	0.31	0.56	0.65	0.74	−9.25	490	**<0.001**
BPRS total	25.89	8.25	24.96	6.38	2.15	490	**0.032**
BPRS positive	6.12	2.73	5.85	2.38	1.86	490	**0.062**
BPRS negative	5.54	2.76	5.00	2.23	4.002	490	**<0.001**
BPRS affect	5.13	1.72	5.54	1.68	−3.94	490	**<0.001**
MADRS total	4.69	5.70	5.77	6.01	−3.04	490	**0.002**
QIDS-SR16 total	3.55	3.52	5.82	3.69	−10.47	490	**<0.001**
ITAQ total	9.83	7.78	9.47	6.38	0.95	490	0.342
ITAQ illness	3.97	3.38	3.43	2.81	3.29	490	**0.001**
ITAQ medication	5.86	4.604	6.04	3.92	−0.81	490	0.416
SDS work/School	4.03	2.19	4.10	3.73	−0.35	490	0.720
SDS social life	4.07	2.203	4.07	3.66	−0.02	490	0.983
SDS family life	4.02	2.25	2.97	2.901	7.16	490	**<0.001**
Patient satisfaction	4.26	0.97	4.70	1.19	−6.67	485	**<0.001**
Relative satisfaction	4.26	1.02	4.86	1.20	−8.45	466	**<0.001**
Doctor satisfaction	4.31	1.05	4.4	1.13	−1.66	490	0.098
WHOQOL-BREF physical health	12.26	1.41	13.92	1.73	−17.604	490	**<0.001**
WHOQOL-BREF psychological health	12.53	1.21	12.57	1.98	−0.42	490	0.668
WHOQOL-BREF social relationships	12.10	2.09	12.77	2.38	−4.87	490	**<0.001**
WHOQOL-BREF environment	11.87	1.29	12.41	1.76	−5.87	490	**<0.001**

Bold values: $P < 0.05$; $^{\$}$ McNemar Test; $^{\%}$ Paired-Samples *T*-Test.

BPRS, Brief Psychiatric Rating Scale; FGAs, First-generation antipsychotics; ITAQ, Insight and Treatment Attitude Questionnaire; MADRS, Montgomery–Asberg Depression Rating Scale; PDD/DDD, Prescribed Daily Dose/Defined Daily Dose; QIDS-SR16, The 16-Item Quick Inventory of Depressive Symptomatology, Self-Report; SGAs, Second-generation antipsychotics; SDS, Sheehan Disability Scale; WHOQOL-BREF, The World Health Organization Quality of Life- brief version.

TABLE 3 Generalized Estimating Equations (GEE) results modeling risk factors associated with violent behavior in 491 patients with schizophrenia across 1 year.

Baseline variables[$]	Coef	SE	*P*	OR	95%*CI (OR)*
Male	0.17	0.17	0.323	1.19	0.84–1.68
Living with other at baselines	0.11	0.27	0.661	1.12	0.66–1.92
First episode	−0.14	0.26	0.597	0.86	0.51–1.46
Education level at baseline (years)	0.06	0.03	0.070	1.06	0.99–1.14
Age of onset (years)	−0.01	0.009	**0.049**	0.98	0.96–1.00
Time-dependent variables[%]					
Married	−0.15	0.17	0.369	0.85	0.61–1.202
Employed	0.11	0.14	0.424	1.12	0.84–1.504
On FGAs	−0.29	0.18	0.118	0.74	0.51–1.07
On Clozapine	−0.36	0.17	**0.034**	0.69	0.49–0.97
On SGAs other than clozapine	0.37	0.15	**0.019**	1.45	1.06–1.98
On Antidepressant	1.14	0.42	**0.007**	3.12	1.35–7.208
On Benzodiazepine	−0.31	0.22	0.156	0.72	0.47–1.12
On Mood Stabilizer	0.58	0.18	**0.001**	1.802	1.26–2.56
On Anticholinergic	−0.28	0.17	0.090	0.74	0.53–1.04
Insomnia in past 1 month	0.32	0.14	**0.025**	1.38	1.04–1.84
Number of lifetime hospitalizations	0.05	0.03	0.103	1.05	0.98–1.13
BPRS positive	0.11	0.03	**0.001**	1.12	1.04–1.19
BPRS negative	−0.03	0.03	0.327	0.96	0.904–1.03
BPRS affect	0.09	0.05	0.075	1.104	0.99–1.23
MADRS total	0.01	0.01	0.270	1.01	0.98–1.05
ITAQ illness	0.01	0.04	0.794	1.01	0.92–1.103
ITAQ medication	−0.09	0.03	**0.004**	0.907	0.84–0.96

Bold values: $P < 0.05$; [$]the value of baseline variables would not change during the whole follow-up period; [%]the value of time-dependent variables would change during follow-up period.
BPRS, Brief Psychiatric Rating Scale; FGAs, First-generation antipsychotics; ITAQ, Insight and Treatment Attitude Questionnaire; MADRS, Montgomery–Asberg Depression Rating Scale; SGAs, Second-generation antipsychotics.

another study (40), whose results showed that the most predictive variables for violence among inpatients with schizophrenia are suspiciousness and hostility, more severe hallucinations, poor insight into delusions and the overall illness, and greater disorganization of thought processes (40).

Otherwise, any type of insomnia (including difficulty initiating sleep, difficulty maintaining sleep and early morning wakening) in the past month was also a risk factor, in line with a systematic review, which reported a relationship between interpersonal violence and a broad range of sleep disturbance, whereby 46 to 100% of respondents endorsed moderate to severe insomnia (24). Symptoms of sleep disruption can predict the onset of positive psychotic symptoms, such as paranoia and hallucinations. With sleep disturbances inextricably linked to increased severity of schizophrenia and worsening clinical outcomes, insomnia is an important therapeutic target within this patient population (5, 41).

Unlike many other studies, this study explored in depth the relationship between psychotropic drugs and violent behavior in participants with schizophrenia. We found that clozapine usage was a protective factor, while usage of SGAs other than clozapine was a risk factor. Whilst all SGAs are prescribed for severe and/or ongoing psychotic symptoms, it is recognized that clozapine has greater efficacy than other SGAs due to its high affinity for dopamine 4 vs. dopamine 2 receptors (42), which might explain our findings. Furthermore, clozapine has also shown the strongest evidence for treating acute violence in schizophrenia (43). Thus, our finding may indicate that clozapine should be preferred to reduce acute aggression and control persistent violence in patients with schizophrenia rather than other SGAs and FGAs (44), especially in refractory conditions (45).

Use of antidepressants by participants showed a 3-fold association with violent behavior. The previously described worsening of depressive symptoms in participants with schizophrenia after 2 years follow-up may explain the increase in antidepressant usage. It is well-known that irritability associated with depression and anxiety could culminate in aggression (46). There is reason to believe that the depression reported here is under-treated and hence irritability leads to aggression, thus increasing the risk for violent behavior in participants with schizophrenia.

Besides, we found that use of mood stabilizers was also a risk factor, as increased mood stabilizer usage itself may manifest because of a more serious disease condition. Compared with our study, previous studies discovered that lithium has been repeatedly shown to reduce irritability and incidents of aggression in bipolar disorder patients (45), while valproate promoted significant reductions in aggression across multiple diagnostic categories (47). It could also be possible that the mood disturbance was under-diagnosed and under-treated in this sample, therefore leading to inconsistent results compared to other studies.

The strengths of this study were as follows: (a) compared to the many cross-sectional studies published before, a follow-up study is a more robust design for this enquiry, in which we could explore the complete development process and some key turning points in the development process. (b) GEE analysis (rather than traditional logistic regression analysis) was applied to identify the risk factors for violent behavior, by which we could effectively explore the changes of sociodemographic and clinical characteristics during the follow-up period that affect the outcome (rather than just explore baseline or endpoint variables). (c) participants in this study were patients with schizophrenia managed in primary mental health care in an under-developed city in China, from which the research findings could be applied to other similar developing regions.

The limitations of this study were as followed: (a) attrition bias: the drop-out rate of this follow-up study is relatively high (about 33.8%), and we only included participants from one rural city (Luoding city), which may have impacted the generalizability of the findings. (b) Follow-up study is a kind of descriptive study, which can only propose etiological hypotheses and clues, rather than determine causal relationship. (c) we only assessed whether the study participants were engaged in violent behavior in the past year or not, rather than recorded different degrees of severity and frequency of violent behaviors, which prevents fine-grained analysis of differences in frequency and severity. In the future follow-up, we will perform stratified analysis to deeply explore the status and characteristics of violent behaviors. (d) stigma, discrimination, and response bias (such as social desirability) may have influenced the accuracy of the results, as some of the scales are self-report. Further, participants reporting to the interviewers with or without the presence of relatives may also influence the results. (e) only individual factors were explored in the present study, whilst social or environmental or system level factors were not included, which are also critical to the occurrence of violent behavior. (f) we only conducted one follow-up till now, which limited the findings of the study, yet there will be on-going follow-ups in the future.

To conclude, risk evaluation, prevention and management of violence are demanded as part of the completed patient assessment and treatment in primary psychiatric practice or other settings. Psychiatrists should pay more attention to the irritability associated with depression and mood disturbance and give priority to the usage of clozapine, as appropriate, in patients with schizophrenia with severe or treatment-refractory illness. They should also evaluate and treat any insomnia experienced by their patients. Otherwise, both primary care practitioners and families should also concern more on the above insomnia problem, and seek help from psychiatrists if necessary.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Clinical Research Ethics Committee of Guangdong Provincial People's Hospital. The patients/participants provided their written informed consent to participate in this study.

Author contributions

Study design: C-LH, S-BW, and CH. Data collection and typing: Z-HH, FW, Q-WW, X-YH, Z-LC, and Y-NX. Analysis and interpretation of data and drafting of the manuscript: Z-HH, FW, and C-LH. Critical revision of the manuscript: C-LH, CH, CM, S-BW, Z-LC, and Y-NX. Approval of the final version for publication: All coauthors. All authors contributed to the article and approved the submitted version.

Funding

This work was supported by Guangdong Provincial Foundation for Basic and Applied Basic Research Natural Science Foundation (grant number: 2022A1515010619).

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.

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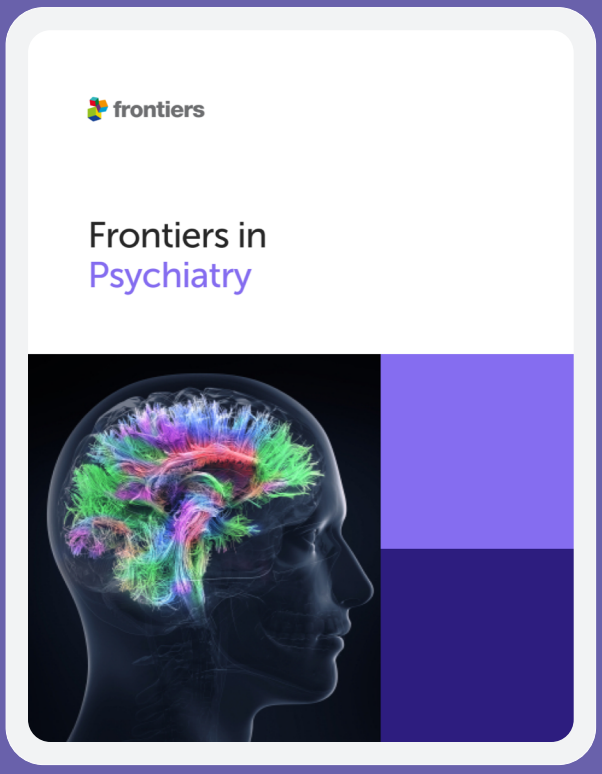
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