frontiers | Research Topics

Community series in mental illness, culture, and society: Dealing with the covid-19 pandemic, volume IV

Edited by
Renato de Filippis, Mohammadreza Shalbafan and Samer El Hayek

Published in
Frontiers in Psychiatry
Frontiers in Public Health

ISSN 1664-8714
ISBN 978-2-8325-2101-4
DOI 10.3389/978-2-8325-2101-4

About Frontiers

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

Frontiers journal series

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

Dedication to quality

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

What are Frontiers Research Topics?

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

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

Community series in mental illness, culture, and society: Dealing with the COVID-19 pandemic, volume IV

Topic editors

Renato de Filippis — Magna Græcia University, Italy

Mohammadreza Shalbafan — Iran University of Medical Sciences, Iran

Samer El Hayek — Erada Center for Treatment and Rehab, United Arab Emirates

Citation

de Filippis, R., Shalbafan, M., El Hayek, S., eds. (2023). *Community series in mental illness, culture, and society: Dealing with the COVID-19 pandemic, volume IV*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-2101-4

Table of contents

frontiers | Frontiers in Psychiatry

TYPE Editorial
PUBLISHED 22 March 2023
DOI 10.3389/fpsyt.2023.1181772

OPEN ACCESS

EDITED AND REVIEWED BY
Wulf Rössler,
Charité Universitätsmedizin Berlin, Germany

*CORRESPONDENCE
Mohammadreza Shalbafan
✉ shalbafan.mr@iums.ac.ir

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

RECEIVED 07 March 2023
ACCEPTED 08 March 2023
PUBLISHED 22 March 2023

CITATION
de Filippis R, El Hayek S and Shalbafan M (2023) Editorial: Community series in mental illness, culture, and society: Dealing with the COVID-19 pandemic - Volume IV. *Front. Psychiatry* 14:1181772. doi: 10.3389/fpsyt.2023.1181772

Editorial: Community series in mental illness, culture, and society: Dealing with the COVID-19 pandemic - Volume IV

Renato de Filippis [1], Samer El Hayek [2] and Mohammadreza Shalbafan [3]*

[1]Psychiatry Unit, Department of Health Sciences, University Magna Graecia of Catanzaro, Catanzaro, Italy, [2]Medical Department, Erada Center for Treatment and Rehab in Dubai, Dubai, United Arab Emirates, [3]Mental Health Research Center, Psychosocial Health Research Institute, Department of Psychiatry, School of Medicine, Iran University of Medical Sciences, Tehran, Iran

KEYWORDS

caregiver burden, pandemic uncertainty, psychological impact, public health, SARS-CoV-2, self-harm, social distancing, social psychiatry

Editorial on the Research Topic
Community series in mental illness, culture, and society: Dealing with the COVID-19 pandemic - Volume IV

The COVID-19 pandemic has had widespread consequences, affecting not only physical health but also mental health, social interactions, and economic stability (1–3). The lockdown and social distancing measures have intensified these issues, particularly for vulnerable individuals, also influencing the delivery of mental health interventions (4). Moreover, the impact of the pandemic has varied across different sociocultural groups, influenced by norms, values, and religions (5–7). This highlights the need to consider not only medical and scientific aspects but also the broader societal and cultural dynamics in addressing public health crises.

Following the previous three volumes of our Community Series Research Topic entitled "*Mental Illness, Culture, and Society: Dealing with the COVID-19 Pandemic*" (8–10), this forth volume features nine new papers that delve deeper into the intricate relationship between the pandemic, society and mental health. The papers included in this collection explore this connection in various ways, highlighting how unique cultures, societies, and backgrounds around the world mediate this complex interplay (11).

Liu Z. et al. analyzed the prolonged effect of the pandemic, 3 years after the outbreak, through the impact of pandemic uncertainty on depression, pandemic preventive behavior intentions, and positive life attitudes The authors used convenient sampling to collect data from 530 participants and discovered that the role of the grouping variable was significant in moderating the impact of uncertainty on positive attitudes and intentions toward pandemic prevention behavior, but it did not have a significant effect on depression. These results revealed a non-linear relationship between pandemic uncertainty and pandemic prevention behavior, as well as positive attitudes toward life, which sheds light on the non-linear nature of the relationship between psychological characteristics and the pandemic.

Along the same lines, Peng et al. focused on the long-term effects of the pandemic by investigating the mental health condition of 1,014 patients from two large Fangcang shelter hospitals in Shanghai. The authors found that dysfunctional beliefs about sleep significantly increased anxiety, depression, and insomnia, particularly in females aged 18–40 years old, with lower education level, higher income, white-collar jobs, or those who believed that the pandemic would have severe economic consequences. Another larger study looking at data from 6,218 individuals at the Fangcang shelter hospital in Shanghai (3.57% of all admitted patients) was conducted by Yu et al. In an attempt to identify the risk factors associated with psychiatric drug use in patients infected with the Omicron variant, the authors discovered that most patients had no previous psychiatric disorders and were prescribed psychiatric medications for the first time. Findings also revealed that female patients, those who were unvaccinated, older individuals, those with longer hospital stays, and those with multiple comorbidities were at higher risk, independent of medication use.

Another relevant aspect, analyzed in the work of Nooraeen et al., was the increase in relapse of individuals with severe mental illness and the consequent burden on their caregivers following virus containment measures. In this article, the authors evaluated 86 psychiatric patients and their caregivers during three different pandemic waves, and 3 and 6 months after the last one. The pandemic has had a dramatic effect on both the relapse and hospitalization rate, with psychopathological aggravation and worsening of caregivers' condition.

Mao et al. applied the Health Belief Model on social networks to analyze COVID-19-related tweets published by national health departments of the United States, South Korea, the United Kingdom, Japan, Germany, and India. Results showed a homogenization in the health departments promotion strategies across countries as well as in the promoted health measures, while there were some differences among users' responses to such promotions.

Among the cognitive fallout of the pandemic in the general population, the work published by Rocha et al. focused on possible changes in the decision-making style caused by anxious and post-traumatic symptoms. Results revealed that individuals with higher trait anxiety were less likely to use rationality in decision-making, particularly when post-traumatic stress symptoms were more severe. Conversely, individuals with lower trait anxiety tended to rely more on reason-based decision-making when faced with higher levels of post-traumatic stress symptoms.

Rammouz et al. investigated how religion may work as a coping strategy for mental health disorders in a population of nursing and medical students in Morocco. In this cross-sectional study, although students without depression showed a higher level of religiosity than those with depression, multivariate regression analysis revealed that religiosity was not a significant factor, either as a risk or protective factor, for depression.

A relevant but often overlooked issue is the increase in self-harm among adolescents with mental health problems during COVID-19 related society-wide isolation. This topic was addressed by the group led by Liu W. et al. Screening 63,877 medical records of children and adolescents who visited the Shanghai Mental Health Center in China between 2017 and 2021, authors demonstrated a global significant increase in self-harm rate in the past 5 years, with a peak in female patients aged between 12 and 13 years, especially among those with emotional disorders, during COVID-19 lockdown measures.

Finally, we report twelve naturalistic cases of first-episode mania after COVID-19 onset in the paper by Saeidi et al. Patients with a family history of mood disorders experienced a shorter onset of mania, whereas there was no significant difference in those who received corticosteroids. Although these results are anecdotal, they nonetheless identify a new line of research with potential clinical implications.

In summary, the articles described in the fourth volume of this Research Topic highlight the ongoing importance of cultural and social factors in shaping the psychiatric consequences of the coronavirus outbreak. Despite the newfound interest in social psychiatry evidenced by the data collected in our Community Series, the COVID-19 pandemic has highlighted the vulnerabilities experienced by the most fragile segments of society and the need for further clinical and epidemiological research in this field going forward.

Author contributions

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

Conflict of interest

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

Publisher's note

References

1. Adiukwu F, de Filippis R, Orsolini L, Gashi Bytyçi D, Shoib S, Ransing R, et al. Scaling up global mental health services during the COVID-19 pandemic and beyond. *Psychiatr Serv.* (2022) 73:231–4. doi: 10.1176/appi.ps.202000774

2. Aamir A, Awan S, de Filippis R, Diwan MN, Ullah I. Effect of COVID-19 on mental health rehabilitation centers. *J Psychosoc Rehabil Ment Heal.* (2021) 8:97–100. doi: 10.1007/s40737-020-00203-7

3. Ullah I, Khan KS, Ali I, Ullah AR, Mukhtar S, de Filippis R, et al. Depression and anxiety among Pakistani healthcare workers amid COVID-19 pandemic: a qualitative study. *Ann Med Surg.* (2022) 78:103863. doi: 10.1016/j.amsu.2022.103863

4. Schuh Teixeira AL, Spadini AV, Pereira-Sanchez V, Ojeahere MI, Morimoto K, Chang A, et al. The urge to implement and expand telepsychiatry during the COVID-19 crisis: early career psychiatrists' perspective. *Rev Psiquiatr Salud Ment.* (2020) 13:174–5. doi: 10.1016/j.rpsm.2020.06.001

5. Shoib S, Gaitán Buitrago JET, Shuja KH, Aqeel M, de Filippis R, Abbas J, et al. Suicidal behavior sociocultural factors in developing countries during COVID-19. *Encephale.* (2022) 48:78–82. doi: 10.1016/j.encep.2021.06.011

6. Ransing R, Ramalho R, de Filippis R, Ojeahere MI, Karaliuniene R, Orsolini L, et al. Infectious disease outbreak related stigma and discrimination during the COVID-19 pandemic: drivers, facilitators, manifestations, and outcomes across the world. *Brain Behav Immun.* (2020) 89:555–8. doi: 10.1016/j.bbi.2020.07.033

7. Adiukwu F, Kamalzadeh L, Pinto da Costa M, Ransing R, de Filippis R, Pereira-Sanchez V, et al. The grief experience during the COVID-19 pandemic across different cultures. *Ann Gen Psychiatry.* (2022) 21:18. doi: 10.1186/s12991-022-00397-z

8. de Filippis R, El Hayek S, Shalbafan M. Editorial: mental illness, culture, and society: dealing with the COVID-19 pandemic. *Front Psychiatry.* (2022) 13:1073768. doi: 10.3389/fpsyt.2022.1073768

9. El Hayek S, de Filippis R, Shalbafan M. Editorial: community series in mental illness, culture, and society: dealing with the COVID-19 pandemic—Volume II. *Front Psychiatry.* (2022) 13:1092845. doi: 10.3389/fpsyt.2022.1092845

10. de Filippis R, Shalbafan M, El Hayek S. Editorial: community series in mental illness, culture, and society: dealing with the COVID-19 pandemic - Volume III. *Front Psychiatry.* (2023) 14:1145115. doi: 10.3389/fpsyt.2023.1145115

11. Ramalho R, Adiukwu F, Gashi Bytyçi D, El Hayek S, Gonzalez-Diaz JM, Larnaout A, et al. Alcohol and tobacco use during the COVID-19 pandemic. A Call for local actions for global impact. *Front Psychiatry.* (2021) 12:634254. doi: 10.3389/fpsyt.2021.634254

frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 01 February 2023
DOI 10.3389/fpubh.2023.1086905

OPEN ACCESS

EDITED BY
Samer El Hayek,
Erada Center for Treatment and Rehab, United Arab Emirates

REVIEWED BY
S. M. Yasir Arafat,
Enam Medical College, Bangladesh
Byron Bitanihirwe,
The University of Manchester, United Kingdom

*CORRESPONDENCE
Seyed Kazem Malakouti
✉ malakouti.k@iums.ac.ir

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

RECEIVED 01 November 2022
ACCEPTED 05 January 2023
PUBLISHED 01 February 2023

CITATION
Nooraeen S, Bazargan-Hejazi S, Naserbakht M, Vahidi C, Shojaerad F, Mousavi SS and Malakouti SK (2023) Impact of COVID-19 pandemic on relapse of individuals with severe mental illness and their caregiver's burden. *Front. Public Health* 11:1086905. doi: 10.3389/fpubh.2023.1086905

Impact of COVID-19 pandemic on relapse of individuals with severe mental illness and their caregiver's burden

Sara Nooraeen[1], Shahrzad Bazargan-Hejazi[2], Morteza Naserbakht[3], Camelia Vahidi[4], Farideh Shojaerad[4], Seyedeh Sahar Mousavi[4] and Seyed Kazem Malakouti[1]*

[1]Mental Health Research Center, School of Behavioral Sciences and Mental Health, Iran University of Medical Sciences, Tehran, Iran, [2]Department of Psychiatry, Charles R. Drew University of Medicine and Science, Los Angeles, CA, United States, [3]Mental Health Research Center, Psychosocial Health Research Institute, Tehran, Iran, [4]Andisheh-Salamat-Ravan Mental Rehabilitation Center, Tehran, Iran

Background: The implementation of quarantine and social distancing measures to control the COVID-19 pandemic led to restrictions at the community level and most of in-person psychiatric services were discontinued. This situation could affect the psychopathology of the patients and the burden of their caregivers. The aim of this study was to investigate the effects of COVID-19 pandemic on people with severe mental illnesses (SMIs) and their caregivers' burden.

Method: The study sample consisted of 86 patients with severe mental illness and 86 caregivers. The mental status, relapse rate, and rehospitalization rate of the patients and the general health status and burden of caregivers were investigated in three waves, including before and 3 and 6 months after the COVID-19 pandemic.

Results: The relapse rate of the patients was 14%, 33.7%, and 43% ($p = 0.000$) and the rehospitalization rate was 4.7%, 7%, and 10.5% in waves 0, 1, and 2, respectively ($p = 0.000$). Most of the psychopathological scales increased in three waves ($p = 0.000$). The caregivers' burden and health condition worsened during the nine months of the study as well ($p = 0.000$).

Conclusion: The COVID-19 pandemic led to the exacerbation of symptoms and increased the relapse rate in people with SMIs. It also worsened the caregivers' condition. People with severe mental illnesses (SMIs) and their caregivers are one of the most vulnerable groups on which the COVID-19 pandemic had a marked negative effect.

KEYWORDS

SMIs, COVID-19, caregiver burden, telepsychiatry, Iran, schizophrenia, bipolar mood disorder

Introduction

According to Lancet commission report convened by the world experts in psychiatry in 2018, the universal increase in mental disorders will cost the global economy $16 trillion by 2030 (1). In 2019, the global outbreak of the novel coronavirus (COVID-19) added another layer of concern to the emerging public mental health crisis (2) due to the implementation of lockdown, social distancing, isolation, and quarantine measures to limit its spread (3–5). In the general population, COVID-related restrictions have led to lifestyle disruption, job loss, sleep disturbances, anxiety, depression, and PTSD (6–9).

In patients exposed to COVID-19, these restrictions could be exacerbated by fear of isolation, loneliness and boredom, affecting their mental health and even triggering suicidal ideation and suicide (10–12). The pandemic has also prevented people from properly mourning for their beloved ones who were lost to the disease (13). Studies that were conducted during the COVID-19 pandemic found that mental health of the participants significantly decreased during this time compared to the pre- pandemic years (5, 14, 15). The combination of these factors has turned COVID-19 into a crisis in terms of mental health among others. The SARS pandemic and its impact on the needs of patients with pre-existing psychiatric disorders suggest that the health consequences of the pandemic on this vulnerable population could be profound (16, 17). Patients with severe mental illness (SMI) such as schizophrenia or bipolar I disorder often receive a variety of treatments including pharmacological treatment, psychosomatic treatment, and rehabilitation (18). Any disruption in their routine care, as a result of pandemic lockdown policies, is likely to exacerbate their conditions (19, 20).

It has been reported that interruptions in the mental health-related utilization of SMIs are associated with a higher risk of recurrence and relapse of symptoms and readmission to the psychiatric ward in these patients (21–23). Furthermore, the job loss rate has been higher for those with psychiatric diseases at the time of the pandemic compared to the general population (24). This further increases the vulnerability of this group which may receive less attention in the pandemic situation compared to the general population (8, 9, 14, 15, 25–28).

The caregivers of SMI patients play a major role in the management of their patients. Whether caregiving is provided by a family member or a formal caregiver, it is part of the core care system that assists patients in getting prescribed treatments and ensures the continuity of care (29). It is common for caregivers to feel frustrated, stressed, and helpless while trying to strike a balance between the responsibilities of the role and providing the best care without burdening their health (30–32). A review of the literature regarding the caregivers' experiences shows a prevalence of 14–47% for depression and anxiety among the caregivers of the SMI patients (33). In the meantime, a higher prevalence is reported for caregivers of schizophrenia patients (30%) (34, 35). Additionally, the caregivers of the SMI patients have lower levels of perceived social support and quality of life (29). The existing evidence supports the role of community mental health programs in enhancing the quality of life of both caregivers and their SMI patients (36–38). However, the impact of the closure of community-based mental health centers due to the COVID-19 pandemic on the mental health condition of Iranian SMI patients is unclear. The aim of the present study was to estimate the impact of the COVID-19 pandemic on the psychopathology of individuals with SMIs and their caregivers' perceived burden.

Methods

Study design and participants

A cohort study was conducted between August 2020 and December 2021. The participants were recruited from the Andishe Salamat Ravan (ASR), Tehran, Iran. ASR is a community-based day-care rehabilitation center that provides mental rehabilitation and outreach services for chronic psychiatric patients. The patients were eligible to participate if they were above 18 years, had a diagnosis of SMI including schizophrenia, bipolar disorder, and chronic major depressive disorder, and were receiving regular care from the ASR (before the pandemic). The eligibility criteria for the caregivers were age above 18 years. The participants that provided written informed consent were scheduled for a face-to-face interview at the ASR. They included 86 SMI patients and their caregivers ($n = 86$). Before the COVID-19 pandemic, as part of the standard of care, these patients were receiving community-based psychiatric services including monthly in-person visits as well as medical and rehabilitation care in the center 3–4 days per week. However, these services were disrupted during the COVID-19 pandemic due to the implementation of quarantine and social distancing protocols and were replaced by telepsychiatry for patients who had access to the Internet and smartphones. Otherwise, the patients were contacted by phone for counseling and were advised to adhere to their individualized treatment plan. All patients received their medications by mail to avoid possible exposure in the drugstore.

Data collection and study measures

Data were collected by three trained interviewers: a physician and two psychologists. The interview time was about 30 min for each patient and his/her caregiver.

Data collection took place in three waves: wave zero refers to 6 months before the COVID-19 pandemic. Waves 1 and 2 refer to 3 and 9 months after World Health Organization declared COVID-19 a pandemic on March 11, 2020 (39). The following measures were used to assess the mental health conditions of the patients with SMIs.

Positive and negative syndrome scale

The Positive and Negative Syndrome Scale (PANSS) is used to measure the severity of schizophrenia symptoms. It was published in 1987 by Stanley et al. (29). It is known as a gold standard measure for the evaluation of the severity of schizophrenia symptoms. It includes a positive scale (7 items), a negative scale (7 items), and a general psychopathology scale (16 items), and takes about 45 min to complete. The Cronbach's alpha coefficient of the PANSS is 0.77. This scale was used to determine the severity of schizophrenia symptoms before and after the COVID-19 pandemic. The reliability and validity of the Persian version of this instrument were confirmed by Ghamari et al. (40). Diagnostic and clinical researchers have reported that this questionnaire has an acceptable construct validity (40).

The young mania rating scale

The YMRS is an 11-item interviewer rated scale (41). The items have five defined grades of severity. Four items are double weighted (irritability, speech, thought content, and disruptive/aggressive behavior (42). This questionnaire was validated by Barekatain et al. in Iran (43). The results of differentiation analysis showed a cut-off point of 17.14, a sensitivity of 98.4%, and a specificity of 98.4%. This scale was used to measure mania symptoms in patients with bipolar disorder.

The beck depression inventory

The BDI (44) is a 21-question multiple-choice self-report inventory for measuring the severity of depression. This instrument was validated in Iran in various studies including a study by Ghassemzadeh et al. (45). The BDI was used to evaluate depressive symptoms in patients with bipolar and major depressive disorders.

Relapse

Disease relapse was assessed in terms of its significance and rehospitalization. A relapse was "mild" if the severity of the illness and the symptoms were serious enough for the therapist to increase medications and frequency of virtual visits to control the exacerbated symptoms.

Rehospitalization indicated that the severity of the exacerbated symptoms made it impossible to control the symptoms at home. To prevent further harm to the patients and their families, hospitalization was inevitable.

The following measures were used to assess the mental health conditions of the caregivers:

The general health questionnaire

The GHQ is a screening tool for identification of minor psychiatric disorders in the general population or within a community or non-psychiatric clinical setting such as a primary care or general outpatient center. The reliability and validity of this questionnaire were evaluated by Taghavi in Iran (46). The coefficients were calculated using three different methods: test-retest, split-half, and Cronbach alpha, which were 0.70, 0.93, and 0.90, respectively. The validity of the questionnaire measured by the Middlesex Hospital Questionnaire (MHQ) was 55 ($P < 0001$). The subscale-total correlations, as another index of validity, were between 0.72 and 0.87 (46). This questionnaire was used to screen the mental health situation of the caregivers.

Family burden interview scale

The FBIS (47) is a semi-structural interview measurement tool with a reliability coefficient of 0.72. This scale was used to measure the burden of caregiving. This scale was used by Chimeh et al. in Iran (48).

Ethical considerations

The protocol of the study was approval by the Ethics Committee of Iran University of Medical Sciences (ethics code: IR.IUMS.REC.1399.416). Written consent was obtained from all participants prior to the study.

Statistical analysis

Analyses were conducted using IBM SPSS 25 statistical software. Descriptive analyses were used to describe the demographic characteristics of the patients and their caregivers. Mauchly's sphericity test was performed to evaluate the sphericity of the tests. Greenhouse–Geisser correction was applied as an alternative to correct the violation of the sphericity. Repeated Measure ANOVA followed by *post hoc* Bonferroni test was applied to detect any overall difference in the severity of the psychopathological symptoms between the three waves.

Interrater reliability of the interviewers was evaluated using the Pearson correlation coefficient. Statistical significance was determined as p-value < 0.05.

Results

Demographic profile

Of 86 patients, 11 withdrew from the study [seven patients with a diagnosis of schizophrenia and four with bipolar mood disorder (BMD)]; therefore, the final sample included 75 patients and 75 caregivers. The Mauchly's sphericity test results were not significant for YMRS ($P = 0.188$), BDI (0.070) and RELAPS (Sig $= 0.348$); therefore, the sphericity assumption was met. However, the sphericity assumption was not met for PANSS ($P < 0.001$), GHQ ($P < 0.001$), FBIS ($P < 0.001$) and rehospitalization ($P = 0.026$). The mean age of the patients was 43.4 $\pm$ 9.5 years (range: 26–72 years), and 86.7% were diagnosed with schizophrenia, 86.7% with BMD, and 13.3% with major depressive disorder (MDD). Table 1 shows the demographic characteristics of the patients and their caregivers.

Severity of psychopathology of patients and caregivers in three waves

As demonstrated in Table 2, the patients' mean scores for psychopathology measures increased over the three waves except for YMRS. The relapse rate was 14, 33.7, and 43%, and the rehospitalization rates were 4.7, 7, and 10.5% in waves 0, 1, and 2, respectively (Table 2).

The results of *post hoc* analysis of the severity of psychopathology and relapse rate are presented in Table 3.

Discussion

Patients

The findings showed that the relapse rate rose from 9.3 to 43% during three waves of the study. Additionally, the patients' symptoms deteriorated 9 months after the COVID-19 pandemic. Similar findings are reported from other countries (24, 49–51). The treatment and management of SMIs such as schizophrenia and bipolar disorders are very costly (52–54). Any increase in the incidence of relapse, as reported in the present study, would not be cost-effective (55). Several researchers have suggested the use of telepsychiatry services as an alternative mitigating strategy to minimize disruption in patient care (56–58). The efficacy of telepsychiatry has been proven in neurotic psychiatric disorders (7, 59, 60). A cross-sectional study conducted in the US found that psychiatric visits to patients through telepsychiatry, mostly by telephone, were much higher

10.3389/fpubh.2023.1086905

TABLE 1 Sociodemographic characteristics of participants (patients and their caregivers).

		No.	%
Patient ($n = 75$)			
Gender			
	Male	56	74.70%
	Female	19	25.30%
Diagnosis			
	Schizophrenia	65	86.70%
	BMD	8	10.70%
	MMD	2	2.60%
Education			
	Illiterate	4	5%
	Middle school	42	56%
	High school diploma	25	34%
	University or higher	4	5%
Marital status			
	Single	62	82.70%
	Married	13	17.30%
Caregiver (n = 75)			
Gender			
	Male	25	33.30%
	Female	50	66.70%
Relationship to patient			
	Parents	40	53.40%
	Sibling	24	32%
	Spouse	7	9.30%
	Other	4	5.30%
Education			
	Illiterate	35	46.70%
	Middle school	29	38.70%
	High school diploma	9	12%
	University or higher	2	2.60%
Marital status			
	Single	21	28%
	Married	54	72%
Mental Illness		19	25.30%
Physical Illness		23	30.70%

compared to before the pandemic and face-to-face visits (61). Studies have shown the efficacy of telepsychiatry services for individuals with SMIs (62, 63). However, in low-to-middle income countries (LMICs), such as Iran, barriers such as lack of access to smartphones, digital illiteracy, poor Internet connections, low telepsychiatry awareness, lack of provider training, and ban of e-prescriptions limit the use of telepsychiatry (64). Therefore, the efficacy and effectiveness of telepsychiatry in LMICs that are disproportionally affected by mental health disorders need further research (65–67).

Caregivers

According to the findings, caregivers experienced a higher burden and worsening of mental health situation. In the present study, more than 50% of the caregivers were patients' parents. They were mostly old, had low education levels, and had some physical and mental problems, which made it difficult to take care of the patients.

The caregivers of psychiatric patients are a vulnerable group (68) that is sometimes neglected while the condition of the patients can affect them. Findings indicate that caregivers are more likely to have psychological problems in comparison with the general population (69, 70). It could be due to the burden of long-term caring for individuals with chronic mental conditions such as medication costs, cigarette smoking, patient's unemployment, and some subjective reasons like stigma, shame, avoiding friends, etc. All of the above studies were conducted in non-COVID situations (38). Few studies have examined the status of the patients in such pandemic conditions and concluded that the burden of caregivers increased during the COVID-19 pandemic markedly (71, 72). There are several possible reasons for this finding. First, many patients and their caregivers lost their jobs during the pandemic, and the lack of adequate financial and social support has created many financial problems for them, which may lead to an increase in the burden. Second, patients spent several hours outside the home to receive day center services. Third, the patients and families became bored and domestic violence increased (73–75). Fear of getting infected with COVID-19 and concerns about the person who should care for the patient in case of disease or death were also sources of stress for families. In the present study, the relapse rate was rather high in wave two (about 40%); however, few patients were hospitalized, which could be due to the fear of families who do not wish to hospitalize their patients even in the case of severe relapses. Caregivers accepted the responsibility of caring for the patient at home, which also increased their burden in turn. Providing telepsychiatric and telerehabilitation services to patients and their caregivers could be crucial (76). It is predicted (77) that as the pandemic continues, it will be harder for these families to cope, particularly considering the low vaccination rate.

Limitation

A small sample size and other methodological problems like the lack of a control group could be considered as the study limitations. Although all of the patients received telephone follow-up (since not all of them had smartphone) and receive their medications, it was not possible to assess the impact of telepsychiatry services due to the lack of a control group.

To the best of our knowledge, this is the first study to understand the degree to which the COVID-19 pandemic exacerbated the symptoms in patients with SMIs and the burden of their caregivers in Iran.

10.3389/fpubh.2023.1086905

TABLE 2 Repeated measures analysis of variance (ANOVA) for psychopathology of patients and mental health of caregivers.

	Wave zero		Wave 1		Wave 2		df	*F*	*P*-value
	M	*SD*	*M*	*SD*	*M*	*SD*			
Patient									
PANSS*	52.14	15.45	55.39	17.43	73.81	22.11	1.197	69.881	<0.001
YMRS**	7.08	7.26	7.54	5.71	4.30	10.04	2.000	0.440	0.660
BDI**	21.00	14.85	25.53	16.74	31.18	12.89	2.000	7.680	0.011
Relapse**	0.19	0.497	0.48	0.627	0.64	0.667	2.000	14.099	<0.001
Rehospitalization*	0.05	0.212	0.07	0.256	0.10	0.308	1.846	1.119	0.326
Caregiver									
GHQ*	15.01	7.11	18.29	9.73	26.68	12.10	1.044	39.047	<0.001
FBIS*	5.57	3.28	8.10	4.00	9.05	3.34	1.009	91.177	<0.001

PANSS, Positive and Negative Syndrome Scale; YMRS, Young Mania Rating Scale; BECK, Beck Depression Inventory; GHQ, General Health Questionnaire; FBIS, Family Burden Interview Scale 1; *Greenhouse–Geisser; **Wilks' Lambda.

TABLE 3 Effect of time passing on psychopathology.

	WAVE		Mean difference	Std. error	*P*-value	95% Confidence interval	
Patient							
PANSS	0	1	−3.406	0.885	<0.001	−5.582	−1.230
	0	2	22.688	2.494	<0.001	28.823	16.552
	1	2	−19.281	2.418	<0.001	−25.229	13.334
YMRS	0	1	−2.667	2.682	NS	−10.756	5.422
	0	2	0.889	3.195	NS	−8.746	10.524
	1	2	3.556	4.46	NS	−9.895	17.006
BDI	0	1	−6.182	2.311	NS	−12.815	0.452
	0	2	−15.818	4.486	0.016	−28.693	−2.943
	1	2	−9.636	4.716	NS	−23.172	3.899
Relapse	0	1	−0.291	0.077	<0.001	−0.48	−0.102
	0	2	−0.453	0.089	<0.001	−0.67	−0.237
	1	2	−0.163	0.086	NS	−0.372	0.047
Rehospitalization	0	1	−0.023	0.033	NS	−0.104	0.057
	0	2	−0.058	0.042	NS	−0.16	0.044
	1	2	−0.035	0.042	NS	−0.137	0.068
Caregiver							
GHQ	0	1	−3.279	0.568	<0.001	−4.667	−1.892
	0	2	−22.326	3.348	<0.001	−30.501	14.15
	1	2	19.047	3.287	<0.001	−27.073	−11.02
FBIS	0	1	−2.535	0.25	<0.001	−3.144	−1.925
	0	2	−31.767	3.214	<0.001	−39.617	−23.918
	1	2	−29.233	3.181	<0.001	−37.002	−21.463

PANSS, Positive and Negative Syndrome Scale; YMRS, Young Mania Rating Scale; BECK, Beck Depression Inventory; GHQ, General Health Questionnaire; FBIS, Family Burden Interview Scale 1.

Conclusion

People with SMIs and their caregivers are a vulnerable group during pandemics that may experience the exacerbation of their mental disease. It may also impose more objective and subjective burdens on their families and caregivers (77). They require more attention to keep up with the general population.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of Iran University of Medical Sciences (Ethics code: IR.IUMS.REC.1399.416). The patients/participants provided their written informed consent to participate in this study.

Author contributions

SN: study design, data gathering, interviewing, and writing manuscript. SB-H: data gathering and writing manuscript. MN: data gathering and data analysis. CV: study design and data gathering. FS and SSM: data gathering and interviewing. SKM: study design and data analysis. All authors contributed to the article and approved the submitted version.

Conflict of interest

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

Publisher's note

References

1. Patel V, Saxena S, Lund C, Thornicroft G, Baingana F, Bolton P, et al. The lancet commission on global mental health and sustainable development. *Lancet.* (2018) 392:1553–98. doi: 10.1016/S0140-6736(18)31612-X

2. Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease, (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health.* (2020) 17:729. doi: 10.3390/ijerph17051729

3. Thivolet J, Cambazard F, Genvo MF. Maternally-transmitted severe neonatal aphthosis. *Ann Dermatol Venereol.* (1982) 109:815–6.

4. Dos Santos CF, Picó-Pérez M, Morgado P. COVID-19 and mental health—what do we know so far? *Front Psychiatr.* (2020) 11:565698. doi: 10.3389/fpsyt.2020.565698

5. Fegert JM, Vitiello B, Plener PL, Clemens V. Challenges and burden of the Coronavirus 2019 (COVID-19) pandemic for child and adolescent mental health: a narrative review to highlight clinical and research needs in the acute phase and the long return to normality. *Child Adol Psychiatr Mental Health.* (2020) 14:20. doi: 10.1186/s13034-020-00329-3

6. Kola L. Global mental health and COVID-19. *Lancet Psychiatr.* (2020) 7:655–7. doi: 10.1016/S2215-0366(20)30235-2

7. Kozloff N, Mulsant BH, Stergiopoulos V, Voineskos AN. The COVID-19 global pandemic: implications for people with schizophrenia and related disorders. *Schizophr Bull.* (2020) 46:752–7. doi: 10.1093/schbul/sbaa051

8. Lima CKT, Medeiros Carvalho PM, Lima IDAAS, Oliveira Nunes JVA, Saraiva JS, Souza RI, et al. The emotional impact of Coronavirus 2019-nCoV, (new Coronavirus disease). *Psychiatry Res.* (2020) 287:112915. doi: 10.1016/j.psychres.2020.112915

9. Vigo D, Patten S, Pajer K, Krausz M, Taylor S, Rush B, et al. *Mental Health of Communities During the COVID-19 Pandemic.* Los Angeles, CA: SAGE Publications. (2020).

10. Gunnell D, Appleby L, Arensman E, Hawton K, John A, Kapur N, et al. Suicide risk and prevention during the COVID-19 pandemic. *Lancet Psychiatr.* (2020) 7:468–71. doi: 10.1016/S2215-0366(20)30171-1

11. Kawohl W, Nordt C. COVID-19, unemployment, and suicide. *Lancet Psychiatr.* (2020) 7:389–90. doi: 10.1016/S2215-0366(20)30141-3

12. Nooraeen S, Javanbakht M, Malakouti SK. Getting closer to our unpleasant previse: possible rise in suicide rate in Iran during COVID-19 pandemic. *Iran J Psychiatry Behav Sci.* (2021) 15:e112213. doi: 10.5812/ijpbs.112213

13. Eisma MC, Boelen PA, Lenferink LI. Prolonged grief disorder following the Coronavirus (COVID-19) pandemic. *Psychiatry Res.* (2020) 288:113031. doi: 10.1016/j.psychres.2020.113031

14. McGinty EE, Presskreischer R, Han H, Barry CL. Psychological distress and loneliness reported by US adults in 2018 and April 2020. *JAMA.* (2020) 324:93–4. doi: 10.1001/jama.2020.9740

15. Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *Lancet Psychiatry.* (2020) 7:883–92. doi: 10.1016/S2215-0366(20)30308-4

16. Cheng ST, Cheung KCC, Cheung CK. Peer victimization and depression among Hong Kong adolescents. *J Clin Psychol.* (2008) 64:766–776. doi: 10.1002/jclp.20489

17. Gerstein MB, Lu ZJ, Van Nostrand EL, Cheng C, Arshinoff BI, Liu T, et al. Integrative analysis of the Caenorhabditis elegans genome by the Modencode project. *Science.* (2010) 330:1775–87. doi: 10.1126/science.1196914

18. Drake RE, Green AI, Mueser KT, Goldman HH. The history of community mental health treatment and rehabilitation for persons with severe mental illness. *Commun Mental Health J.* (2003) 39:427–40. doi: 10.1023/A:1025860919277

19. Mueser KT, Bond GR, Drake RE, Resnick SG. Models of community care for severe mental illness: a review of research on case management. *Schizophrenia Bullet.* (1998) 24:37–74. doi: 10.1093/oxfordjournals.schbul.a033314

20. Kopelovich SLM, Buck BE, Brenner C, Moser L, Jarskog LF, Harker S, et al. Community mental health care delivery during the COVID-19 pandemic: practical strategies for improving care for people with serious mental illness. *Commun Mental Health J.* (2021) 57:405–15. doi: 10.1007/s10597-020-00662-z

21. Dennis RA, Caceda R. Why COVID-19 is especially difficult for those with schizophrenia: reasons and solutions. *Primary Care Comp CNS Disorders.* (2020) 22:26175. doi: 10.4088/PCC.20com02739

22. Holmes EA, O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry.* (2020) 7:547–60. doi: 10.1016/S2215-0366(20)30168-1

23. Busch AB, Huskamp HA, Raja P, Rose S, Mehrotra A. Disruptions in care for medicare beneficiaries with severe mental illness during the COVID-19 pandemic. *JAMA Network Open.* (2022) 5:e2145677. doi: 10.1001/jamanetworkopen.2021.45677

24. Van Rheenen TE, Meyer D, Neill E, Phillipou A, Tan EJ, Toh WL, et al. Mental health status of individuals with a mood-disorder during the COVID-19 pandemic in Australia: initial results from the COLLATE project. *J Aff Disorders.* (2020) 275:69–77. doi: 10.1016/j.jad.2020.06.037

25. North CS, Pfefferbaum B. Mental health response to community disasters: a systematic review. *JAMA.* (2013) 310:507–18. doi: 10.1001/jama.2013.107799

26. Goldmann E, Galea S. Mental health consequences of disasters. *Annu Rev Public Health.* (2014) 35:169–83. doi: 10.1146/annurev-publhealth-032013-182435

27. Egede LE, Ruggiero KJ, Frueh BC. Ensuring mental health access for vulnerable populations in COVID era. *J Psychiatr Res.* (2020) 129:147–8. doi: 10.1016/j.jpsychires.2020.07.011

28. Almeda N, García-Alonso C. Mental health planning at a very early stage of the COVID-19 crisis: a systematic review of online international strategies and recommendations. *BMC Psychitr.* (2021) 21:43. doi: 10.1186/s12888-020-03015-y

29. Stanley S, Balakrishnan S. Informal caregiving in schizophrenia: correlates and predictors of perceived rewards. *Social Work Mental Health.* (2021) 19:230–47. doi: 10.1080/15332985.2021.1904089

30. Ong HC, Ibrahim N, Wahab S. Psychological distress, perceived stigma, and coping among caregivers of patients with schizophrenia. *Psychol Res Behav Managem.* (2016) 9:211. doi: 10.2147/PRBM.S112129

31. Alam MS, Ali MJ, Bhuiyan AB, Solaiman M, Rahman MA. The impact of COVID-19 pandemic on the economic growth in Bangladesh: a conceptual review. *Am Econ Soc Rev.* (2020) 6:1–12. doi: 10.46281/aesr.v6i2.844

32. Fonseca L, Diniz E, Mendonca G, Malinowski F, Mari J, Gadelha A, et al. Schizophrenia and COVID-19: risks and recommendations. *Braz J Psychiatr.* (2020) 42:236–8. doi: 10.1590/1516-4446-2020-0010

33. Ampalam P, Gunturu S, Padma V. A comparative study of caregiver burden in psychiatric illness and chronic medical illness. *Indian J Psychiatr.* (2012) 54:239. doi: 10.4103/0019-5545.102423

34. Gutiérrez-Maldonado J, Caqueo-Urízar A, Kavanagh DJ. Burden of care and general health in families of patients with schizophrenia. *Soc Psychiatr Epidemiol.* (2005) 40:899–904. doi: 10.1007/s00127-005-0963-5

35. Malakouti SK, Davoudi F, Khalid S, Asl MA, Khan MM, Alirezaei N, et al. The epidemiology of suicide behaviors among the countries of the Eastern Mediterranean Region of WHO: a systematic review. *Acta Med Iranica.* (2015) 53:257–65.

36. Mansouri N, Chimeh N, Dehghani M, Malakouti SK, Taherkhani H, Abarashi Z, et al. Risk factors associated with psychiatric hospitalization among Iranian schizophrenic patients. *Iranian J Psychiatr Behav Sci.* (2013) 7:16.

37. Mansouri N, Malakouti SK, Chimeh N, Rezvanifar S, Mohseni M, Mansouri E, et al. Chronic hospitalized and household maintained consumers; characteristics and differences among referees to the Iranian society supporting individuals with Schizophrenia. *Iranian J Psychiatr Behav Sci.* (2014) 8:5.

38. Ribé JM, Salamero M, Pérez-Testor C, Mercadal J, Aguilera C, Cleris M, et al. Quality of life in family caregivers of schizophrenia patients in Spain: caregiver characteristics, caregiving burden, family functioning, and social and professional support. *Int J Psychiatry Clin Practice.* (2018) 22:25–33. doi: 10.1080/13651501.2017.1360500

39. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. *Acta Biomed.* (2020) 91:157–60. doi: 10.23750/abm.v91i1.9397

40. Ghamari GH, Molavi P, Heshmati R. Exploration of the factor structure of positive and negative syndrome scale in schizophrenia spectrum disorders. *J Clin Psychol.* (2010) 2:6.

41. Young RC, Biggs JT, Ziegler VE, Meyer DA. A rating scale for mania: reliability, validity and sensitivity. *Br J Psychiatry.* (1978) 133:429–35. doi: 10.1192/bjp.133.5.429

42. Tohen M, Bowden C, Nierenberg AA, Geddes J. *Clinical Trial Design Challenges in Mood Disorders*. Cambridge, Academic Press (2015).

43. Barekatain M, Tavakoli M, Molavi H, Maroufi M. Standardization, reliability and validity of the young mania rating scale. *Psychology.* (2007) 11:150–66.

44. Beck AT, Steer RA. Internal consistencies of the original and revised beck depression inventory. *J Clin Psychol.* (1984) 40:1365–7. doi: 10.1002/1097-4679(198411)40:6<1365::AID-JCLP2270400615>3.0.CO;2-D

45. Ghassemzadeh H, Mojtabai R, Karamghadiri N, Ebrahimkhani N. Psychometric properties of a persian-language version of the beck depression inventory–second edition: BDI-II-PERSIAN. *Depress Anxiety.* (2005) 21:185–92. doi: 10.1002/da.20070

46. Taghavi S. Validity and reliability of the general health questionnaire, (ghq-28) in college students of shiraz university. *J Psychol.* (2002) 5:381–98.

47. Pai S, Kapur RL. The burden on the family of a psychiatric patient: development of an interview schedule. *Br J Psychiatry.* (1981) 138:332–5. doi: 10.1192/bjp.138.4.332

48. Chimeh N, Malakoti K, Panaghi L, Ahmad Abadi Z, Nojomi M. Care giver burden and mental health in schizophrenia. *J Family Res.* (2008) 4:277–92.

49. Muruganandam P, Neelamegam S, Menon V, Alexander J, Chaturvedi SK. COVID-19 and Severe Mental Illness: Impact on patients and its relation with their awareness about COVID-19. *Psychiatry Res.* (2020) 291:113265. doi: 10.1016/j.psychres.2020.113265

50. Rajkumar RP. Bipolar disorder, COVID-19, and the risk of relapse. *Bipolar Disord.* (2020) 22:640. doi: 10.1111/bdi.12947

51. Mutlu E, Anil Yagcioglu AE. Relapse in patients with serious mental disorders during the COVID-19 outbreak: a retrospective chart review from a community mental health center. *Eur Arch Psychiatry Clin Neurosci.* (2021) 271:381–3. doi: 10.1007/s00406-020-01203-1

52. Brettschneider, C., and Riedel-Heller, S., and König, H. (2014). A systematic review of economic evaluations of treatments for borderline personality disorder. *PLoS ONE* 9, e107748. doi: 10.1371/journal.pone.0107748

53. Cloutier M, Greene M, Guerin A, Touya M, Wu E. The economic burden of bipolar I disorder in the United States in 2015. *J Aff Disorders.* (2018) 226:45–51. doi: 10.1016/j.jad.2017.09.011

54. Kovács G, Almási T, Millier A, Toumi M, Horváth M, Kóczián K, et al. Direct healthcare cost of schizophrenia–European overview. *Eur Psychiatr.* (2018) 48:79–92. doi: 10.1016/j.eurpsy.2017.10.008

55. Pennington M, McCrone P. The cost of relapse in schizophrenia. *Pharmacoeconomics.* (2017) 35:921–36. doi: 10.1007/s40273-017-0515-3

56. O'Brien M, McNicholas F. The use of telepsychiatry during COVID-19 and beyond. *Irish J Psychol Med.* (2020) 37:250–5. doi: 10.1017/ipm.2020.54

57. Schuh Teixeira AL, Spadini AV, Pereira-Sanchez V, Ojeahere MI, Morimoto K, Chang A, et al. The urge to implement and expand telepsychiatry during the COVID-19 crisis: early career psychiatrists' perspective. *Rev Psiquiatr Salud Ment.* (2020) 13:174–5. doi: 10.1016/j.rpsm.2020.06.001

58. Zarghami A, Farjam M, Fakhraei B, Hashemzadeh K, Yazdanpanah MH. A report of the telepsychiatric evaluation of SARS-CoV-2 patients. *Telemed J E Health.* (2020) 26:1461–5. doi: 10.1089/tmj.2020.0125

59. Campbell R, O'Gorman J, Cernovsky ZZ. Reactions of psychiatric patients to telepsychiatry. *Ment Illn.* (2015) 7:6101. doi: 10.4081/mi.2015.6101

60. Hungerbuehler I, Valiengo L. Home-based psychiatric outpatient care through videoconferencing for depression: a randomized controlled follow-up trial. *JMIR Mental.* (2016) 3:e36. doi: 10.2196/mental.5675

61. Avalone L, Barron C, King C, Linn-Walton R, Lau J, McQuistion HL, et al. Rapid telepsychiatry implementation during COVID-19: increased attendance at the largest health system in the United States. *Psychiatr Serv.* (2021) 72:708–11. doi: 10.1176/appi.ps.202000574

62. Kasckow J, Felmet K, Appelt C, Thompson R, Rotondi A, Haas G, et al. Telepsychiatry in the assessment and treatment of schizophrenia. *Clin Schizophr Relat Psychoses.* (2014) 8:21–7. doi: 10.3371/CSRP.KAFE.021513

63. Baker AL, Turner A, Beck A. Telephone-delivered psychosocial interventions targeting key health priorities in adults with a psychotic disorder: systematic review. *Psychol Med.* (2018) 48:2637–57. doi: 10.1017/S0033291718001125

64. Ramalho R, Adiukwu F, Gashi Bytyçi D, El Hayek S, Gonzalez-Diaz JM, Larnaout A, et al. Telepsychiatry and healthcare access inequities during the COVID-19 pandemic. *Asian J Psychiatr.* (2020) 53:102234. doi: 10.1016/j.ajp.2020.102234

65. Naslund JA, Aschbrenner KA, Araya R, Marsch LA, Unützer J, Patel V, et al. Digital technology for treating and preventing mental disorders in low-income and middle-income countries: a narrative review of the literature. *Lancet Psychiatry.* (2017) 4:486–500. doi: 10.1016/S2215-0366(17)30096-2

66. De Sousa A, Mohandas E, Javed A. Psychological interventions during COVID-19: challenges for low and middle income countries. *Asian J Psychiatr.* (2020) 51:102128. doi: 10.1016/j.ajp.2020.102128

67. Diwan MN, Ali Awan H, Aamir A, Filippis DE, Ullah R. Telepsychiatry in low- and middle-income countries during COVID-19: pandemic, barriers, and road model. *J Nerv Mental Dis.* (2021) 209:144–6. doi: 10.1097/NMD.0000000000001245

68. Moudatsou M, Koukouli S. Caring for patients with psychosis: mental health professionals' views on informal caregivers' needs. *J Environ Pub Health.* (2021) 18:2964. doi: 10.3390/ijerph18062964

69. Malakouti SK, Nouri Ghasem Abadi R, Naghavi Ravandi M, Ahmadi Abhari SA, Nasr Esphahani M, Afgheh S, et al. The burden of caregivers of chronic mental patients and their needs to care and therapeutic services. *Hakim Res J.* (2003) 6:1–10.

70. Ebrahim OS, Al-Attar GST, Gabra RH, Osman DMM. Stigma and burden of mental illness and their correlates among family caregivers of mentally ill patients. *J Egypt Pub Health Assoc.* (2020) 95:31. doi: 10.1186/s42506-020-00059-6

71. Zoladl M, Afroughi S, Nooryan K, Kharamin S, Haghgoo A, Parandvar Y, et al. Applying collaborative care model on intensive caregiver burden and resilient family caregivers of patients with mental disorders: a randomized controlled trial. *Iran J Psychiatry.* (2020) 15:17–26. doi: 10.18502/ijps.v15i1.2436

72. Yasuma N, Yamaguchi S. Care difficulties and burden during COVID-19 pandemic lockdowns among caregivers of people with schizophrenia: a cross-sectional study. *Neuro Rep.* (2021) 41:241–7. doi: 10.1002/npr2.12171

73. Bradbury-Jones C, Isham L. The pandemic paradox: the consequences of COVID-19 on domestic violence. *J Clin Nurs.* (2020) 29:2047–9. doi: 10.1111/jocn.15296

74. Gulati G, Kelly BD. Domestic violence against women and the COVID-19 pandemic: what is the role of psychiatry? *Int J Law Psychiatry.* (2020) 71:101594. doi: 10.1016/j.ijlp.2020.101594

75. Mazza M, Marano G, Lai C, Janiri L, Sani G. Danger in danger: interpersonal violence during COVID-19 quarantine. *Psychiatry Res.* (2020) 289:113046. doi: 10.1016/j.psychres.2020.113046

76. Nirmala BP, Vranda MN, Reddy S. Expressed emotion and caregiver burden in patients with schizophrenia. *Indian J Psychol Med.* (2011) 33:119–22. doi: 10.4103/0253-7176.92052

77. Nooraeen S, Javanbakht M, Malakouti SK. The challenges of providing community psychiatric services in the COVID-19 Era: The probability of soaring rehospitalization and caregivers' burden of people with severe mental illnesses. *Med J Islamic.* (2021) 35:1237–8. doi: 10.47176/mjiri.35.181

frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 08 February 2023
DOI 10.3389/fpubh.2023.1093648

OPEN ACCESS

EDITED BY
Mohammadreza Shalbafan,
Iran University of Medical Sciences, Iran

REVIEWED BY
Junxiang Chen,
University of Pittsburgh, United States
Hanyin Wang,
Northwestern University, United States
José Devís-Devís,
University of Valencia, Spain
Chang Heon Lee,
United Arab Emirates University, United Arab Emirates

*CORRESPONDENCE
Di Wang
✉ dwang@must.edu.mo

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

RECEIVED 09 November 2022
ACCEPTED 16 January 2023
PUBLISHED 08 February 2023

CITATION
Mao Z, Wang D and Zheng S (2023) Health belief model and social media engagement: A cross-national study of health promotion strategies against COVID-19 in 2020. *Front. Public Health* 11:1093648. doi: 10.3389/fpubh.2023.1093648

Health belief model and social media engagement: A cross-national study of health promotion strategies against COVID-19 in 2020

Zhifei Mao[1], Di Wang[2,3]* and Shanshan Zheng[2]

[1]School of Media and Communication, Shenzhen University, Shenzhen, China, [2]Faculty of Humanities and Arts, Macau University of Science and Technology, Macau, China, [3]Research Center for Pandemic and Epidemic Prediction and Intelligence, Faculty of Innovative Engineering, Macau University of Science and Technology, Macau, China

Background: Using the Health Belief Model (HBM), this study analyzed tweets related to COVID-19 published by national health departments of the United States, the South Korea, the United Kingdom, Japan, Germany, and India to explore their differences in (1) the health measures against COVID-19, (2) the health promotion strategies, (3) the social media engagements that those measures and strategies have triggered.

Method: We conducted a content analysis with 1,200 randomly selected COVID-19-related tweets from six national health departments' Twitter accounts from 1 January 2020 to 31 December 2020. We coded the six HBM constructs and 21 sub-themes of the HBM constructs for each tweet.

Results: Results showed that all six HBM constructs were used in the full sample. The most commonly used HBM construct was cues to action, followed by susceptibility, benefits, self-efficacy, severity, and barriers. All the HBM constructs were positively related to Twitter engagement variables except barriers. Further analysis illustrated that people from the six countries responded differently to the HBM constructs and the HBM sub-themes. Twitter users in Germany, India, the U.S., and Japan positively reacted to the clear directions of "what to do against COVID-19" (cues to action), while Twitter users in the U.S. and Japan were also eager to know the justifications for such directions (benefits); people in South Korea and the U.K. were mainly seeking a diagnosis of the severity and susceptibility of COVID-19, instead of health measures, of COVID-19 in the year 2020.

Conclusions: This study showed the use of HBM constructs is generally effective in inducing Twitter engagement. The further comparison illustrated a homogenization in the promotion strategies that the health departments implemented and the health measures they promoted, yet responses to such promotions varied across nations. This study broadened the scope of HBM applications from predicting health behaviors in surveys to guiding the design of health promotion messages online.

KEYWORDS

COVID-19, public health, social media, online behavior, content analysis

Introduction

Since the outbreak of COVID-19, policymakers all around the world have faced a common problem: how to persuade their citizens to embrace health policies to counter the epidemic. Before the COVID-19 vaccinations were released, health policies on COVID-19 were mainly focused on non-pharmaceutical health measures, such as wearing masks, maintaining social distancing, and personal sanitation (1). Previous studies have indicated that some of those policies, such as wearing masks and social distancing measures, were controversial and highly politicalized by various individuals and parties across different nations (2). Other policies or official suggestions, such as hygiene and sanitation measures such as washing hands, were much less debatable, yet were easily neglected or underestimated by citizens (3). Under these circumstances, it is crucial for policymakers to not only launch health policies related to COVID-19 swiftly but also to promote them to the public, convincing their citizens of the benefits of following the health policies.

Deviating from traditional studies that examined the media end and the audience end separately, data from the new media platforms granted us a chance to explore the media content and its corresponding effect simultaneously. We can analyze, for example, a particular tweet on COVID-19-related health policies and how Twitter users respond to it by measuring its engagement variables. By doing so, we can analyze the public promotion of health policies concerning COVID-19 from both the audiences' and the promotion strategies' end.

In this research, we borrow insights from the Health Belief Model (HBM) to conceptualize those strategies. The model illustrates that people's adoption of health behaviors is affected by several beliefs, including (a) perceived susceptibility (whether they are vulnerable to a disease), (b) perceived severity (the severity of a disease), (c) perceived barriers (the difficulty of preventative actions), (d) perceived benefits (the benefits of taking those actions), (e) self-efficacy (whether they can successfully implement the recommended health behavior), and (f) cues to actions (stimulus cues that trigger individuals to engage in appropriate health behaviors) (4, 5).

The classical way to apply HBM is through surveys, examining the relationship between people's beliefs and their health behaviors (6). Some researchers replicated this form of study to examine people's health beliefs related to COVID-19 (7–9). In recent years, new media have become an extremely important space for health promotion. Thus, only using the method of a survey to study HBM would lose valuable and rich information on social media. In addition, in surveys, people could be influenced by social desirability bias, and answer questions in a socially desirable way. But due to the anonymity of the Internet, people's likes and retweets in social media could more realistically reflect their true attitudes and interest. Therefore, the data on social media serve as an excellent platform to the study the effect of health promotion strategies.

Indeed, some studies have already explored HBM constructs on social platforms like Twitter. Such studies could be categorized into two categories. First, some researchers regarded HBM constructs as *the perceptions or attitudes of the public on a health crisis and its measures* (10–12). After the outbreak of COVID-19, some researchers used HBM constructs to identify people's perceptions of COVID-19 and its health measures, and by examining the frequency of which they could estimate to what extent people have formed a health belief of COVID-19 (13). These studies demonstrated the possibility of applying HBM to health promotion online, while failed to test the correlations between the health promotion strategies used by the health department and people's responses to them since they focused on the side of the public perceptions only. Others regarded HBM constructs as *different promotion strategies implemented by a health department*. For example, by examining the frequency of the constructs that appeared in health departments' Twitter accounts and people's reactions to those constructs, researchers could draw a picture of the preference of strategies that a health department would use to promote COVID-19 related health measures, as well as the effects of them (14, 15).

This study borrows the insights of the second group of studies to examine the correlations between the health promotion strategies of the health department (HBM constructs) and people's responses to them (likes and retweets). We will test whether the existence of the HBM constructs could induce higher Twitter engagements (likes and retweets). Furthermore, our contribution to the literature is 3-fold: First, this study shall take an in-depth look at the sub-themes of the HBM constructs to examine the *specific* health promotion strategies. Previous research usually treated each HBM construct as a whole without distinguishing the sub-themes of each construct. However, people may respond differently toward different health measures (e.g., they may like cues to action on vaccines but dislike or feel aloof for cues to action on masks). Therefore, it is imperative to examine the sub-themes within each HBM construct. Second, this study shall comprehensively profile Twitter users from different countries based on their different reactions toward the health promotion related to COVID-19 online. This helps the policymakers understand their citizens, and therefore they can further improve their communication strategies. Third, this study shall launch a cross-national comparative study to examine the similarities and differences between the health departments in their health promotion and the Twitter users in their responses to the health departments. Vermandere et al. (16) argued that it is necessary to test the application of health behavior theory in different environments to justify its rationality in promoting and intervening in health behavior in different settings. Previous studies have shown that the impact of the HBM constructs on Twitter engagement differed among the three major news agencies: the COVID-19 vaccination promotion using HBM constructs was effective for Reuters, but seems to be counterproductive for AFP (17). Moreover, people in different societies also have their favored ways of regarding Twitter engagements (18). Taking the possible differences among societies into consideration, we will implement a comparative study to answer the following questions:

RQ1: What are the differences in using the HBM constructs between the six national health departments' tweets?
RQ2: Does Twitter engagement vary across the six national health departments?
RQ3: To what extent does the presence of HBM constructs in tweets by national health departments impact Twitter engagement?
RQ4: Does the effect of HBM constructs on Twitter engagement vary across the six national health departments?

TABLE 1 Operationalization of HBM variables.

HBM constructs and operationalization	Sub-themes	Examples
1. Susceptibility [define population(s) at risk, and risk levels; personalize risk based on a person's features or behavior; heighten susceptibility if too low.]	1.1. The susceptibility of COVID-19 to the vulnerable group	Some people are at higher risk of being hospitalized if they get #coronavirus. Read NHS advice which sets out very clearly the different advice to different groups who are more vulnerable to #COVID19.
	1.2. The susceptibility of COVID-19 to the general public	The number of people infected with the new corona is increasing rapidly in some areas.
2. Severity (specify the consequences of the risk and the condition.)	2.1. The severity of COVID-19 to the vulnerable group	Older adults and people who have severe chronic medical conditions like heart, lung, or kidney disease or diabetes, may be at higher risk for severe illness from COVID-19.
	2.2. The severity of COVID-19 to the general public	As of 9 am 30 March, a total of 134,946 have been tested: 112,805 negative. 22,141 positive. As of 5 p.m. on 29 March, of those hospitalized in the U.K., 1,408 have sadly died.
3. Benefits (clarify the positive effects of taking the advised action to reduce the risk or seriousness of the impact.)	3.1. Benefits of physical and social distancing measures for the general public	Wearing a face covering and staying six feet apart doesn't just protect you, it protects those around you.
	3.2. Benefits of personal measures	A mask is one of the best ways to help prevent the spread of COVID-19.
	3.3. Benefits of virus testing and patient tracking	Testing is free, quick, and vital to stop the spread of coronavirus.
	3.4. Benefits of pharmaceutical interventions	An effective vaccine is the biggest breakthrough since #COVID19 was identified. It could save thousands of lives. Learn more about #COVID19 vaccination: http://nhs.uk/covidvaccine
4. Barriers (identify the tangible and psychological costs of the advised action.)	4.1. Barriers to medical resources strategies	This means that hospitals, medical practices, and nursing homes hardly have a chance to replenish their stocks and procure what they need in such a highly competitive market.
5. Cues to action (remind to take action.)	5.1. Cues to action on movement restriction	Several areas in England are moving into higher tiers from 00:01 tomorrow. ⚠ This is to limit the spread of #COVID19 as cases continue to rise across the country. See the list of local restriction tiers by area
	5.2. Cues to action on physical and social distancing measures for confirmed/suspected cases	If you have symptoms of COVID-19 (new continuous cough OR a high temperature), it's important that you stay at home for 7 days to help protect your friends and neighbors.
	5.3. Cues to action on physical and social distancing measures for the general public	Have plans this weekend? If you will be around others, stay at least 6 ft apart and wear a cloth face covering to slow the spread of #COVID19.
	5.4. Cues to action on personal measures	Continue social distancing, wearing a face covering, and washing your hands frequently to help protect yourself and others around you from #COVID19.
	5.5. Cues to action on the protection of special groups	Before COVID-19 vaccines are authorized, a CDC advisory committee recommended healthcare personnel and long-term care facility residents should receive #COVID19 vaccination first, while supplies are limited.
	5.6. Cues to action on medical resources strategies	We recently announced that 15,000 @PenlonGlobal devices will be sent to the #NHS frontline to support coronavirus (#COVID19) patients.
	5.7. Cues to action on virus testing and patient tracking	Are you 65 or over and live in England? If you or anyone in your household has #coronavirus symptoms, you can book a test online.
	5.8. Cues to action on pharmaceutical interventions	"I want to encourage everyone who has the opportunity, to get vaccinated so that we can have a veil of protection over this country that would end this pandemic." - Dr. Anthony Fauci
6. Self-efficacy (provide training and guidance in performing an action to increase people's self-efficacy in dealing with COVID-19.)	6.1. Self-efficacy (training or guidance on physical and social distancing measures for confirmed/suspected cases)	You can take a medical examination, check your fever, and take a sample through the car window while in the car. By minimizing contact between medical staff and patients, the risk of infection can be reduced and the speed of testing can be increased.
	6.2. Self-efficacy (training or guidance on personal measures)	Wash your hands more often. Use soap and water for 20 s or use hand sanitizer.
	6.3. Self-efficacy (training or guidance on virus testing and patient tracking)	Does your child need to have a #COVID19 test? If you're taking your child for a test, show them this video to explain what will happen ▶ If your child has any #coronavirus symptoms, book a test call 119 or visit http://NHS.uk
	6.4. Self-efficacy (training or guidance on pharmaceutical interventions)	General Gus Perna, Chief Operating Officer for Operation Warp Speed (#OWS), explains the five key tenets behind the successful operation to rapidly develop, produce and distribute a safe and effective #COVID19 vaccine to the American people.

TABLE 2 The frequency of HBM constructs used by country.

	Susceptibility	Severity	Benefits	Barriers	Cues to action	Self-efficacy
Total	74 (6.2)	28 (2.3)	56 (4.7)	4 (0.3)	490 (40.8)	30 (2.5)
The U.K.	6 (3.0)	2 (1.0)	8 (4.0)	1 (0.5)	106 (53.0)	8 (4.0)
The U.S.	13 (6.5)	2 (1.0)	25 (12.5)	0 (0)	102 (51.0)	10 (5.0)
Germany	16 (8.0)	2 (1.0)	9 (4.5)	3 (1.5)	74 (37.0)	4 (2.0)
Japan	15 (7.5)	9 (4.5)	1 (0.5)	0 (0)	51 (25.5)	1 (0.5)
South Korea	10 (5.0)	5 (2.5)	7 (3.5)	0 (0)	84 (42.0)	2 (1.0)
India	14 (7.0)	8 (4.0)	6 (3.0)	0 (0)	73 (36.5)	5 (2.5)
Chi-square	5.99	11.26*	37.46***	11.04	43.16***	12.31*

Values inside the parenthesis represent the percentage of *n*. $^{*}p < 0.05$; $^{***}p < 0.001$.

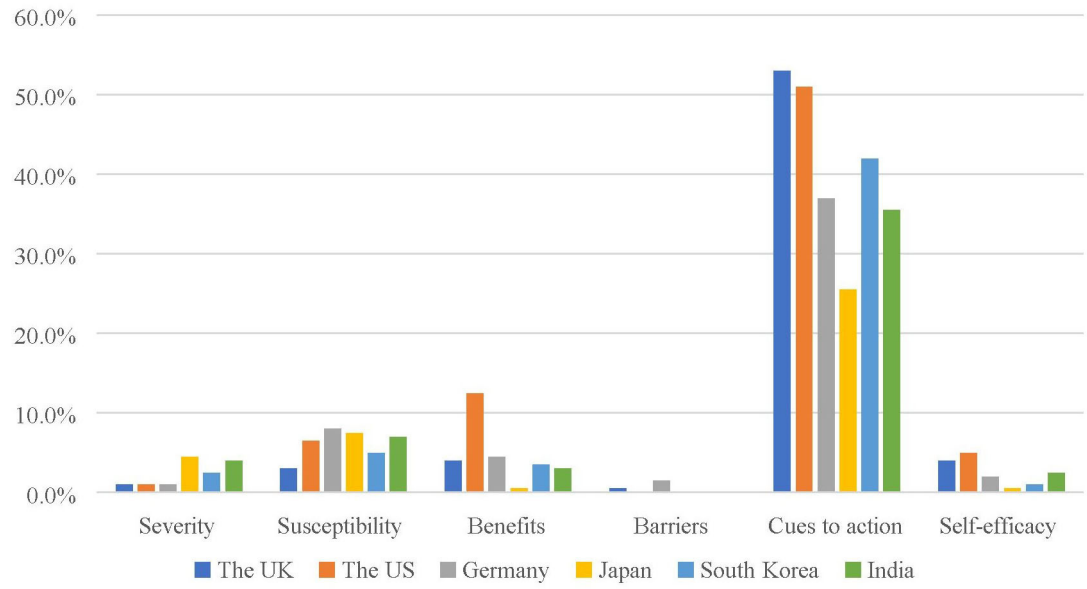


FIGURE 1
HBM constructs used by the six national health department's tweets.

Method

We used Python® to retrieve information about COVID-19 on Twitter using Twitter's Application Programming Interfaces in January 2021. The time frame of the study was from January 1, 2020, to December 31, 2020. The year 2020 was selected because 2020 was the first year of the COVID-19 outbreak. For most countries, COVID-19 vaccines were not available until December 2020. Before the advent of the COVID-19 vaccines, countries around the world implemented many non-pharmaceutical measures, such as social distancing, wearing masks, and even lockdowns. However, after the advent of the COVID-19 vaccine, many measures, such as lockdowns, were canceled (1). Therefore, 2020 is of great significance for health departments across the globe to promote health measures to fight against COVID-19.

A quantitative content analysis was conducted with 1,200 randomly selected COVID-19-related tweets from six national health departments' Twitter accounts in 2020. To control the impact of the economy on policies, the six countries were selected based on the rank of Gross Domestic Product (GDP) in 2020 (19). To further diversify our data, we drew the three highest-ranking GDP countries from the East (Japan, India, and South Korea) and the West (the U.S., Germany, and the U.K.). China, the country with the largest GDP in the East, was excluded from the sample because Twitter is not available there.

The search key words were "2019nCoV, 2019-nCoV, 2019n_CoV, Coronavirus, Corona, Novel coronavirus, novelcoronavirus2019, COVID, COVID19, COVID-19, COVID2019, nCoV2019, NCOV19, NCOV, nCoV2020, neuartige virus, virus, Lungenentzündung, , , ,,, 19, , , , , , ." As COVID-19 was named "", or unknown pneumonia

TABLE 3 The frequency of the sub-themes of the HBM constructs by country.

Sub-themes of HBM constructs	UK	US	Germany	Japan	South Korea	India	Total
1.1. The susceptibility of COVID-19 to the vulnerable group	1 (0.5)	6 (3.0)	8 (4.0)	0 (0)	1 (0.5)	3 (1.5)	19 (1.6)
1.2. The susceptibility of COVID-19 to the general public	5 (0.5)	7 (3.5)	9 (4.5)	16 (8.0)	9 (4.5)	11 (5.5)	57 (4.8)
2.1. The severity of COVID-19 to the vulnerable group	0 (0)	1 (0.5)	1 (0.5)	0 (0)	2 (1.0)	1 (0.5)	5 (0.4)
2.2. The severity of COVID-19 to the general public	2 (1.0)	1 (0.5)	1 (0.5)	9 (4.5)	2 (1.0)	7 (3.5)	22 (1.8)
3.1. Benefits of physical and social distancing measures for the general public	0 (0)	6 (3.0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (0.5)
3.2. Benefits of personal measures	4 (2.0)	15 (7.5)	3 (1.5)	1 (0.5)	0 (0)	3 (1.5)	26 (2.2)
3.3. Benefits of virus testing and patient tracking	2 (1.0)	1 (0.5)	0 (0)	0 (0)	1 (0.5)	0 (0)	4 (0.3)
3.4. Benefits of pharmaceutical interventions	2 (1.0)	3 (1.5)	3 (1.5)	0 (0)	0 (0)	0 (0)	8 (0.7)
4.1. Barriers to medical resources strategies	1 (0.5)	0 (0)	3 (1.5)	0 (0)	0 (0)	0 (0)	4 (0.3)
5.1. Cues to action on movement restriction	2 (1.0)	2 (1.0)	3 (1.5)	0 (0)	10 (5.0)	0 (0)	17 (1.4)
5.2. Cues to action on physical and social distancing measures for confirmed/suspected cases	16 (8.0)	5 (2.5)	1 (0.5)	3 (1.5)	2 (1.0)	2 (1.0)	29 (2.4)
5.3. Cues to action on physical and social distancing measures for the general public	27 (13.5)	34 (17.0)	24 (12.0)	5 (2.5)	30 (15.0)	34 (17.0)	154 (12.8)
5.4. Cues to action on personal measures	26 (13.0)	49 (24.5)	29 (14.5)	16 (8.0)	14 (7.0)	40 (20.0)	174 (14.5)
5.5. Cues to action on the protection of special groups	0 (0)	2 (1.0)	1 (0.5)	0 (0)	2 (1.0)	3 (1.5)	8 (0.7)
5.6. Cues to action on medical resources strategies	2 (1.0)	5 (2.5)	8 (4.0)	0 (0)	9 (4.5)	3 (1.5)	27 (2.3)
5.7. Cues to action on virus testing and patient tracking	42 (21.0)	3 (1.5)	10 (5.0)	0 (0)	6 (3.0)	3 (1.5)	64 (5.3)
5.8. Cues to action on pharmaceutical interventions	4 (2.0)	15 (7.5)	7 (3.5)	0 (0)	0 (0)	5 (2.5)	31 (2.6)
6.1. Self-efficacy (training or guidance on physical and social distancing measures for confirmed/suspected cases)	0 (0)	0 (0)	0 (0)	1 (0.5)	0 (0)	0 (0)	1 (0.1)
6.2. Self-efficacy (training or guidance on personal measures)	7 (3.5)	9 (4.5)	4 (2.0)	1 (0.5)	2 (1.0)	5 (2.5)	28 (2.3)
6.3. Self-efficacy (training or guidance on virus testing and patient tracking)	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.1)
6.4. Self-efficacy (training or guidance on pharmaceutical interventions)	0 (0)	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.1)

Values inside the parenthesis represent percentage of *n*.

in Japan before the WHO named it COVID-19 on Feb 11, 2020, we included "" in the Japanese search words. Tweets about pneumonia, but was not related to COVID-19, were excluded manually later. After manually excluding unrelated tweets, a total of 15,856 tweets were downloaded, including 1,558 tweets about COVID-19 from the U.S. Department of Health and Human Services' Twitter account (@HHSGov), 2,027 tweets from the Germany Federal Ministry of Health's Twitter account (@BMG_Bund), 2,602 tweets from the Japanese Ministry of Health, Labour and Welfare's Twitter account (@MHLWitter), 3,302 tweets from the U.K. Department of Health and Social Care's Twitter account (@DHSCgovuk), 2,375 tweets from the India Ministry of Health's Twitter account (@MoHFW_INDIA), and 3,992 tweets from the South Korea Ministry of Health and Welfare's Twitter account (@mohwpr).

We randomly selected 200 tweets from the search results of each of the six national health departments' Twitter accounts. The full text, as well as images and videos (the length of the video ranged from 1 to 55 min) of the 1,200 tweets, were examined. All the files were downloaded in English except those from Germany, Japan, and South Korea. Videos were converted into audio files and then to text by using professional audio conversion software, Xunjie®. Then all the text was translated into English by professional translators for analysis. The data for Twitter-specific variables were downloaded from the Twitter website including the number of likes, and the number of retweets. Each tweet was examined for one or more of the HBM constructs, that is, when the six HBM constructs are coded, it is a multiple choice rather than a single choice. We also coded 21 sub-themes of the HBM constructs. Following Glanz (20) and the health policies of each country (9), the operationalizations of the HBM variables are shown in Table 1.

Two graduate students who are fluent in English coded all the files. We calculated the inter-coder reliability of the two coders by double-coding a random subsample ($n = 240$ or 20%) of the data. Krippendorff's alpha ranged from 0.85 to 1.0 for the six main variables (susceptibility, severity, benefits, barriers, cues to action, and self-efficacy) and 0.80–1.0 for the 21 sub-themes.

10.3389/fpubh.2023.1093648

TABLE 4 Descriptive statistics for Twitter engagement in the six national health departments' tweets.

Country	Engagement variable	Range	Mean (SD)	Skewness	Kurtosis	*N*
The U.K.	Like	14–64,644	570.18 (4,575.20)	13.94	196.17	200
	Retweet	3–11,186	180.25 (808.31)	12.87	196.17	200
The U.S.	Like	0–8,909	294.30 (805.23)	7.68	71.76	200
	Retweet	0–2,789	164.56 (340.84)	5.06	30.15	200
Germany	Like	0–8,267	209.38 (670.05)	9.60	108.79	200
	Retweet	0–2,967	88.37 (288.46)	7.27	61.35	200
Japan	Like	40–2,205	147.06 (238.64)	6.06	41.68	200
	Retweet	14–3,306	96.48 (256.65)	10.42	125.36	200
South Korea	Like	2–10,721	329.58 (1,133.64)	7.48	62.45	200
	Retweet	0–6,617	301.36 (751.86)	6.35	47.60	200
India	Like	6–18,729	264.11 (1,320.59)	13.88	194.91	200
	Retweet	0–4,219	71.57 (297.04)	13.82	193.80	200
Total	Like	0–64,644	302.43 (2,046.05)	26.94	823.71	1,200
	Retweet	0–11,186	150.43 (516.79)	12.74	218.42	1,200

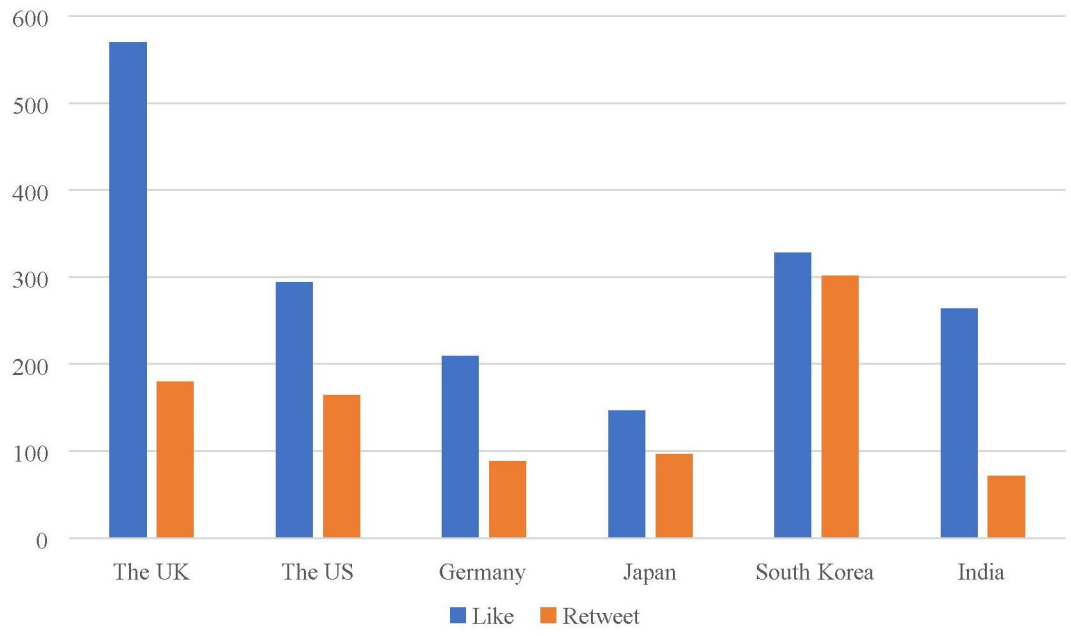


FIGURE 2
The mean number of likes and retweets by country.

Results

HBM constructs used in six national health department's tweets

To answer RQ1 and RQ2, we will use Chi-square tests to examine the differences in the HBM constructs and Twitter engagement among the six national health departments' tweets. As can be seen in Table 2, the most often used HBM construct was cues to action (n = 490, 40.8%), followed by susceptibility (n = 74, 6.2%), benefits (n = 56, 4.7%), self-efficacy (n = 30, 2.5%), severity (n = 28, 2.3%), and barriers (n = 4,0.3%).

When we compare the use of each HBM construct by country, results showed that the six national health department's Twitter accounts showed significant difference in the frequency of severity ($\chi^2 = 11.26, p < 0.05$), benefits ($\chi^2 = 37.41, p < 0.001$), cues to action ($\chi^2 = 43.16, p < 0.001$), and self-efficacy ($\chi^2 = 12.31, p < 0.05$). *Post-hoc* analysis showed that the U.S. health department mentioned

TABLE 5 HBM constructs and Twitter engagement.

HBM construct	Engagement variables	Mean ranks of the group with the HBM variable present	Mean ranks of the group with the HBM variable absent	Mann-Whitney *U*	*Z*
Susceptibility	Retweets	673.85	595.68	36,234.00	−1.88
	Likes	688.12	594.74	35,178.00*	−2.25
Severity	Retweets	716.89	597.72	13,149.00	−1.80
	Likes	761.59	596.65	11,897.50*	−2.49
Benefits	Retweets	717.53	594.77	25,478.50*	−2.59
	Likes	713.91	594.95	25,681.00*	−2.51
Barriers	Retweets	578.13	600.57	2,302.50	−0.13
	Likes	675.38	600.25	2,092.50	−0.43
Cues to action	Retweets	677.13	547.62	136,402.00***	−6.36
	Likes	663.28	557.17	143,188.50***	−5.21
Self-efficacy	Retweets	772.33	596.09	12,395.00**	−2.75
	Likes	729.68	597.19	13,674.50*	−2.07

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 6 Sub-themes of the HBM constructs and Twitter engagement for the whole sample.

Sub-theme of HBM constructs	Engagement variables	Mean ranks of the group with the HBM variable present	Mean ranks of the group with the HBM variable absent	Mann-Whitney *U*	*Z*
2.1. The severity of COVID-19 to the vulnerable group	Retweets	892.40	599.28	1,528.00	−1.89
	Likes	956.30	599.01	1,208.50*	−2.30
3.1. Benefits of physical and social distancing measures for the general public	Retweets	1,010.83	598.44	1,120.00**	−2.91
	Likes	1,026.50	598.36	1,026.00**	−3.02
3.2. Benefits of personal measures	Retweets	773.06	596.68	10,775.50*	−2.57
	Likes	760.10	596.97	11,112.50*	−2.37
5.1. Cues to action on movement restriction	Retweets	810.06	597.49	6,493.00*	−2.51
	Likes	681.82	599.33	8,673.00	−0.97
5.3. Cues to action on physical and social distancing measures for the general public	Retweets	738.13	578.41	62,976.00***	−5.51
	Likes	717.26	581.76	66,440.00***	−4.68
5.4. Cues to action on personal measures	Retweets	736.45	576.04	68,176.50***	−5.77
	Likes	738.91	575.59	677,726.50***	−5.87
5.8. Cues to action on pharmaceutical interventions	Retweets	436.33	604.57	12,218.50*	−2.59
	Likes	556.28	601.60	15,697.00	−0.70
6.2. Self-efficacy (training or guidance on personal measures)	Retweets	810.25	595.49	10,535.00**	−3.24
	Likes	769.75	596.46	11,669.00**	−2.62

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

significantly more the benefits of taking preventive behaviors (n = 25) than the expected count (n = 9.3) while the Japanese health department mentioned significantly fewer benefits of taking preventive behaviors ($n = 1$) than the expected count ($n = 9.3$). The U.K. and the U.S. health department mentioned significantly more cues to action ($n = 106$ for the U.K. and $n = 102$ for the U.S.) in their tweets than the expected count ($n = 81.7$). For visual comparison, see Figure 1.

Table 3 showed the frequency of sub-themes of the HBM constructs by country. For the whole sample, the most mentioned

TABLE 7 The HBM constructs and Twitter engagement by country.

	HBM variable	Engagement variables	Mean ranks of the group with the HBM variable present	Mean ranks of the group with the HBM variable absent	Mann-Whitney *U*	*Z*
U.K.	Severity	Retweets	179.50	99.70	40.00	−1.94
		Likes	180.50	99.69	38.00*	−1.97
U.S.	Susceptibility	Retweets	143.81	97.49	652.50**	−2.79
		Likes	135.08	98.10	766.00*	−2.23
	Benefits	Retweets	135.16	95.55	1,321.00**	−3.20
		Likes	135.32	95.53	1,317.00**	−3.22
	Cues to action	Retweets	112.64	87.87	3,760**	−3.03
		Likes	115.21	85.19	3,498.00***	−3.67
	Self-efficacy	Retweets	154.95	97.63	405.50**	−3.05
		Likes	153.25	97.72	422.50**	−2.96
Germany	Cues to action	Retweets	114.68	92.17	3,613.00**	−2.66
		Likes	113.93	92.61	3,668.00*	−2.52
Japan	Benefits	Retweets	198.00	100.01	2.00*	−1.69
		Likes	197.00	100.02	3.0*	−1.67
	Cues to action	Retweets	142.04	86.28	1,681.00***	−5.94
		Likes	131.96	89.73	2,195.00***	−−4.50
South Korea	Severity	Retweets	174.40	98.61	118.00**	−−2.89
		Likes	171.00	98.69	135.00**	−2.76
	Susceptibility	Retweets	144.60	98.18	509.00*	−2.47
		Likes	141.30	98.35	542.00*	−−2.29
India	Cues to action	Retweets	126.18	85.74	2,761.00***	−4.76
		Likes	122.71	87.74	3,014.50***	−4.11

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

sub-themes were those under cues to action, such as cues to action on personal measures ($n = 174$, 14.5%) and on physical and social distancing measures for the general public ($n = 154$, 12.8%). Sub-themes that were mentioned less frequently are those under susceptibility, such as the susceptibility of COVID-19 to the general public ($n = 57$, 4.8%). Sub-themes under severity, benefit, and self-efficacy were seldom mentioned, while the only sub-theme of barrier, barriers of medical resources strategies, was mentioned only four times (0.3%).

When we break the results by country, a similar pattern can be observed. One exception was Japan, which only emphasized the susceptibility and the severity of COVID-19 to the general public and a few sub-themes of cues to action.

Differences in the Twitter engagement

For the entire sample, the mean number of retweets was 150.43 ($SD = 516.79$) and the mean number of likes was 302.43 ($SD = 2,046.05$). One-way ANOVA test showed that the six countries' health departments did not differ significantly in terms of the number of likes, $F_{(5,1,194)} = 1.02$, $p > 0.05$, but differed significantly in terms of the number of retweets, $F_{(5,1,194)} = 5.63$, $p < 0.001$. As our data met the assumption of homogeneity of variances, we used Tukey's honestly significant difference (HSD) *post-hoc* test to further test the differences in the number of retweets across countries. *Post-hoc* (HSD) analysis showed that South Korea's number of retweets ($M = 301.36$, $SD = 751.86$) was higher than that of Germany ($M = 88.37$, $SD = 288.46$), Japan ($M = 96.48$, $SD = 256.65$) and India ($M = 71.57$, $SD = 297.04$). All six countries' data showed a positive skew, which indicates that the tail is on the right side of the distribution. The kurtosis values were all >3, which meant that the data produced more outliers than the normal distribution (see Table 4). Figure 2 showed the visual comparison of Twitter engagement across countries.

The effect of the HBM constructs in tweets on Twitter engagement

As the Twitter engagement variables were not normally distributed, we used non-parametric Mann-Whitney *U*-tests to examine the effect of the presence of HBM constructs on Twitter engagement, in response to RQ3 and RQ4. Mann Whitney *U*-test is used to compare the difference between two independent groups when the dependent variable is ordinal or continuous but not normally distributed and is generally considered a non-parametric alternative to the independent *t*-test (21). In our study, we compared

10.3389/fpubh.2023.1093648

TABLE 8 Sub-themes of HBM constructs and Twitter engagement by country.

Country	Sub-theme of HBM constructs	Engagement variables	Mean ranks of the group with the HBM variable present	Mean ranks of the group with the HBM variable absent	Mann-Whitney *U*	*Z*
UK	2.2. The severity of COVID-19 to the general public	Retweets	179.50	99.70	40.00*	−1.94
		Likes	180.50	99.69	38.00*	−1.97
US	1.1. The susceptibility of COVID-19 to the vulnerable groups	Retweets	149.92	98.97	285.50*	−2.12
		Likes	145.67	99.10	311.00	−1.94
	3.1. Benefits of physical and social distancing measures for the general public	Retweets	156.00	98.78	249.00*	−2.39
		Likes	164.58	98.52	197.50**	−2.75
	3.2. Benefits of personal measures	Retweets	141.50	97.18	772.50**	−2.85
		Likes	142.13	97.12	763.00**	−2.90
	5.3. Cues to action on physical and social distancing measures for the general public	Retweets	131.60	94.13	1,764.50***	−3.44
		Likes	134.31	93.58	1,672.50***	−3.74
	5.4. Cues to action on personal measures	Retweets	139.30	87.91	1,798.50***	−5.40
		Likes	142.36	86.92	1,648.50***	−5.83
	5.8. Cues to action on pharmaceutical interventions	Retweets	69.13	103.04	917.00*	−2.18
		Likes	84.43	101.80	1,146.50	−1.12
	6.2. Self-efficacy (training or guidance on personal measures)	Retweets	169.00	97.27	243.00***	−3.63
		Likes	167.78	97.33	254.00***	−3.57
Germany	5.4. Cues to action on personal measures	Retweets	132.43	95.08	1,553.50**	−3.21
		Likes	125.76	96.22	1,747.00*	−2.54
Japan	3.2. Benefits of personal measures	Retweets	198.00	100.01	2.00*	−1.69
		Likes	197.00	100.02	3.00*	−1.67
	5.4. Cues to action on personal measures	Retweets	147.19	96.44	725.00***	−3.36
		Likes	148.03	96.37	711.50***	−3.43
South Korea	1.2. The susceptibility of COVID-19 to the general public	Retweets	142.11	98.54	485.00*	−2.21
		Likes	137.67	98.75	525.00*	−1.97
	2.1. The severity of COVID-19 to the vulnerable groups	Retweets	189.50	99.60	20.00*	−2.19
		Likes	189.50	99.60	20.00*	−2.19
India	5.3. Cues to action on physical and social distancing measures for the general public	Retweets	143.50	91.69	1,360.00***	−4.76
		Likes	134.74	93.49	1,658.00***	−3.79
	5.4. Cues to action on personal measures	Retweets	139.08	90.86	1,657.00***	−4.71
		Likes	132.64	92.47	1,914.50***	−3.93

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

the tweets that used the HBM constructs with those that did not use the HBM constructs.

Table 5 showed that tweets emphasizing the susceptibility of COVID-19 were liked more often (Mean ranks = 688.12) than tweets that did not emphasize the susceptibility of COVID-19 (Mean ranks = 594.74), Mann-Whitney U = 35,178.00, $p < 0.05$; tweets emphasizing the severity of COVID-19 were liked more often (Mean ranks = 761.59) than tweets that did not emphasize the severity of COVID-19 (Mean ranks = 596.65), Mann-Whitney $U = 11{,}897.50$, $p < 0.05$.

Tweets emphasizing the benefits of taking preventative measures were retweeted more often (Mean ranks = 717.53) than tweets that did not emphasize the benefits of taking preventative measures (Mean ranks = 594.77), Mann-Whitney $U = 25{,}478.50$, $p < 0.05$. Similarly, tweets emphasizing the benefits of taking preventative measures were also liked more often (Mean ranks = 713.91) than tweets that did not emphasize the benefits of taking preventative measures (Mean ranks = 594.95), Mann-Whitney $U = 25{,}681.00$, $p < 0.05$.

Tweets emphasizing cues to action were retweeted more often (Mean ranks = 677.13) than tweets that did not emphasize cues to action (Mean ranks = 547.62), Mann-Whitney U = 136,402.00, $p < 0.001$. Similarly, tweets emphasizing cues to action were also liked more often (Mean ranks = 663.28) than tweets that did not emphasize cues to action (Mean ranks = 557.17), Mann-Whitney $U = 143{,}188.50$, $p < 0.001$.

Tweets emphasizing training and guidance to increase self-efficacy were retweeted more often (Mean ranks = 772.33) than tweets that did not emphasize training and guidance to increase self-efficacy (Mean ranks = 596.09), Mann-Whitney $U = 12{,}395.00$, $p < 0.01$. Similarly, tweets emphasizing training and guidance to increase self-efficacy were also liked more often (Mean ranks = 729.68) than tweets that did not emphasize training and guidance to increase self-efficacy (Mean ranks = 597.19), Mann-Whitney $U = 13{,}674.50$, $p < 0.05$. The only HBM variable that did not have an impact on Twitter engagement is barriers.

To explore what specific topics were liked and/or retweeted most under the six HBM constructs, we also ran a series of Mann-Whitney U-tests to explore the relationship between the sub-themes of the HBM constructs and Twitter engagement for the whole sample. Table 6 showed that seven sub-themes of the HBM constructs [the severity of COVID-19 to the vulnerable group, benefits of physical and social distancing measures for the general public, benefits of personal measures, cues to action on movement restriction, cues to action on physical and social distancing measure for the general public, cues to action on personal measures and self-efficacy (training or guidance on personal measures)] were positively related to the Twitter engagement while one sub-theme (cues to action on pharmaceutical interventions) was negatively related to Twitter retweet for the whole sample.

To further understand the relationship between the HBM constructs and Twitter engagement for each country, we ran a series of Mann-Whitney U-tests to explore the relationship between the HBM constructs and Twitter engagement for by country. When we ran the analysis by country, we can see four of the HBM constructs (susceptibility, benefits, cues to action, and self-efficacy) were effective for the U.S., while only some of the HBM constructs were effective for the other five countries in inducing Twitter engagement (see Table 7). Specifically, severity was a positive predictor of the number of likes for the U.K.; cues to action was the only HBM that is positively related to Twitter engagement for Germany and India; severity and vulnerability were effective in inducing Twitter engagement for South Korea; benefits and cues to action are positive related to Twitter engagement for Japan.

To sum up, the most effective HBM construct was cues to action which was effective in inducing Twitter engagement for four countries (the U.S., Germany, Japan, and India). Severity and susceptibility were both effective for South Korea, while severity was partially effective for the U.K. and susceptibility was effective for the U.S. in inducing Twitter engagement. Benefit was effective in inducing Twitter engagement for the U.S. and Japan. Self-efficacy was only effective in inducing Twitter engagement for the U.S. As only four tweets mentioned barriers (one in the U.K. and three in Germany), there were not enough data to examine the effect of barriers on Twitter engagement.

To explore what sub-themes of the HBM constructs were effective in inducing Twitter engagement for each country, we further ran the sub-themes of HBM constructs and Twitter engagement by country (Table 8). Specifically, the severity of COVID-19 to the general public was positively related to Twitter engagement for the U.K. One sub-theme of susceptibility (susceptibility of COVID-19 to vulnerable groups), two sub-themes of benefits (the benefits of personal measures and physical and social distancing measures for the general public), three sub-themes of cues to action (action on physical and social distancing measures for the general public, personal measures and pharmaceutical interventions), and one sub-theme of self-efficacy (training or guidance on personal measures) were positively related to Twitter engagement for the U.S. Cues to action on personal measures were the only positive predictor of Twitter engagement for Germany. The benefits of personal measures and cues to action on personal measures were positively related to Twitter engagement for Japan. The susceptibility of COVID-19 to the general public and the severity of COVID-19 to vulnerable groups were two positive predictors of Twitter engagement for South Korea. Finally, cues to action on physical and social distancing measures for the general public and cues to action on personal measures were two positive predictors of Twitter engagement for India.

Discussion

This study aimed to explore to what extent national health departments applied the HBM constructs in their COVID-19-related tweets and the effect of the HBM constructs in messages on Twitter engagement for six national health departments. After comparing the results across six nations, we found, regardless of political and cultural differences, health departments across nations all used the HBM constructs as communication strategies to promote their health policies against COVID-19 on Twitter. Overall, the most often used HBM constructs by the six countries' health departments was cues to action, followed by susceptibility, benefits, self-efficacy, severity, and barriers. This finding is consistent with previous studies that found the HBM constructs were used by national health departments' tweets across nations (14). One thing in common across nations is that the health departments were keen on providing directions (cues to actions) for the public, guiding them on what to do against COVID-19. Different from previous studies that only treated HBM as six single constructs, we also analyzed the sub-themes within each construct. Results showed that actions cued by national health departments varied from movement restrictions, social distancing measures, taking personal measures (e.g., washing hands), protecting

vulnerable groups, enhancing medical resources strategies, doing virus testing and patient tracking, to pharmaceutical interventions (see Table 3). Among all the health measures, social distancing measures and personal measures were the most promoted measures across nations.

The question is: did people accept health departments' suggestions? What kind of justifications could convince people to accept those health measures? Based on the data of HBM, we systematically characterized the people of six countries regarding their different responses to their health department's health promotion of COVID-19 on Twitter. We named them seekers of diagnosis, seekers of directions, and seekers of justifications, respectively. The seekers of diagnosis were the people who were still seeking the nature (severity and susceptibility) of COVID-19, while the seekers of directions and justifications were keen on knowing "what to do" (cues to actions) and why to do (benefits, barriers, self-efficacy), respectively.

South Korean and the U.K. people as *seekers of diagnosis*

First, we named the people of South Korea and the United Kingdom as "seekers of diagnosis." The public of these two nations positively reacted to those tweets that mentioned the severity or susceptibility of the epidemic, while not positively responding to the tweets that mentioned the justification or directions for actions. HBM theorists argued that the constructs of severity and susceptibility not only refer to the knowledge of a disease but also the necessity of further health measures (5). Borrow their insights, in our study, we regard these two constructs as a *diagnosis* that legitimize or illegitimate further treatments. Without convincing people how serious COVID-19 was and how vulnerable people could be exposed to such disease, it is impossible for the health departments to further persuade people to take action against it. The data indicated that in the first year since the COVID-19 outbreak, the people of the U.K. and South Korea on Twitter were still seeking the nature, rather than the treatments, of COVID-19. Between these two groups of diagnosis seekers, the U.K. people were concerned more about how vulnerable they would be exposed to the epidemic, while the Korean citizens were concerned about both the severity and vulnerability of the disease.

German and Indian people as seekers of directions

The very opposite of the above two countries was Twitter users from Germany and India. Those only positively responded to those tweets that mentioned "cues to actions", were named "seekers of directions." According to HBM, the construct of cues to actions refers to the stimulus cues that direct individuals to implement certain health behaviors (4). People from Germany and India used "like" to express their support and retweeted the relevant tweets to share them with their followers. The data indicated that, rather than focusing on a diagnosis of the disease or a justification of health measures, many German and Indian people have reached a conclusion that a health measure should be taken, and they were actively seeking a clear direction of "what to do" rather than "why to do it."

Interestingly, though both actively seeking for directions from the health departments against COVID-19, Indian citizens were more willing to support and share those tweets mentioning the directions of personal measures (e.g., washing hands, wearing masks) and social distancing measure, while German people only significantly liked and retweeted the tweets that called for taking personal measures. For health departments of Germany and India, keeping social distancing and taking personal measures were the two most frequently suggested actions (see Table 3), yet German people selectively reacted to the personal measures only. Our analysis illustrates that people's positive reactions to cues to actions did not mean that they supported all the health measures their health departments call for. Researchers need to pay attention to people's selective acceptance (or rejection) of certain health measures.

The U.S. and Japanese people as *seekers of justifications*

We named the last two groups, the Twitter users from the U.S. and Japan, as seekers of justifications. On the one hand, like German and Indian people, the U.S. and Japanese people positively reacted to the construct of cues to actions (directions); on the other hand, they were also seeking justifications for such directions during the first year since the COVID-19 outbreak. In the case of the U.S., people were likely to share and like the tweets that mentioned cues to actions of social distancing measures, taking personal measures, and pharmaceutical interventions. Meanwhile, they positively reacted to those tweets that explained the necessity of those actions, from "the possibility of infection with COVID-19" (susceptibility), "the benefits of health measures" (benefits), to "training or guidance on how the health measures can be successfully implemented" (self-efficacy). People in Japan positively reacted to the tweets that urged them to take personal measures against COVID-19, and those tweets that mentioned the benefits of the health measures.

In sum, we used HBM to characterize sampled people in six different countries, based on their reactions to the health promotion tweets posted by the health department in each country. We found that overall speaking, the people in Germany, India, the U.S., and Japan were more on the "convinced side" since they positively reacted to those clear directions of "what to do against COVID-19"; Yet the U.S. and Japan were also eager to know the justifications of such directions, to know "why to do it." People in South Korea and the U.K. were still seeking a diagnosis, instead of health measures, of COVID-19. We also found that people from six countries responded differently to the health measures that health departments suggested. For example, all the health departments promoted a social distancing policy and took personal measures using the construct of cues to actions; however, only people from two countries (the U.S. and India) actively reacted to such measures. It is very clear from the data that the social distancing policy is more controversial and debatable.

This study has several limitations that could be addressed by future research. First, to make the countries comparable, we drew our sample from the six countries with the highest GDPs. Countries with low GDPs were overlooked in our study. Future studies could compare the difference between countries high in GDP and those with low GDP to see whether the HBM constructs also apply to countries low in GDP. Second, the study focused on those who would consider the views of the health departments. Those who distrusted

health departments would not have even followed their official Twitter accounts or paid attention to the departments' suggestions. This is the missing piece of the puzzle of the current study, and we call for future studies to consider how to include those people in the research. Third, this study only sampled 1,200 tweets from health departments in six countries. Future research can expand the sample size of each country and include more countries in the analysis.

Conclusion

HBM was once regarded as an "outdated" theory (22), an old-fashioned behavioral model that predicts health behaviors in surveys. However, this study proved that HBM worked well in the digital media era, which can sketch the health measures promoted by the policymakers, evaluate the *specific* health promotion strategies that the policymakers use to promote the health measures and profile the people exposed to the health promotion. This study also broadened the use of HBM, providing a comprehensive framework for future big data research to examine health promotion.

Implications for policymakers

Policymakers can implement HMB to understand the public and review the effectiveness of their promotion strategies, knowing the needs of their people more efficiently. Based on HBM, policymakers can quickly locate the needs (those HBM constructs that are mostly liked and retweeted) and doubts (those constructs that are ignored and less liked) of the citizens and rebuild their promotion strategies swiftly. We call for policymakers to pay specific attention to the "gap" between the health measures they have released and the echoes from the public, finding out the health measures that are not positively received by their people. In this way, policymakers can further improve their health promotion strategies.

Data availability statement

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

Author contributions

ZM and DW conceived the idea of the research, collected and analyzed the data, and prepared the first and subsequent drafts. SZ participated in data collection and analysis. All authors contributed to the article and approved the submitted version.

Funding

This research was supported by the Humanity and Social Science Youth Fund of Ministry of Education of the People's Republic of China (grant number: 20C10590040) to ZM.

Conflict of interest

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

Publisher's note

References

1. Wang D, Mao Z. A comparative study of public health and social measures of COVID-19 advocated in different countries. *Health Policy.* (2021) 125:957–71. doi: 10.1016/j.healthpol.2021.05.016

2. Ansell B, Cansunar A, Elkjaer MA. Social distancing, politics and wealth. *West Eur Polit.* (2021) 44:1283–313. doi: 10.1080/01402382.2021.1917154

3. Purnama SG, Susanna D. Hygiene and sanitation challenge for COVID-19 prevention in Indonesia. *Kesmas.* (2020) 6–13. doi: 10.21109/kesmas.v15i2.3932

4. Becker MH, Rosenstock IM. Compliance with medical advice. *Health Care Hum Behav.* (1984) 175–208.

5. Rosenstock IM. Historical origins of the health belief model. *Health Educ Monogr.* (1974) 2:328–35. doi: 10.1177/109019817400200403

6. Janz NK, Becker MH. The health belief model: a decade later. *Health Educ Q.* (1984) 11:1–47. doi: 10.1177/109019818401100101

7. Barattucci M, Pagliaro S, Ballone C, Teresi M, Consoli C, Garofalo A, et al. Trust in science as a possible mediator between different antecedents and COVID-19 booster vaccination intention: an integration of health belief model (HBM) and theory of planned behavior (TPB). *Vaccines.* (2022) 10:1099. doi: 10.3390/vaccines10071099

8. Daragmeh A, Sági J, Zéman Z. Continuous intention to use e-wallet in the context of the covid-19 pandemic: Integrating the health belief model (hbm) and technology continuous theory (tct). *J Open Innovat Technol Market Comp.* (2021) 7:132. doi: 10.3390/joitmc7020132

9. Sheppard J, Thomas CB. Community pharmacists and communication in the time of COVID-19: applying the health belief model. *Res Soc Administr Pharm.* (2021) 17:1984–7. doi: 10.1016/j.sapharm.2020.03.017

10. Diddi P, Lundy LK. Organizational Twitter use: content analysis of Tweets during breast cancer awareness month. *J Health Commun.* (2017) 22:243–53. doi: 10.1080/10810730.2016.1266716

11. Meadows CZ, Tang L, Liu W. Twitter message types, health beliefs, and vaccine attitudes during the 2015 measles outbreak in California. *Am J Infect Control.* (2019) 47:1314–8. doi: 10.1016/j.ajic.2019.05.007

12. Du J, Luo C, Wei Q, Chen Y, Tao C. Exploring difference in public perceptions on HPV vaccine between gender groups from Twitter using deep learning. In: *Paper Presented at the KDDS Health 2019 Conference.* Anchorage, AK (2019).

13. Wang H, Li Y, Hutch M, Naidech A, Luo Y. Using tweets to understand how COVID-19–related health beliefs are affected in the age of social media: Twitter data analysis study. *J Med Internet Res.* (2021) 23:e26302. doi: 10.2196/26302

14. Guidry JP, O'Donnell NH, Meganck SL, Lovari A, Miller CA, Messner M, et al. Tweeting a pandemic: communicating# COVID19 across the globe. *Health Commun.* (2022) 1–10. doi: 10.1080/10410236.2022.2071192

15. Tang L, Liu W, Thomas B, Tran HT, Zou W, Zhang X, et al. Texas public agencies' tweets and public engagement during the COVID-19 pandemic: natural

language processing approach. *JMIR Public Health Surveill.* (2021) 7:e26720. doi: 10.2196/26720

16. Vermandere H, van Stam MA, Naanyu V, Michielsen K, Degomme O, Oort F. Uptake of the human papillomavirus vaccine in Kenya: testing the health belief model through pathway modeling on cohort data. *Global Health.* (2016) 12:1–13. doi: 10.1186/s12992-016-0211-7

17. Wang D, Lu J. How news agencies' Twitter posts on COVID-19 vaccines attract audiences' Twitter engagement: a content analysis. *Int J Environ Res Public Health.* (2022) 19:2716. doi: 10.3390/ijerph19052716

18. Hawelka B, Sitko I, Beinat E, Sobolevsky S, Kazakopoulos P, Ratti C. Geo-located Twitter as proxy for global mobility patterns. *Cartogr Geogr Inf Sci.* (2014) 41:260–71. doi: 10.1080/15230406.2014.890072

19. International Monetary Fund. *GDP, Current Prices*. List (2020). Available online at: https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEOWORLD/APQ/MAE (accessed November 1, 2022).

20. Glanz K. *Theory at a Glance: A Guide for Health Promotion Practice. NIH Publication No. 97-3896*. US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Cancer Institute (1997).

21. Laerd Statistics (2022). *Mann-Whitney U Test Using SPSS Statistics*. Available online at: https://statistics.laerd.com/spss-tutorials/mann-whitney-u-test-using-spss-statistics.php (accessed November 1, 2022).

22. Washington TA, Meyer-Adams N, Anaya S. Eradicating Perinatal HIV transmission is possible: a model for social work practitioners. *Health Soc Work.* (2009) 34:149–52. doi: 10.1093/hsw/34.2.149

frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 13 February 2023
DOI 10.3389/fpsyt.2023.1100849

OPEN ACCESS

EDITED BY
Mohammadreza Shalbafan,
Iran University of Medical Sciences,
Iran

REVIEWED BY
K. Valsraj,
South London and Maudsley NHS Foundation Trust,
United Kingdom
Saeed Ahmed,
Rutland Regional Medical Center,
United States
Muhammad Ali Equatora,
Politeknik Ilmu Pemasyarakatan,
Indonesia

*CORRESPONDENCE
Yufang Bi
✉ byf10784@rjh.com.cn
Hanbing Shang
✉ hjshb@126.com
Erzhen Chen
✉ chenerzhen@hotmail.com

†These authors have contributed equally to this work

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

RECEIVED 17 November 2022
ACCEPTED 18 January 2023
PUBLISHED 13 February 2023

CITATION
Yu P, Bian X, Xie Z, Wang X, Zhang X, Gu Z, Yang Z, Jing F, Qiu W, Lin J, Tang J, Huang C, Zhang Y, Chen Y, Zhang Z, Bi Y, Shang H and Chen E (2023) Risk factor analysis of omicron patients with mental health problems in the Fangcang shelter hospital based on psychiatric drug intervention during the COVID-19 pandemic in Shanghai, China.
Front. Psychiatry 14:1100849.
doi: 10.3389/fpsyt.2023.1100849

Risk factor analysis of omicron patients with mental health problems in the Fangcang shelter hospital based on psychiatric drug intervention during the COVID-19 pandemic in Shanghai, China

Ping Yu[1†], Xiaolan Bian[1†], Zhihui Xie[2†], Xu Wang[3], Xujing Zhang[4], Zhidong Gu[5], Zhitao Yang[6], Feng Jing[6], Weiyu Qiu[1], Jingsheng Lin[7], Jie Tang[7], Chen Huang[6], Yibo Zhang[8], Ying Chen[6], Zongfeng Zhang[9], Yufang Bi[10]*, Hanbing Shang[5,11]* and Erzhen Chen[6]*

[1]Department of Pharmacy, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [2]Department of Medical Affairs, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Department of Asset Management, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [4]Department of Foreign Cooperation and Development, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [5]Ruijin-Hainan Hospital, Shanghai Jiao Tong University School of Medicine, Bo'ao Research Hospital, Qionghai, Hainan, China, [6]Department of Emergency, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [7]Department of Disciplinary Development and Planning, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [8]Department of Hospital-infection Control, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [9]Department of Psychiatry, Ningbo Kangning Hospital, Ningbo, Zhejiang, China, [10]Department of Endocrine and Metabolic Diseases, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [11]Department of Neurosurgery, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Backgrounds: The widespread coronavirus disease 2019 (COVID-19) outbreak impacted the mental health of infected patients admitted to Fangcang shelter hospital a large-scale, temporary structure converted from existing public venues to isolate patients with mild or moderate symptoms of COVID-19 infection.

Objective: This study aimed to investigate the risk factors of the infected patients from a new pharmacological perspective based on psychiatric drug consumption rather than questionnaires for the first time.

Methods: We summarised the medical information and analysed the prevalence proportion, characteristics, and the related risk factors of omicron variants infected patients in the Fangcang Shelter Hospital of the National Exhibition and Convention Center (Shanghai) from 9 April 2022 to 31 May 2022.

Results: In this study, 6,218 individuals at 3.57% of all admitted patients in the Fangcang shelter were collected suffering from mental health problems in severe conditions including schizophrenia, depression, insomnia, and anxiety who needed psychiatric drug intervention. In the group, 97.44% experienced their first prescription of psychiatric drugs and had no diagnosed historical psychiatric diseases. Further analysis indicated that female sex, no vaccination, older age, longer hospitalization time, and more comorbidities were independent risk factors for the drug-intervened patients.

Conclusion: This is the first study to analyse the mental health problems of omicron variants infected patients hospitalised in Fangcang shelter hospitals. The research demonstrated the necessity of potential mental and psychological service development in Fangcang shelters during the COVID-19 pandemic and other public emergency responses.

KEYWORDS

COVID-19, mental health, psychiatric drugs intervention, Fangcang shelter hospital, public health

1. Introduction

The new coronavirus disease 2019 (COVID-19) has become a global public health emergency which was declared a concern by the World Health Organization (WHO) (1). The omicron variant of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused the disease to evolve into a serious epidemic outbreak; it spread quickly around Shanghai in March 2022, with more than 60,000 confirmed positive infected patients by 31 May 2022. The government implemented efficient strategies, such as quick isolation, screening, and rebuilding Fangcang shelter hospital, to protect public health in a timely manner, prevent the spread of the virus, and manage infected people (2).

Fangcang shelter hospital, one of the effective countermeasures, played a powerful role in preventing and controlling (3) which were first implemented as a novel public health concept during the Hubei COVID-19 medical rescue in 2020 (4). Fangcang shelter hospitals concept were originally brought from the military field hospitals as the temporary medical facilities for public health emergencies control. These structures were mostly converted from stadiums, exhibition halls, and other public venues supplying medical services such as infection isolation, disease monitoring and treatment, food supply, and social activities provision. Fangcang shelter hospitals were constructed to supply service for the infected patients with mild or moderate symptoms who are isolated from their families or communities. In the first COVID-19 pandemic of Wuhan, Fangcang shelter hospitals showed have been proven to be the most effective and timely way to prevent virus transmission and control the infection outbreak rapidly (5, 6). These experiences supplied a certain basis for the controlling subsequent infections outbreak. During the COVID-19 pandemic, Shanghai quickly constructed large scale Fangcang shelter hospitals to response to the omicron variant of the COVID-19 pandemic.

The National Exhibition and Convention Center (Shanghai) Fangcang hospital was the largest one designed to accommodate 46,872 beds, which received 174,308 infections from 9 April 2022 to 31 May 2022, and all the infected patients were cured to discharge or transferred to designated hospitals. Such a large number of infected patients required comprehensive attention.

Evidence shows that the occurrence of major public health events like severe acute respiratory syndrome (7, 8) and Ebola virus disease caused not only physical implications but also mental health problems (9). Similarly, people of varied backgrounds affected by COVID-19 reportedly suffered from a burden of psychological problems (10, 11). The impact of COVID-19 on patients' psychology has caused an international concern (12). Based on questionnaires, previous studies in Wuhan Fangcang shelter hospitals reported that many admitted patients faced anxiety, depression, insomnia, perceived stress, post-traumatic stress symptoms, and so on (13, 14).

Compared with the Wuhan variant of SARS-Cov-2, omicron variants in Shanghai had lower mortality or severity rate. However, it caused a larger-scale pandemic with higher rate of infection, faster spread, and stronger stealthiness which greatly influenced people's daily life. Before being admitted to the Fangcang shelter hospitals, the normal life of infected patients was disrupted due to the prolonged home quarantine and imposed lockdown of the government. Mental health outcomes, including anxiety, depression, and sleep disorders, were reported to exist extensively among individuals because of inadequate information, life supplies, fears of infection, and boredom (15, 16).

After being admitted, infected patients experienced the temporarily built public environment, which was quite different from the usual hospitals, such as excessive noise, interfering light, and decreased privacy. Further, they had to suffer from the feeling of being separated from family and adapting to a new and strange environment. Some of them often got bothered and felt a lack of hope due to uncertain treatment or outcomes, although their symptoms were mild and moderate (15). Fangcang shelter hospitals could only supply basic medical care and treatment for infected patients with a history of diseases. The facilities were not as comprehensive in meeting patients' personalised medical needs as the traditional hospitals due to limited medical drugs and instruments. In addition, the family members of infected patients might have had a high risk of infection. These unstable factors could impact the mental health of infected patients and stimulate psychiatric problems of anxiety, depression, or sleep disorders.

Studies have reported different proportions of infected people facing mental health problems in Fangcang shelter hospitals. Patients with severe mental health problems, including psychiatric or psychological disorders, need certain interventions, while most infected persons with mild symptoms could recover autonomously without intervention. All previous studies reported high morbidity of mental health problems in Fangcang shelter hospitals such as the Wuhan Fangcang, based on a questionnaire or assessment scales and analysis with limited data and samples. As a new variant, the characteristics of omicron variant are very different with an unprecedented outbreak in Shanghai. Characters of infected patients might vary as the relatively common accepted vaccination. However, little efforts have been denoted to the mental health problems of omicron variant of SARS-CoV-2 infected people in Fangcang shelter hospitals. This is important since it can help us better understand omicron infection and find the appropriate solution to deal with it. On the other hand, all previous studies are based on a questionnaire or assessment scales with the advantages of economy, easy to operate, and cost-saving. However, the study based on a questionnaire or assessment scales has a strong subjectivity and possesses inevitably defects. First, questionnaire survey is difficult to design comprehensively. Second, the low recovery rate will affect its representativeness. Third, the quality of the acquired information cannot be guaranteed. When respondents fill in the questionnaire, they may give an estimated answer or avoid the essential things, which affects the accuracy of information. Currently, adopting a pharmacological approach according to the drug consumption is more objective. What's more, serious mental health problems might cause prolonged effect on the patient's later life or work, or even irreversible. Additionally, the potential risk factors for infected patients with mental health problems in severe conditions proposed by the reported articles were not comprehensive enough. This study aims to evaluate the mental health outcomes of COVID-19 infected patients in Fangcang shelter hospitals according to psychiatric drug consumption and analyse the associated potential risk factors. The infected individual facing mental health challenges was analyzed from a pharmacological perspective based on drug intervention, which has not been reported previously. This study could provide some evidence of the necessity of timely mental health services for targeted populations in Fangcang management shelter hospitals and policy development during the COVID-19 epidemic.

2. Methods

The National Exhibition and Convention Centre of Shanghai Fangcang Shelter Hospital were constructed as a temporary medical building for the admission and hospitalisation of infected patients with moderate and mild COVID-19 symptoms. It received 174,308 infected patients from 9 April 2022 to 31 May 2022. The infected patients were cured to discharge or transferred to a designated hospital for treatment with severe symptoms. The information of infected patients who used the drugs as listed (risperidone, olanzapine, quetiapine, paroxetine, sertraline, venlafaxine, flupentixol-melitracen, escitalopram oxalate, zolpidem tartrate, estazolam) was collected as the drug intervention group. Patients diagnosed of schizophrenia were mainly prescribed with risperidone, olanzapine and quetiapine. For depression diagnosis, patients were prescribed with paroxetine, sertraline, venlafaxine, flupentixol-melitracen or escitalopram oxalate according their individual specific symptom. Patients with insomnia were prescribed with zolpidem. And patients with symptoms of anxiety or sleep disorders were intervened with estazolam. The information was integrated when the infected individual used different drugs were classified listed as schizophrenia, depression, insomnia, anxiety or sleep disorder according to the symptom severity from severe to mild. A total of 6,218 individuals treated with the list drugs in the Fangcang shelter hospital were processed. Simultaneously, information of a corresponding comparable control group of 30,000 infected patients who has no listed psychiatric drug intervention was randomly drawn out based on the number of patients in the drug intervention group.

2.1. Statistical analysis

All the data were analysed using SPSS version 22 (IBM, Armonk, NY, United States) or GraphPad Prism version 8.0.0 (GraphPad Software, San Diego, CA, United States). Continuous data of hospitalized time for normal variables were quantitatively analysed and presented as mean ± standard deviation. The univariate analysis to study the affected factors was performed using the chi-squared (χ^2) test. All factors with $p < 0.05$ in the univariate analyses were included in the multivariate analysis. The multivariate logistic regression analyses were performed to identify the independent factors using stepwise variable selection. A $p < 0.05$ was considered statistically significant.

3. Results

3.1. Prevalence of infected patients requiring psychiatric drugs intervention

A total of 6,218 infected persons who used associated psychiatric drugs were included in the study, making up 3.57% of all the admissions (6,218 of 174,308 infected patients) in the National Convention and Exhibition Centre of Shanghai Fangcang Shelter Hospital of China from 9 April 2022 to 31 May 2022. Among the patients whose data were collected, 3.20% needed drugs to treat schizophrenia, such as risperidone, olanzapine, and quetiapine, with 3.07% being prescribed these drugs for the first time. Further, 1.88% needed drugs to control depression, such as paroxetine, sertraline, venlafaxine, flupentixol-melitracen, and escitalopram. 54.76% needed zolpidem to treat insomnia, with 53.51% having no such previous prescriptions. Likewise, 40.16% needed estazolam to treat anxiety and sleep disorders, with 38.10% being prescribed these drugs for the first time. 3.46% had a history of psychiatric disease (see Table 1). The most common symptom in the group of infected patients associated with COVID-19 was cough, at 13.77% (844 of 6,128 infected patients intervened with psychiatric drugs), followed by subsequent sputum and fever at 8.99% (551 of 6,128) and 4.96% (304 of 6,128), respectively, shown separately in Figure 1A. As shown in Figure 1B, the top three current comorbidities were hypertension at 17.02% (1,043 of 6,128 infected patients intervened with psychiatric drugs), diabetes at 6.38% (391 of 6,128), and coronary disease at 4.80% (294 of 6,128).

TABLE 1 The prevalence of infected patients needing administration of associated psychiatric drugs.

psychiatric drugs	*n* (%)	diagnosis	First prescription (*n*, %)
risperidone	5 (0.08)	schizophrenia	191 (3.07)
olanzapine	34 (0.55)		
quetiapine	160 (2.57)		
paroxetine	32 (0.51)	depression	116 (1.87)
sertraline	27 (0.43)		
venlafaxine	21 (0.34)		
flupentixol-melitracen	31 (0.50)		
escitalopram	6 (0.10)		
zolpidem	3,405 (54.76)	insomnia	3,327 (53.51)
estazolam	2,497 (40.16)	anxiety or sleep disorder	2,369 (38.10)

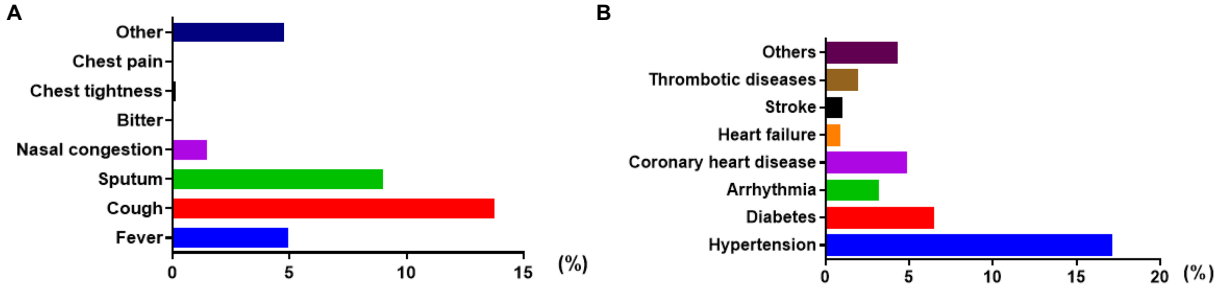


FIGURE 1
General characteristics of physical symptoms and distribution of comorbidities in infected patients treated with associated psychiatric drugs. **(A)** proportion of COVID-19 symptoms. **(B)** proportion of comorbidities.

3.2. Patient characteristics

The demographic and clinical characteristics of the treated patients with mental health problems in severe conditions who needed drug intervention were analysed. Similar information of 30,000 patients with no psychiatric drug intervention was randomly drawn out as the comparable control group according to the number of patients in the intervention group. For the group with mental health problems intervened using psychiatric drugs, the prevalence was high among patients who are females (51.57%, 3,160), older (18–44 years, 25.90%, 1,587; 45–59 years, 31.74%, 1,945; ≥60 years, 43.15%, 2,644), unmarried (single, 4,382, 71.51%; divorced, 160, 2.61%; widowed, 127, 2.07%), unvaccinated (2,099, 34.25%), and had more comorbidities (1,848, 13.84%; ≥2,638, 10.41%). The intervention group had a longer hospitalisation time of 9.98 days compared with the control group of 7.29 days. Additional details of data among different groups are shown in Table 2. Statistic results indicated the related factors of infected patients in the psychiatric drug intervention group, including sex, age, marital status, occupation, hospitalisation time, number of concomitant physical symptoms of COVID-19, vaccination, and number of comorbidities based on covariates with $p < 0.05$.

3.3. Risk factors for infected patients with psychosomatic problems needing drug intervention

The risk factors for infected patients with mental health problems needing psychiatric drug intervention were analysed and presented in Table 3. Sex and vaccination were analysed as categorical variables, while age, hospitalisation time, and comorbidities were analysed as continuous variables. The results of multivariate logistic regression analyses showed that female sex (odds ratio [OR], 1.502; 95% confidence interval [CI] 1.414 to 1.596; $p < 0.0001$), older age (OR, 2.2331; 95% CI, 2.146 to 2.321; $p < 0.0001$), longer hospitalisation time (OR, 1.186; 95% CI, 1.177 to 1.195; $p < 0.0001$), no vaccination (OR, 1.217; 95% CI, 1.139 to 1.301; $p < 0.0001$), and more comorbidities (OR, 1.106; 95% CI, 1.060 to 1.153; $p < 0.0001$) were independent risk factors for infected persons

TABLE 2 Characteristics of the sample in different groups.

Characteristic	No drug intervention	drug intervention	χ^2	Value of p
Sex, *n* (%)			237.512	<0.0001
Female	12,066 (79.25)	3,160 (20.75)		
Male	17,934 (85.43)	3,058 (14.57)		
Age, *n* (%)			3387.812	<0.0001
<=18	1,518 (97.31)	42 (2.69)		
18–44	15,366 (90.64)	1,587 (9.36)		
45–59	9,158 (82.48)	1945 (17.52)		
≥60	3,958 (59.95)	2,644 (50.05)		
Marital status, *n* (%)			439.503	<0.0001
Single	17,614 (80.08)	4,382 (19.92)		
Married	11,338 (87.98)	1,549 (12.02)		
Divorced	762 (82.65)	160 (17.35)		
Widowed	286 (69.24)	127 (30.75)		
Occupation, *n* (%)			2038.747	<0.0001
self-employed individual	721 (84.82)	129 (15.18)		
worker	4,713 (87.78)	656 (12.22)		
farmer	1,286 (82.65)	270 (17.35)		
business manager	10,481 (83.32)	2098 (16.68)		
retire (leave) personnel	741 (87.18)	109 (12.82)		
jobless people	892 (82.9)	184 (17.1)		
student	1,371 (96.08)	56 (3.92)		
office clerk	4,263 (88.46)	556 (11.54)		
professionals	1,084 (87.7)	152 (12.3)		
freelance	1804 (87.62)	255 (12.38)		
others	2,644 (60.13)	1753 (39.87)		
Vaccination times, *n* (%)			277.638	<0.0001
0	7,163 (77.34)	2099 (22.66)		
≥1	22,837 (84.72)	4,119 (15.28)		
Co-symptoms, *n* (%)			9.963	0.0189
0	24,035 (82.61)	5,061 (17.39)		
1	2,840 (84.5)	521 (15.5)		
2	2,143 (83.71)	417 (16.29)		
≥3	982 (81.77)	219 (18.23)		
Comorbidities, *n* (%)			674.175	<0.0001
0	26,521 (84.86)	4,732 (15.14)		
1	2,155 (71.76)	848 (28.24)		
≥2	1,324 (67.48)	638 (32.52)		
Hospitalized time, *n* (Mean ± SD)			*F*	Value of p
	30,000 (7.29 ± 3.13)	6,218 (9.98 ± 4.36)	3270.477	<0.0001

TABLE 3 Multivariate logistic regression analysis of risk factors influencing psychiatric drug use.

Variables	B	SE	Walds	Value of *p*	OR (95% CL)
Sex (female/male Ref)	0.407	0.031	175.155	<0.0001	1.502 (1.414 to 1.596)
Age (≥60/45–59/19–44/≤18 Ref)	0.803	0.020	1612.943	<0.0001	2.231 (2.146 to 2.321)
Hospitalized time	0.171	0.004	1783.959	<0.0001	1.186 (1.177 to 1.195)
Vaccination (0/≥1 Ref)	0.197	0.034	33.894	<0.0001	1.217 (1.139 to 1.301)
Comorbidities (≥2/1/0 Ref)	0.100	0.022	21.548	<0.0001	1.106 (1.060 to 1.153)

B, Partial regression weight; SE, Standard error.

hospitalised in the Fangcang shelter with mental health problems in severe conditions needing psychiatric drug intervention.

4. Discussion

To our knowledge, this is the first study analysing mental health problems of COVID-19 infected patients hospitalised in Fangcang shelter hospitals from a new perspective based on psychiatric drug intervention. This study aimed to evaluate the characteristics of COVID-19 infected patients with mental health in Fangcang shelter hospitals according to psychiatric drug consumption, analyse the associated potential risk factors, and eventually explore the necessity of developing mental health services timely for targeted populations in Fangcang management shelter hospitals and policy development during the COVID-19 epidemic. A previous study indicated a more severe level of mental health problems in the Fangcang shelter than the norm. However, severe mental health situations requiring drug interventions have not been previously reported. In this study, we found that 3.57% of all admitted infected patients in the Fangcang shelter hospital needed antipsychotic drugs intervention to treat mental health problems, including schizophrenia, depression, insomnia, and anxiety or sleep disorder. This indicated a more severe situation of mental health of the COVID-19 infected patients admitted to Fangcang shelter hospitals. Among them, 96.54% had no medical history of psychiatric diseases before. Further study revealed that female sex, no vaccination, older age, longer hospitalisation time, and more comorbidities were independent risk factors for hospitalised infected patients with mental health problems in severe conditions needing drug intervention. Though intervention of mental health problem involved in various aspects, it's an intuitional way to analyze the information according to the psychiatric drugs which has not been reported previously. Understanding the situation of psychiatric drug consumption provided a new insight into the mental health impact of the COVID-19 pandemic on the patients with confirmed positive infected patients in Fangcang shelter hospitals. This may provide evidence for the necessity of potential development of an improvement of psychiatry service for COVID-19 infected patients in Fangcang shelter hospitals or norms during the occurrence of public health emergencies.

Public emergency events could generally cause mental health problems. Globally, the WHO estimated that a disaster resulted in diverse mental health problems for 30–50% of the population (17). Since 30 January 2020, the COVID-19 pandemic has been declared a worldwide public health emergency by the WHO, which was considered an international concern (18). Numerous studies reported that people who experienced COVID-19 infection were at high risk of having mental health challenges such as anxiety, depression, sleep disorder, and even post-traumatic stress disorder. The prevalence of mental health problems existed in confirmed or suspected patients and the general public during the COVID-19 pandemic, while patients with COVID-19 had a higher risk of mental health problems than others (19).

Infected people admitted to Fangcang shelters needed psychiatric drug intervention, which might have had serious consequences, since they faced mental health problems that could not be alleviated *via* any other measures. The current study was generally based on questionnaires, while no study has been reported from the drug intervention perspective. For infected patients diagnosed with serious psychiatric symptoms, such as uncontrolled anxiety or insomnia, the corresponding drugs would be needed (14, 20). In this study, we collected data on all the infected patients who used related psychiatric drugs. These patients may face with severe mental health problem which could lead to prolonged influence for their later life. Results showed that most infected patients facing sleep disorders or anxiety were treated with zolpidem at 54.76% and estazolam at 40.16%. Others were diagnosed with schizophrenia at 3.20% using risperidone, olanzapine, and quetiapine, and depression at 1.88% using paroxetine, sertraline, venlafaxine, flupentixol-melitracen, and escitalopram. A small percentage (3.46%) of infected patients also had basic psychiatric diseases. However, Hao et al. found that psychiatric patients suffered worse physical health and were more susceptible to psychiatric illnesses, such as post-traumatic stress disorder, severe insomnia, depression, anxiety, and stress (21). Further, 96.54% had no diagnosed history of psychiatric disease and 5.08% of cases needed definite antidepressant or anti-schizophrenia drugs, which confirmed the severity of negative mental health impact on infected persons admitted to the Fangcang shelter during the COVID-19 epidemic.

Public health emergencies were the initial and immediate reasons for people experienced psychiatric or psychological health problems. People suffered from irrational nervousness or were scared that the omicron variant of SARS-CoV-2 would cause a life-threatening epidemic disease based on the acknowledgment of the virus in Wuhan (22), while receiving little information on the omicron variant in Shanghai at the beginning of its outbreak. Although it is reported that omicron variant caused significantly lower hospitalisation incidence, shorter hospitalisation time, and less severe admission and fatality rate than any other variants, the risk perception of people was aroused due to the extremely wide eruption of multiple mutations of the omicron variant which resulted in its significant immune escape and unprecedented rapid spread (23, 24).

In addition, large numbers of infected patients have been placed into a longer quarantine isolation or social distancing to control the transmission of the epidemic before admission, which was identified to cause a high risk of mental health problems (16, 25, 26). Unlike the traditional hospital, the large-scale Fangcang shelter hospitals were mostly temporary structures with limited medical conditions and a lack of expected care because of insufficient healthcare workers (13, 27). Infected persons struggled with lifestyle changes and could not adapt to hospital life in the new environment. Patients admitted to Fangcang shelter hospitals may have experienced mental health problems such as loneliness, anger, anxiety, depression, insomnia due to separation from family, perception of uncertain physical discomfort, fear of bad prognosis or uncertain recovery, worry about family members' infection

risk, as well as exposure to negative media coverage. All of these were sources of severe mental health problems for admitted patients, which might have ultimately negatively affected their life quality and social function (14, 28, 29).

Our multivariate logistic regression analysis revealed that female sex was a risk factor for infected patients with severe mental health problems needing drug intervention. The result was in line with a few empirical studies on higher susceptibility and prevalence of mental health problems in women compared with men (30, 31). The COVID-19 pandemic has been reported to have a significantly bad impact on aged individuals, mainly owing to social isolation and health concerns (32–34). Older patients admitted to the Fangcang shelter were more likely to have been living alone and have felt sad when medical care or personalised medicine for their accompanied basic physical diseases was not satisfactory as in general hospitals (35). Thus, our results also showed that older age and more comorbidities are independent risk factors for psychological issues among infected patients as previous reported research (36, 37). Longer hospitalisation time was found to be another independent factor related to the use of psychiatric drugs. Patients may experience mental health problems owing to the uncertain outcome of the infection, anxiety about neighbours' discharge, and prolonged separation from family. Also, the worse mental health condition could delay the recovery of COVID-19 symptoms owing to the interaction between the two outcomes.

Vaccination with one or two doses has been proven to significantly reduce the severity rate of COVID-19 and protect against hospitalisation and mortality (38). Clinical studies report that booster dose vaccination reduces the symptomatic disease to mild and significant chances of recovery (39, 40). The knowledge of reported information could comfort people's anxiety to a certain degree. Thus, vaccination may indirectly positively affect the mental situation of patients admitted to the Fangcang shelter by reducing the risk of severe COVID-19. According to the statistics, the mental situation of the infected patients without vaccination was worser than that of patients with vaccination. Our study found that vaccination served as a protection from mental health problems resulting from infected patients which was in accordance with previous studies (41).

5. Limitations

This study analysed a large sample of infected persons with severe mental health problems based on the use of psychiatric drugs in the Fangcang shelter. However, the study is lack of the overall mental health situation of infected persons which can influence the analysis results. Questionnaires to evaluate the overall mental health situation are required for further investigation. This study was performed only in the National Convention and Exhibition Center (Shanghai) Fangcang hospital and is lack of representativeness. As temporal structures, the Fangcang shelter hospitals differ in the environment and level of medical care, and this could not be accounted for since our study was not multinational or multicenter. The long-term mental health outcomes of COVID-19 infected patients or the effectiveness of psychiatric drug interventions in mitigating these outcomes need to be investigate as well. Therefore, more related data among infected persons in other Fangcang shelter hospitals need to be collected and analysed. The mental health research in our study was conducted in a short time frame, and follow-up in future longitudinal studies is also needed. The conclusion of this study was analyzed and conducted based on the perceptual information of psychopharmacotherapy. Besides drug therapy, intervention modes of mental health also include psychotherapy, behavior therapy, health education and so on, which are needed to be explored by more studies. Other potential risk factors need further investigation because of the temporary emergency program with limited information collection, which may have influenced the results such as preexisting mental health conditions or social support.

6. Conclusion

This study identified the prevalence and characteristics of omicron variants infected patients with mental health problems in severe conditions using psychiatric drugs and analysed the risk factors among these individuals in the Fangcang shelter hospitals. Among them, most experienced sleep disorder or anxiety, needing zolpidem and estazolam intervention. Others needed drugs to treat schizophrenia or control depression symptoms. Female sex, older age, presence of more comorbidities, and longer hospitalisation time were independent risk factors. We also concluded that vaccination had a protective correlation with the mental health of these infected patients. Our findings provided in-depth consideration about the mental health problems of omicron variants infected patients in the Fangcang shelter hospitals, and demonstrated the necessity of intervention service development on public mental health to reduce the negative psychological impact of infected patients in Fangcang shelter hospitals during the COVID-19 pandemic and other public emergency responses.

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 Ruijin hospital affilited to Shanghai Jiaotong University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

EC, YB, and HS preformed the conception design. PY, HS, and XZ drafted the manuscript. JL, JT, ZY, FJ, YC, YZ, and WQ conducted data extraction. ZX, XW, and CH analysed the data. XB, ZZ, and ZG revised the final manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

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

Publisher's note

References

1. Araf, Y, Akter, F, Tang, YD, Fatemi, R, Parvez, MSA, Zheng, C, et al. Omicron variant of Sars-Cov-2: genomics, transmissibility, and responses to current Covid-19 vaccines. *J Med Virol*. (2022) 94:1825–32. doi: 10.1002/jmv.27588

2. Legido-Quigley, H, Asgari, N, Teo, YY, Leung, GM, Oshitani, H, Fukuda, K, et al. Are high-performing health systems resilient against the Covid-19 epidemic? *Lancet*. (2020) 395:848–50. doi: 10.1016/S0140-6736(20)30551-1

3. Chen, S, Zhang, Z, Yang, J, Wang, J, Zhai, X, Barnighausen, T, et al. Fangcang shelter hospitals: a novel concept for responding to public health emergencies. *Lancet*. (2020) 395:1305–14. doi: 10.1016/S0140-6736(20)30744-3

4. Peng, F, Tu, L, Yang, Y, Hu, P, Wang, R, Hu, Q, et al. Management and treatment of Covid-19: the Chinese experience. *Can J Cardiol*. (2020) 36:915–30. doi: 10.1016/j.cjca.2020.04.010

5. Zhu, W, Wang, Y, Xiao, K, Zhang, H, Tian, Y, Clifford, SP, et al. Establishing and managing a temporary coronavirus disease 2019 specialty Hospital in Wuhan. *Anesthesiology*. (2020) 132:1339–45. doi: 10.1097/ALN.0000000000003299

6. Pan, A, Liu, L, Wang, C, Guo, H, Hao, X, Wang, Q, et al. Association of Public Health Interventions with the epidemiology of the Covid-19 outbreak in Wuhan. *JAMA (Russkoe izd)*. (2020) 323:1915–23. doi: 10.1001/jama.2020.6130

7. MacDonald, PDM, Endres-Dighe, SM, Macoubray, AJ, and Shorey, JM. Majority of fortune 500 companies in 2018 did not recognize risk of epidemics such as COVID-19. *Front Public Health*. (2021) 9:726987. doi: 10.3389/fpubh.2021.726987

8. Dixit, S, Musa, A, Sillva, AB, Reddy, RS, Abohashrh, M, Kakaraparthi, VN, et al. The impact of post-traumatic stress of Sars-Cov-2 affliction on psychological and mental health of student survivors: cross sectional study. *Front Public Health*. (2022) 10:845741. doi: 10.3389/fpubh.2022.845741

9. Cenat, JM, Felix, N, Blais-Rochette, C, Rousseau, C, Bukaka, J, Derivois, D, et al. Prevalence of mental health problems in populations affected by the Ebola virus disease: a systematic review and meta-analysis. *Psychiatry Res*. (2020) 289:113033. doi: 10.1016/j.psychres.2020.113033

10. Hossain, MM, Tasnim, S, Sultana, A, Faizah, F, Mazumder, H, Zou, L, et al. Epidemiology of mental health problems in Covid-19: a review. *F1000Res*. (2020) 9:636. doi: 10.12688/f1000research.24457.1

11. Pfefferbaum, B, and North, CS. Mental health and the Covid-19 pandemic. *N Engl J Med*. (2020) 383:510–2. doi: 10.1056/NEJMp2008017

12. Zhou, SJ, Zhang, LG, Wang, LL, Guo, ZC, Wang, JQ, Chen, JC, et al. Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of Covid-19. *Eur Child Adolesc Psychiatry*. (2020) 29:749–58. doi: 10.1007/s00787-020-01541-4

13. Gu, Y, Zhu, Y, Xu, F, Xi, J, and Xu, G. Factors associated with mental health outcomes among patients with Covid-19 treated in the Fangcang shelter Hospital in China. *Asia Pac Psychiatry*. (2021) 13:e12443. doi: 10.1111/appy.12443

14. Zhang, GY, Liu, Q, Lin, JY, Yan, L, Shen, L, and Si, TM. Mental health outcomes among patients from Fangcang shelter hospitals exposed to coronavirus disease 2019: an observational cross-sectional study. *Chronic Dis Transl Med*. (2021) 7:57–64. doi: 10.1016/j.cdtm.2020.12.001

15. Hossain, MM, Sultana, A, and Purohit, N. Mental health outcomes of quarantine and isolation for infection prevention: a systematic umbrella review of the global evidence. *Epidemiol Health*. (2020) 42:e2020038. doi: 10.4178/epih.e2020038

16. Brooks, SK, Webster, RK, Smith, LE, Woodland, L, Wessely, S, Greenberg, N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet*. (2020) 395:912–20. doi: 10.1016/S0140-6736(20)30460-8

17. Brooks, S, Amlot, R, Rubin, GJ, and Greenberg, N. Psychological resilience and post-traumatic growth in disaster-exposed Organisations: overview of the literature. *BMJ Mil Health*. (2020) 166:52–6. doi: 10.1136/jramc-2017-000876

18. Lu, J, Zhao, M, Wu, QY, Ma, CY, Du, XD, Lu, XC, et al. Mental health needs of the COVID-19 patients and staff in the Fangcang shelter hospital: a qualitative research in Wuhan, China. *Glob Ment Health (Camb)*. (2021) 8:e33. doi: 10.1017/gmh.2021.23

19. Shi, L, Lu, ZA, Que, JY, Huang, XL, Liu, L, Ran, MS, et al. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. *JAMA Netw Open*. (2020) 3:e2014053. doi: 10.1001/jamanetworkopen.2020.14053

20. Yao, H, Chen, JH, and Xu, YF. Patients with mental health disorders in the Covid-19 epidemic. *Lancet Psychiatry*. (2020) 7:e21. doi: 10.1016/S2215-0366(20)30090-0

21. Hao, F, Tan, W, Jiang, L, Zhang, L, Zhao, X, Zou, Y, et al. Do psychiatric patients experience more psychiatric symptoms during Covid-19 pandemic and lockdown? A case-control study with service and research implications for Immunopsychiatry. *Brain Behav Immun*. (2020) 87:100–6. doi: 10.1016/j.bbi.2020.04.069

22. Zhou, F, Yu, T, Du, R, Fan, G, Liu, Y, Liu, Z, et al. Clinical course and risk factors for mortality of adult inpatients with Covid-19 in Wuhan, China: a retrospective cohort study. *Lancet*. (2020) 395:1054–62. doi: 10.1016/S0140-6736(20)30566-3

23. Ai, J, Zhang, H, Zhang, Y, Lin, K, Zhang, Y, Wu, J, et al. Omicron variant showed lower neutralizing sensitivity than other Sars-Cov-2 variants to immune sera elicited by vaccines after boost. *Emerg Microbes Infect*. (2022) 11:337–43. doi: 10.1080/22221751.2021.2022440

24. Mohsin, M, and Mahmud, S. Omicron Sars-Cov-2 variant of concern: a review on its transmissibility, immune evasion, reinfection, and severity. *Medicine (Baltimore)*. (2022) 101:e29165. doi: 10.1097/MD.0000000000029165

25. Yamamoto, T, Uchiumi, C, Suzuki, N, Yoshimoto, J, and Murillo-Rodriguez, E. The psychological impact of 'Mild Lockdown' in Japan during the Covid-19 pandemic: a Nationwide survey under a declared state of emergency. *Int J Environ Res Public Health*. (2020) 17:9382. doi: 10.3390/ijerph17249382

26. Talevi, D, Socci, V, Carai, M, Carnaghi, G, Faleri, S, Trebbi, E, et al. Mental health outcomes of the Covid-19 pandemic. *Riv Psichiatr*. (2020) 55:137–44. doi: 10.1708/3382.33569

27. Shang, L, Xu, J, and Cao, B. Fangcang shelter hospitals in Covid-19 pandemic: the practice and its significance. *Clin Microbiol Infect*. (2020) 26:976–8. doi: 10.1016/j.cmi.2020.04.038

28. Xiang, YT, Yang, Y, Li, W, Zhang, L, Zhang, Q, Cheung, T, et al. Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *Lancet Psychiatry*. (2020) 7:228–9. doi: 10.1016/S2215-0366(20)30046-8

29. Bo, HX, Li, W, Yang, Y, Wang, Y, Zhang, Q, Cheung, T, et al. Posttraumatic stress symptoms and attitude toward crisis mental health services among clinically stable patients with Covid-19 in China. *Psychol Med*. (2021) 51:1052–3. doi: 10.1017/S0033291720000999

30. Liu, N, Zhang, F, Wei, C, Jia, Y, Shang, Z, Sun, L, et al. Prevalence and predictors of Ptss during Covid-19 outbreak in China hardest-hit areas: gender differences matter. *Psychiatry Res*. (2020) 287:112921. doi: 10.1016/j.psychres.2020.112921

31. Almeida, M, Shrestha, AD, Stojanac, D, and Miller, LJ. The impact of the Covid-19 pandemic on Women's mental health. *Arch Womens Ment Health*. (2020) 23:741–8. doi: 10.1007/s00737-020-01092-2

32. Novais, F, Cordeiro, C, Camara Pestana, P, Corte-Real, B, Reynolds Sousa, T, Delerue Matos, A, et al. The impact of Covid-19 in older people in Portugal: results from the survey of health, ageing and retirement (share). *Acta Medica Port*. (2021) 34:761–6. doi: 10.20344/amp.16209

33. Sepulveda-Loyola, W, Rodriguez-Sanchez, I, Perez-Rodriguez, P, Ganz, F, Torralba, R, Oliveira, DV, et al. Impact of social isolation due to Covid-19 on health in older people: mental and physical effects and recommendations. *J Nutr Health Aging*. (2020) 24:938–47. doi: 10.1007/s12603-020-1500-7

34. Grolli, RE, Mingoti, MED, Bertollo, AG, Luzardo, AR, Quevedo, J, Reus, GZ, et al. Impact of Covid-19 in the mental health in elderly: psychological and biological updates. *Mol Neurobiol*. (2021) 58:1905–16. doi: 10.1007/s12035-020-02249-x

35. Zalsman, G, Stanley, B, Szanto, K, Clarke, DE, Carli, V, and Mehlum, L. Suicide in the time of Covid-19: review and recommendations. *Arch Suicide Res*. (2020) 24:477–82. doi: 10.1080/13811118.2020.1830242

36. Wong, SYS, Zhang, D, Sit, RWS, Yip, BHK, Chung, RY, Wong, CKM, et al. Impact of Covid-19 on loneliness, mental health, and health service utilisation: a prospective cohort study of older adults with multimorbidity in primary care. *Br J Gen Pract*. (2020) 70:e817–24. doi: 10.3399/bjgp20X713021

37. Bojdani, E, Rajagopalan, A, Chen, A, Gearin, P, Olcott, W, Shankar, V, et al. Covid-19 pandemic: impact on psychiatric care in the United States. *Psychiatry Res*. (2020) 289:113069. doi: 10.1016/j.psychres.2020.113069

38. Lopez Bernal, J, Andrews, N, Gower, C, Robertson, C, Stowe, J, Tessier, E, et al. Effectiveness of the Pfizer-Biontech and Oxford-Astrazeneca vaccines on Covid-19 related symptoms, hospital admissions, and mortality in older adults in England: test negative case-control study. *BMJ*. (2021) 373:n1088. doi: 10.1136/bmj.n1088

39. Andrews, N, Tessier, E, Stowe, J, Gower, C, Kirsebom, F, Simmons, R, et al. Duration of protection against mild and severe disease by Covid-19 vaccines. *N Engl J Med*. (2022) 386:340–50. doi: 10.1056/NEJMoa2115481

40. Bar-On, YM, Goldberg, Y, Mandel, M, Bodenheimer, O, Freedman, L, Kalkstein, N, et al. Protection of Bnt162b2 vaccine booster against Covid-19 in Israel. *N Engl J Med*. (2021) 385:1393–400. doi: 10.1056/NEJMoa2114255

41. Babicki, M, Malchrzak, W, Hans-Wytrychowska, A, and Mastalerz-Migas, A. Impact of vaccination on the sense of security, the anxiety of Covid-19 and quality of life among polish. A Nationwide Online Survey in Poland. *Vaccine*. (2021) 9:1444. doi: 10.3390/vaccines9121444

frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 23 February 2023
DOI 10.3389/fpubh.2023.1136152

OPEN ACCESS

EDITED BY
Mohammadreza Shalbafan,
Iran University of Medical Sciences, Iran

REVIEWED BY
Rui Liu,
Capital Medical University, China
Tianshu Zhou,
City University of Hong Kong, Hong Kong SAR, China
Burcu Küçükkaya,
Trakya University, Türkiye

*CORRESPONDENCE
Ang Li
✉ angli@bjfu.edu.cn

†These authors have contributed equally to this work and share first authorship

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

RECEIVED 02 January 2023
ACCEPTED 06 February 2023
PUBLISHED 23 February 2023

CITATION
Liu Z, Liu Y, Li A and Zhu T (2023) Nonlinear effects of pandemic uncertainty on depression, pandemic preventive behavior intentions, and positive life attitudes: Moderating effects of high and low uncertainty grouping. *Front. Public Health* 11:1136152. doi: 10.3389/fpubh.2023.1136152

Nonlinear effects of pandemic uncertainty on depression, pandemic preventive behavior intentions, and positive life attitudes: Moderating effects of high and low uncertainty grouping

Zeyu Liu[1,2†], Yun Liu[1,2,3†], Ang Li[4*] and Tingshao Zhu[1,2]

[1]Institute of Psychology, Chinese Academy of Sciences, Beijing, China, [2]Department of Psychology, University of Chinese Academy of Sciences, Beijing, China, [3]Dalian Vocational and Technical College, Dalian, China, [4]Department of Psychology, Beijing Forestry University, Beijing, China

Backgrounds: COVID-19 is difficult to end in a short time and people are still facing huge uncertainties. Since people's lives are gradually returning to normal, the sense of control and intolerance of uncertainty, which were mainly focused by past studies, are not specific to COVID-19 and will be more influenced by some factors unrelated to the pandemic. Therefore, they may be difficult to accurately reflect the individuals' perceptions of uncertainty. Besides, past research just after the outbreak mainly investigated people in high levels of uncertainty, we don't know the impact of uncertainties on individuals' psychological states when people gradually recovered their sense of control. To solve these problems, we proposed the concept of "pandemic uncertainty" and investigated its impact on people's daily lives.

Methods: During October 20, 2021 to October 22, 2021, this study obtained data about uncertainty, depression, positive attitude, pandemic preventive behavior intentions, personality, and social support from 530 subjects using convenient sampling. The subjects were all college students from the Dalian University of Technology and Dalian Vocational and Technical College. According to the distribution of uncertainty, we divided the dataset into high and low groups. Subsequently, by using uncertainty as the independent variable, the grouping variable as the moderating variable, and other variables as the control variables, the moderating effects were analyzed for depression, positive attitude, and pandemic preventive behavior intentions, respectively.

Results: The results showed that the grouping variable significantly moderate the influence of uncertainty on positive attitude and pandemic preventive behavior intentions but had no significant effect on depression. Simple slope analysis revealed that high grouping uncertainty significantly and positively predicted positive attitude and pandemic preventive behavior intentions, while low grouping effects were not significant.

Conclusion: These results reveal a nonlinear effect of pandemic uncertainty on the pandemic preventive behavior intentions and positive life attitudes and enlighten us about the nonlinear relationship of psychological characteristics during a pandemic.

KEYWORDS

normalized era of COVID-19, pandemic uncertainty, depression, positive life attitudes, preventive behavior intentions, nonlinear effects, orderly state of life, moderating effects

1. Introduction

Since the outbreak of COVID-19, the pandemic has never ended with the continuous variation of the virus. Nevertheless, most countries have long found a way to coexist with this pandemic, and their economies and societies are gradually returning to stable operation, instead of being stagnant as they were. Although people are used to living with a pandemic, the pandemic is like a sword of Damocles hanging over people's heads, and their lives are in great uncertainty (1–3). This uncertainty includes two aspects: (a) the uncertainty of the spread of the pandemic and of being infected; and (b) the uncertainty of the future development of the pandemic. As COVID-19 is difficult to eradicate in a short time, it is important to prevent COVID-19 from interfering with people's normal life (4). And exploring the impact of this uncertainty on psychological outcomes (like people's mental health, positive attitude toward life, and pandemic preventive behavior intentions) will help people to restore a healthy and orderly state of life.

Although previous studies have focused on this uncertainty, few studies have directly discussed this concept; they have focused more on similar concepts like a sense of control and intolerance of uncertainty. The sense of control is used to measure the extent to which individuals think they can influence events and situations in their lives (5, 6). People with higher sense of control usually think that they can decide what happens in their lives, while those with lower sense of control think that they can't decide anything (7). Besides, intolerance of uncertainty is used to measure an individual's ability to tolerate negative uncertainty (8, 9). People with higher levels of intolerance need to ensure the predictability of the future and tend to avoid unexpected events (10). During the pandemic period, a great deal of work has been done to explore the association of sense of control and intolerance of uncertainty with mental states. For example, (11) found that individuals with a lower sense of control had a greater psychological burden in pandemic-controlled areas; (12) found that teachers with lower sense of control were more strongly affected by acute stress symptoms (depression, anxiety, fear, etc.) triggered by the pandemic; A large number of studies also found that intolerance of uncertainty is a significant predictor of depression and anxiety (9, 13, 14).

However, in the "normalized era of pandemic", it may not be appropriate in continuing to adopt the concepts of sense of control and tolerance of uncertainty. Firstly, they are not specific to COVID-19. Most studies use general scales to measure, for example, (15) used the Sense of Control Scale (16), which asks individuals about the degree of controllability and predictability of important areas of their lives (9); used the Uncertainty Tolerance Scale (17), which is used to measure individuals' cognitive, emotional, and behavioral responses of individuals to uncertain situations. The results pay more attention to the sense of control and uncertainty tolerance in one's daily life rather than to the pandemic situation. At the beginning of the outbreak, people's daily lives was greatly affected by containment and isolation measures, and the out-of-control and uncertainty mainly came from the pandemic (18, 19); whereas, at present, people's lives are gradually returning to normal, and their sense of control and uncertainty will be more influenced by some factors unrelated to the pandemic (such as factors related to individuals' work, education, or children's development), which makes it difficult to accurately reflect individuals' perceptions of the spread of the pandemic and the uncertainty of their own infection. Secondly, they are more concerned with the current state of individuals, which cannot reflect their uncertainty about the future development of the pandemic. These reasons may lead to differences between the two concepts and the concept of epidemic specificity in their effects on epidemy-related behaviors and psychological states. For example, (20) found perceptions of COVID-19 uncertainty were not associated with vaccine intentions, but tolerance of uncertainty was significantly negatively correlated with vaccine intentions (21) broke down the uncertainty and found, it was the uncertainty from various information about viruses and outbreaks rather than other uncertainties, that had a significant predictive effect on people's acute stress disorder.

Considering the reasons and the evidence above, it is urgent to find a new concept that can accurately reflect people's uncertainty about the epidemic, which will help us to investigate the impact of the epidemic more accurately on the public's psychological state and formulate appropriate intervention measures to avoid wasting strained public resources. Therefore, we define "uncertainty about the pandemic" (hereafter uncertainty) to describe individuals' views on the uncertainty of the future development of the pandemic and the uncertainty of its spread of the pandemic and infection. Individuals with high uncertainty believe that there is a higher risk of pandemic spread and infection, and they are pessimistic about the future development of the pandemic. For people with a low level of uncertainty, the situation is just the opposite.

Another question is how to measure the impact of this uncertainty on people's normal lives from a psychological perspective. A direct measure is people's positive attitude toward life in the face of the pandemic. Studies have shown that a positive attitude to life can effectively guarantee the quality of

people's daily work (22), ensure people's social communication and interpersonal relationship (23), and alleviate the pain and negative impact of COVID-19 (24, 25). In addition, mental health is a vital part of a healthy life (19). In the first year of the outbreak of COVID-19, depression, anxiety, suicidal tendencies, and loneliness were on the rise all over the world (18, 19, 26). Although in the normalized era of pandemic, this trend has been eased to a certain extent (1, 27). However, it is still necessary to explore the impact of uncertainty on mental health to ensure people's normal life. Finally, with COVID-19 not yet eradicated, preventive behaviors such as wearing masks, disinfecting regularly, and reducing outings are gradually becoming part of people's daily routines (28). Therefore, exploring the influence of uncertainty on pandemic preventive behavior intentions not only guarantees people's daily lives but also has far-reaching significance to curb the spread of the pandemic situation.

Since uncertainty is a new concept, it is necessary to figure out how uncertainty affect people's positive attitude toward life, mental health, and behavioral tendencies toward pandemic prevention. Evidence from a large number of related concepts shows that people's sense of control and tolerance of uncertainty during a pandemic is an important predictor of mental health problems such as depression, anxiety, and suicidal tendencies (9, 12, 14, 18, 26). In turn, losing control can lead to the individual's strong desire to regain a sense of control, which will lead to impulse consumption (29), addictive social media use (15), and more frequent protective behaviors (30). However, it should be noted that after the outbreak of the epidemic, people's sense of control was generally reduced (31), which indicated that people were in a special state of stress (31). Although many meaningful results were obtained in this period, the research explored the relationship between people's mental state and sense of control under stress. In the normalized era of pandemic, although some people were still at a low level of control, a considerable number of people gradually recovered their sense of control. Detecting differences in the influence of uncertainty across populations was necessary, which will help us implement the interventions more accurately to avoid wasting strained public resources. Therefore, instead of investigating the average effect of the population, we should investigate whether the previous conclusions hold for people with low sense of control, and how uncertainty affects people with high sense of control.

To sum up, this study suggests that the uncertainty of pandemic situation can be used to describe the uncertainty of individual's future development of pandemic situation, as well as the uncertainty of pandemic spread and self-infection. On this basis, this study further explores the impact of epidemiological uncertainty on people's positive attitude toward life, depression levels and pandemic preventive behavior intentions. This study **hypothesized** that the high and low grouping of uncertainty moderates the effect of uncertainty itself on psychological states. When the level of pandemic uncertainty is high, people's pandemic preventive behavior intentions and depression levels increase and positive life attitudes diminish as uncertainty increases; When the level of uncertainty is low, this effect will be reduced or even disappear.

TABLE 1 Demographics information.

Demographic	*N*	%
Gender		
Male	314	59.25
Female	216	40.75
Region		
East	428	80.75
Middle	60	11.32
West	42	7.92
Household registration		
City	172	32.45
Town	108	20.38
Rural	250	47.17
Healthy status		
Very well	374	70.57
Good	100	18.87
General	48	9.06
Not very well	6	1.13
Bad	2	0.38
The severity level of COVID-19 in your hometown		
1: Not severe	407	76.79
2: Less severe	63	63
3: Usually severe	44	8.3
4: More severe	6	1.13
5: Very severe	10	1.89

2. Materials and methods

2.1. Procedure and participants

In this study, data were collected through an online questionnaire, and the data collection time was from October 20, 2021, to October 22, 2021. Convenient sampling was performed, and the questionnaire was distributed *via* social media. Using G-power, we calculated that the minimum sample size was 487 when the significance level was 0.05, the statistical power was 0.8, and the effect size was 0.04. The subjects of the study are college students from the Dalian University of Technology and Dalian Vocational and Technical College and were filtered by polygraph questions and response times. Finally, 530 valid data were collected. The demographic information of the subjects is shown in Table 1.

2.2. Measures

2.2.1. Uncertainty sense toward COVID-19

During the pandemic, a self-made scale was used to measure residents' uncertainty. The scale contains six questions (Table 2)

TABLE 2 Survey on uncertainty sense, positivity attitude and preventive behavioral intentions.

Factors	Items (1 strongly disagree to 5 strongly agree)
Uncertainty sense toward COVID-19	I always compare myself with the symptoms of pneumonia.
	I feel like I'm going to break down at any moment.
	I feel overwhelmed by this epidemic.
	I keep thinking that the epidemic will get out of control.
	I am very pessimistic about the future development of the epidemic.
	I feel very dangerous when I see strangers coming toward me
Positive attitude	I have been exercising during the pandemic.
	During the pandemic, I'm focused on doing what I've always wanted to do.
	During the pandemic, I develop my interest.
Preventive behavioral intentions	During the pandemic, I manage to cut down on going out.
	During the pandemic, I wear a mask when going out.
	During the pandemic, I advise my family to wear masks.
	During the pandemic, I wash my hands and disinfect frequently.

that asks subjects about their perceptions of the spread of the pandemic and their own infection, as well as their perceptions of the future development of the pandemic. The Likert scale with 5 points was adopted for all questions (from 1 strongly disagreed to 5 strongly agreed). The higher the subjects' average score, the higher their perception of the risk of pandemic spread and infection, and the higher their pessimistic perception of the future development of the pandemic. In this study, the Cronbach's α score for this scale was 0.93.

The scores of uncertainty ranged from 1 to 5, and 3 points indicated that the uncertainty of the subjects was in the middle level. According to the distribution of subjects' uncertainty scores (Figure 1), we divided them into two groups: the medium-high group (with scores $\geq$3) and the low group (with scores $<$3). Finally, we obtained that there were 209 subjects in the medium-high group and 311 subjects in the low group, and there were significant differences in the scores of uncertainty between such two groups [$t_{(528)} = 29.93, p < 0.001$].

2.2.2. Depression

This study focused on depression in mental health. The Center for Epidemiologic Studies Depression Scale [CESD; (32)], was used for measuring individual levels of depression. This scale contains 20 questions, asking whether the subjects have experienced symptoms related to depression in the past few weeks. All questions were graded on the Likert scale with a 5-point scale. The higher total score of the CESD with the higher severity of depression. In this study, the Cronbach's α score for this scale was 0.90.

2.2.3. Positive attitude

The self-made scale was used to measure the positive attitude of residents toward life during the pandemic. The scale contains three questions (Table 2), asking subjects about their enthusiasm to keep exercising, focus on work and cultivate interest during the pandemic. The Likert scale with 5 points was adopted for all questions (from 1 strongly disagreed to 5 strongly agreed). The higher the mean score of the subjects, the more positive the attitude toward life during the pandemic. In this study, the Cronbach's α score for this scale was 0.93.

2.2.4. Preventive behavioral intentions

The self-made scale was used to measure the behavioral tendencies of residents to prevent the pandemic during the outbreak. The scale contains four questions (Table 2), asking subjects' agreement with protective behaviors such as wearing masks, hand washing and disinfection, and reducing going outside during an outbreak. The Likert scale with 5 points was adopted for all questions (from 1 strongly disagreed to 5 strongly agreed). The higher the mean score of the subjects, the higher the pandemic preventive behavior intentions. In this study, the Cronbach's α score for this scale was 0.94.

2.2.5. Personality

People's inherent psychological traits can have an impact on positive life attitudes, depression levels, and pandemic preventive behavior intentions. Personality, as the sum of an individual emotions, thoughts, and behavioral tendencies, plays an important role in this process. Previous studies have shown that people's mental health (33), positive life attitudes (34) and behavioral tendencies (35) are significantly influenced by personality. For example, individuals with higher neuroticism scores were more likely to be depressed and have a pessimistic outlook on life (36, 37). Individuals with higher conscientiousness scores were more likely to adopt preventive behaviors during the pandemic (38, 39). To exclude the interference of personality on the findings, we included personality as control variables in this study. The Big Five personality scale developed by (40) was used in this study to measure the personality of the subjects. The scale contains five dimensions: neuroticism, conscientiousness, agreeableness, extraversion, and openness, and each dimension contains eight questions. The Likert scale with 5 points was adopted for all questions (from 1 very disagreed to 5 very agreed). In this study, the Cronbach's α scores were 0.91, 0.85, 0.71, 0.94, and 0.79, respectively.

2.2.6. Social support

In addition to personality, the level of social support of individuals can also influence positive attitude toward life, depression levels and the preventive behavior intentions. Social support refers to the spiritual or material support given to

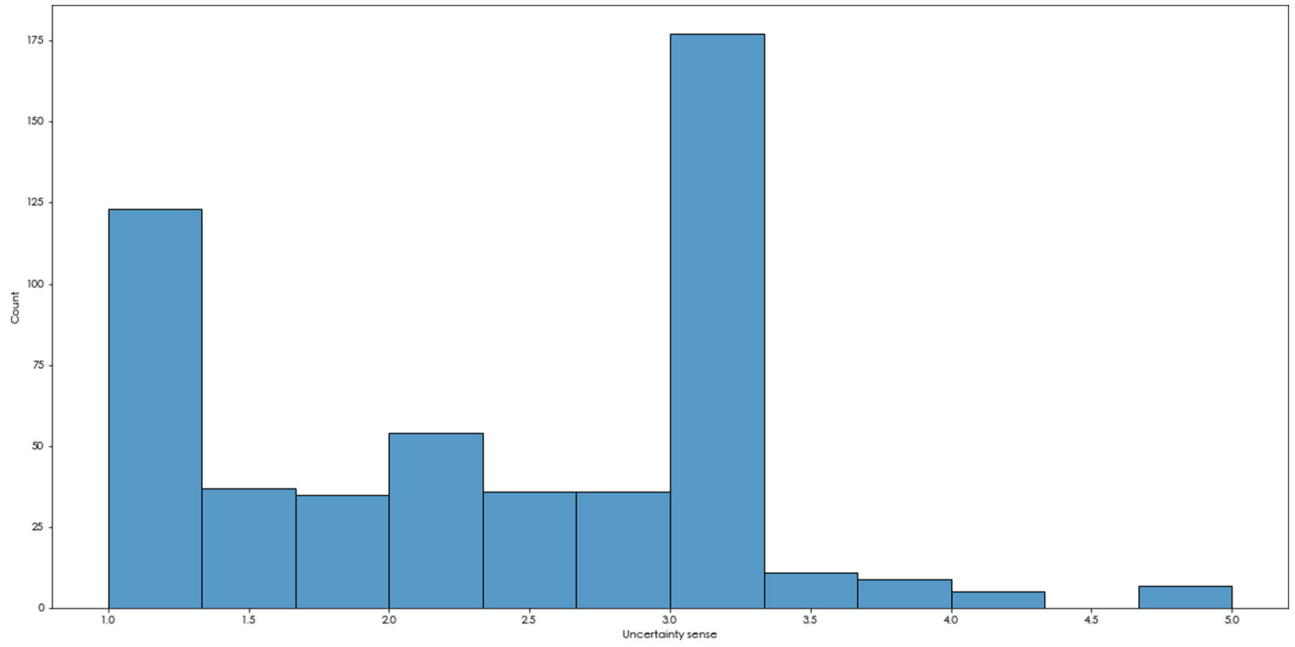


FIGURE 1
The distribution of uncertainty sense.

individuals by all aspects of society, including parents, relatives, and friends (41). Relevant research shows that individuals who lack social support have more serious tendencies to depression (42) and more negative attitude toward life (43). To control for the effect of social support, we also included social support as control variables. We used the Social Support Rate Scale [SSRS; (44)] to measure the social support of the subjects. The scale contains 10 questions with three sub-dimensions: subjective support, objective support, and support utilization. In this study, the Cronbach's α scores for each dimension were 0.87, 0.77, 0.70.

2.2.7. Demographic information

Besides the above scales, we also asked the participants for demographic information, including gender, geographic locations, type of household registration, health status, and the severity of the pandemic in the hometown. Geographical locations are divided according to the location of the hometown according to the following criteria: the eastern region has 13 provinces, including Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, Liaoning, Jilin and Heilongjiang provinces; the middle region has 6 provinces, including Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan; the western region has 12 provinces, including Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang. The severity of the pandemic in the hometown was measured by a question "What do you think is the severity of the epidemic in your hometown (from not severe to very severe)".

2.3. Statistical analyses

We used Python for statistical analyses. In this study, the independent variable was uncertainty sense, and the dependent variables were depression, positive life attitudes and pandemic preventive behavior intentions. Welch's analyses of variance (ANOVA) were first used to examine the relationships between demographic variables and dependent variables. Second, we performed Shapiro–Wilk test to test the normality of the data. We then performed descriptive and Pearson's correlation analyses for continuous-type variables. Variables that were significantly correlated with the dependent variable were entered into the subsequent analyses. To explore whether the effects of uncertainty differed across levels of uncertainty, we divided subjects into medium-high and low grouping based on the range and distribution of uncertainty and examined the moderating effect of group as a moderating variable. Least squares regression was conducted, and the heteroscedastic robust standard error was estimated. We used two-step regression, and the interaction terms only enter the equation of the second step. The p-value <0.05 was considered to be significant.

3. Results

3.1. Impact of demographic features

We first analyzed the effects of demographic variables on pandemic preventive behavior intentions, positive life attitudes, and depression. We used Welch's ANOVA, which possesses better robustness for heteroscedasticity. The results showed in Table 3.

TABLE 3 The effects of demographic variables on preventive behavior intentions, positive life attitudes, and depression.

		CESD			Positivity			Behavioral intentions		
		M±SD	*F*	*p*	M±SD	*F*	*p*	M±SD	*F*	*p*
Gender	Male	2.61 ± 0.75	5.71	0.017	3.66 ± 1.07	0.14	0.706	3.94 ± 1.06	0.89	0.345
	Female	2.46 ± 0.69			3.7 ± 0.93			3.86 ± 0.98		
Geography	East	2.51 ± 0.74	4.01	0.022	3.7 ± 1.02	0.84	0.84	3.94 ± 1.04	1.91	0.155
	Middle	2.72 ± 0.62			3.53 ± 0.94			3.66 ± 1.06		
	West	2.7 ± 0.7			3.7 ± 1.01			3.92 ± 0.89		
Type of household registration	City	2.56 ± 0.77	0.04	0.959	3.66 ± 1.06	1.16	0.316	3.8 ± 1.12	3.08	0.047
	Town	2.55 ± 0.72			3.56 ± 1.1			3.81 ± 1.08		
	Rural	2.54 ± 0.7			3.74 ± 0.93			4.03 ± 0.93		
Health status	Very well	2.44 ± 0.75	13.34	0.002	3.79 ± 1.03	4.73	0.039	3.95 ± 1.07	2.91	0.107
	Good	2.68 ± 0.64			3.51 ± 0.98			3.98 ± 0.93		
	General	2.96 ± 0.39			3.23 ± 0.73			3.51 ± 0.79		
	Not very well	3.16 ± 0.59			3.44 ± 1.42			3.67 ± 1.03		
	Bad	3.25 ± 0.35			3.5 ± 0.71			3.38 ± 0.53		
Severity of COVID-19	1	2.47 ± 0.75	14.93	<0.001	3.72 ± 1.05	2.84	0.046	3.97 ± 1.06	11.77	<0.001
	2	2.78 ± 0.6			3.61 ± 0.85			3.85 ± 0.89		
	3	2.86 ± 0.48			3.41 ± 0.82			3.43 ± 0.85		
	4	3.1 ± 0.21			2.94 ± 0.74			3.08 ± 0.34		
	5	2.64 ± 0.91			3.9 ± 0.79			4.35 ± 0.75		

Gender had a significant effect on depression ($F_{(1,485)} = 5.71$, $p = 0.017$). Geography had a significant effect on depression ($F_{(2,81)} = 4.01$, $p = 0.022$). Type of household registration had a significant effect on pandemic preventive behavior intentions ($F_{(2,260)} = 3.08$, $p = 0.047$). Health status had a significant effect on depression ($F_{(4,7)} = 13.34$, $p = 0.002$); Health status had a significant effect on positive attitude ($F_{(4,7)} = 4.73$, $p = 0.039$). The severity of the pandemic in the home town had a significant effect on depression ($F_{(4,27)} = 14.93$, $p < 0.001$); the severity of the pandemic in the home town had a significant effect on positive attitude ($F_{(4,25)} = 2.84$, $p = 0.046$); the severity of the pandemic in the home town has a significant effect on pandemic preventive behavior intentions ($F_{(4,27)} = 11.77$, $p < 0.001$).

3.2. Descriptive statistics and correlations

Shapiro–Wilk test show that we cannot reject the assumption of normality for all continuous variables (for all variables, $p > 0.05$). Thus Pearson' correlation analysis can be used in this study. Table 4 presents the descriptive statistics and correlation coefficients for the continuous type variables. Almost all the correlation coefficients reached a significant level ($p < 0.05$), except a non-significant correlation coefficient between pandemic preventive behavior intentions and support utilization ($r = 0.080$, $p = 0.094$).

3.3. The moderating effect of grouping variable

Taking uncertainty as the independent variable and the group variable as moderating variable, we tested whether the influence of uncertainty on depression, pandemic preventive behavior intentions, and positive attitude was regulated by the group. During the regression, variables significantly correlated with the dependent variable were entered into the equation as control variables, whereas the categorical variables were coded as dummy variables for treatment. The results are shown in Table 5. Specifically, uncertainty can significantly and positively predict CESD ($\beta = 0.43$, $p < 0.001$); whereas the group and interaction terms could not significantly predict CESD (Group: $\beta = -0.13$, $p = 0.282$; Interaction: $\beta = 0.13$, $p = 0.241$). For pandemic preventive behavior intentions, when the moderating variables were not included, the negative edge of uncertainty was significant ($\beta = -0.08$, $p = 0.067$). Whereas, when the moderating variables were included, the uncertainty had a significant positive predictive intention ($\beta = 0.24$, $p < 0.001$). Besides, group significantly and negatively predicted behavior intentions ($\beta = -0.99$, $p < 0.001$), and Interaction significantly and positively predicted behavior intentions ($\beta = 0.60$, $p < 0.001$). Simple slope analysis shows that uncertainty had no significant effect on pandemic preventive behavior intentions in low group ($\beta = 0.002$, $p = 0.973$), whereas that had a significant and positive effect ($\beta = 0.60$, $p < 0.001$) in the high group. The result of positive attitude was similar to behavioral intentions. When the moderating variables were not included,

10.3389/fpubh.2023.1136152

TABLE 4 Means, standard deviations, and correlation matrix of variables.

	M±SD	1	2	3	4	5	6	7	8	9	10	11	12
1 Neuroticism	2.39 ± 0.86	1											
2 Conscientiousness	3.64 ± 0.81	−0.317***	1										
3 Agreeableness	3.55 ± 0.67	−0.323***	0.649***	1									
4 Extroversion	3.55 ± 0.84	−0.109*	0.620***	0.525***	1								
5 Openness	3.27 ± 0.67	−0.271***	0.511***	0.406***	0.597***	1							
6 CESD	2.55 ± 0.73	0.621***	−0.441***	−0.460***	−0.221***	−0.441***	1						
7 Objective supports	9.11 ± 3.88	−0.188***	0.275***	0.295***	0.255***	0.303***	−0.290***	1					
8 Subjective supports	21.75 ± 5.09	−0.382***	0.370***	0.368***	0.248***	0.395***	−0.421***	0.582***	1				
9 Supports utilization	7.65 ± 2.31	−0.260***	0.232***	0.231***	0.119**	0.314***	−0.321***	0.303***	0.541***	1			
10 Uncertainty sense	2.25 ± 0.91	0.508***	−0.365***	−0.424***	−0.208***	−0.241***	0.658***	−0.204***	−0.307***	−0.201***	1		
11 Behavioral intentions	3.91 ± 1.03	−0.181***	0.416***	0.467***	0.412***	0.308***	−0.332***	0.240***	0.307***	0.080	−0.271***	1	
12 Positivity attitude	3.68 ± 1.01	−0.244***	0.465***	0.449***	0.451***	0.417***	−0.339***	0.248***	0.366***	0.231***	−0.258***	0.656***	1

*p < 0.05, **p < 0.01, ***p < 0.001.

uncertainty could not significantly predict positive attitude ($\beta = -0.02$, $p = 0.617$). After the moderating variables were included, uncertainty significantly predicted positive attitude ($\beta = 0.14$, $p = 0.047$). Besides, group significantly and negatively predicted positive attitude ($\beta = -0.55$, $p < 0.001$); Interaction significantly and positively predicted positive attitude ($\beta = 0.56$, $p < 0.001$). The simple slope analysis shows that uncertainty could not significantly predict positive attitude in the low group ($\beta = -0.08$, $p = 0.262$); whereas, in the high group, uncertainty had a significant positive effect ($\beta = 0.48$, $p < 0.001$).

We noted that the moderating effect of grouping was significant for positive life attitudes. Despite this, there was a significant positive effect of uncertainty on the medium-high group of uncertainty ($\beta = 0.48$, $p < 0.001$), which contradicted our hypothesis. And interestingly, the negative effect of low grouping ($\beta = -0.08$, $p = 0.262$; although not significant) seemed to imply that as uncertainty rose, the positive attitude toward life dropped firstly and then rose. Furthermore, the level of positive attitude was lowest when uncertainty was at a moderate level. The descriptive analysis confirmed our hypothesis (Figure 2). The relationship between uncertainty and positive life attitudes was "positive U-shaped".

4. Discussion

This study proposes a sense of uncertainty to better describe people's perceptions of uncertainty about the future development of the pandemic and uncertainty about the spread of the pandemic and their own being infected at a time when the pandemic is gradually being controlled. And based on this, this study explores the effects of this uncertainty on people's positive life attitudes, depression levels, and pandemic preventive behavior intentions. This study further shows that levels of uncertainty can moderate the influence of uncertainty on mental states. Specifically, when the level of pandemic uncertainty is high, people's pandemic preventive behavior intentions and depression levels increase and positive life attitudes diminish as uncertainty increases; whereas, when the uncertainty level is low, this influence will be reduced or even disappear. Using an online questionnaire, this study collected data on uncertainty, positive life attitudes, depression, pandemic preventive behavior intentions, personality, and social support from 530 subjects, and tested the hypothesis through an analysis of moderate effects.

The results of the analysis partially supported our hypothesis. The group variable did not have a significant moderating effect on depression levels. This suggested that an increase in uncertainty consistently resulted in an increase in depression levels, regardless of whether the individual was at a high or low level of uncertainty. This monotonic linear relationship was consistent with the evidence from sense of control and uncertainty tolerance (9, 12, 14, 18, 26). For positive life attitudes, although the moderating effect of group was significant, the effect was in the opposite direction of our hypothesis for the medium-high group. Our further analysis also revealed that the relationship between uncertainty and positive life attitudes was "positive U-shaped". Specifically, at low uncertainty, positive life attitudes decreased with increasing uncertainty (although not significantly), whereas at high uncertainty, positive life attitudes increased with increasing

TABLE 5 The interaction of uncertainty sense and group on CESD, behavioral intentions and positivity.

	CESD				Behavioral intentions				Positivity			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Control variables												
Neuroticism	0.293***	0.034	0.294***	0.034	0.042	0.046	0.040	0.045	−0.037	0.046	−0.033	0.045
Conscientiousness	−0.089*	0.041	−0.090*	0.042	0.049	0.057	0.057	0.055	0.107	0.056	0.103	0.055
Agreeableness	−0.107**	0.039	−0.108**	0.039	0.250***	0.052	0.229***	0.051	0.157**	0.052	0.150**	0.051
Extroversion	0.166***	0.040	0.161***	0.040	0.203***	0.054	0.161**	0.053	0.190***	0.053	0.166**	0.053
Openness	−0.245***	0.037	−0.244***	0.037	−0.005	0.050	−0.004	0.048	0.105*	0.049	0.111*	0.048
Objective support	−0.055	0.034	−0.058	0.034	0.018	0.046	0.003	0.045	−0.018	0.045	−0.029	0.045
Subjective support	−0.022	0.041	−0.024	0.041	0.112*	0.050	0.114*	0.049	0.173***	0.051	0.170***	0.053
Support utilization	−0.035	0.033	−0.034	0.033								
Female	−0.147**	0.056	−0.141**	0.057								
East	−0.052	0.104	−0.041	0.105								
Middle	−0.040	0.128	−0.026	0.129								
City					−0.232**	0.085	−0.229**	0.083				
Town					−0.207*	0.100	−0.173	0.096				
Healthy: very well	0.205	0.471	0.235	0.472					−0.485	0.620	−0.309	0.614
Healthy: good	0.231	0.475	0.266	0.477					−0.627	0.624	−0.431	0.619
Healthy: general	0.175	0.478	0.209	0.479					−0.502	0.628	−0.308	0.622
Healthy: not very well	0.126	0.522	0.127	0.523					−0.343	0.694	−0.305	0.686
Severity of covid-19: 1	0.296	0.202	0.324	0.204	−0.349	0.278	−0.157	0.270	−0.167	0.273	−0.044	0.271
Severity of covid-19: 2	0.234	0.215	0.268	0.217	−0.324	0.293	−0.090	0.286	−0.071	0.289	0.073	0.288
Severity of covid-19: 3	0.238	0.223	0.285	0.227	−0.584	0.303	−0.240	0.298	−0.129	0.300	0.073	0.302
Severity of covid-19: 4	0.237	0.336	0.274	0.338	−0.768	0.443	−0.574	0.430	−0.528	0.452	−0.356	0.448
Independent variables												
Uncertainty sense	0.389***	0.033	0.427***	0.052	−0.084	0.046	0.238***	0.069	−0.022	0.044	0.138*	0.069
Group			−0.130	0.121			−0.990***	0.158			−0.549***	0.160
Interaction												
Uncertainty sense × Group			0.133	0.114			0.599***	0.149			0.557***	0.150
R^2	0.635		0.626		0.300		0.350		0.330		0.350	
ΔR^2			0.001				0.050				0.020	

*p < 0.05, **p < 0.01, ***p < 0.001.

uncertainty. To our knowledge, this is the first time since the pandemic that uncertainty (or its associated sense of control and uncertainty tolerance) has been found to have a nonlinear effect on people's psychological states.

This phenomenon may be related to the psychological typhoon eye effect (45). A psychological typhoon eye refers to the phenomenon that individuals in the central area where a disaster occurs have a calmer psychological reaction than those outside

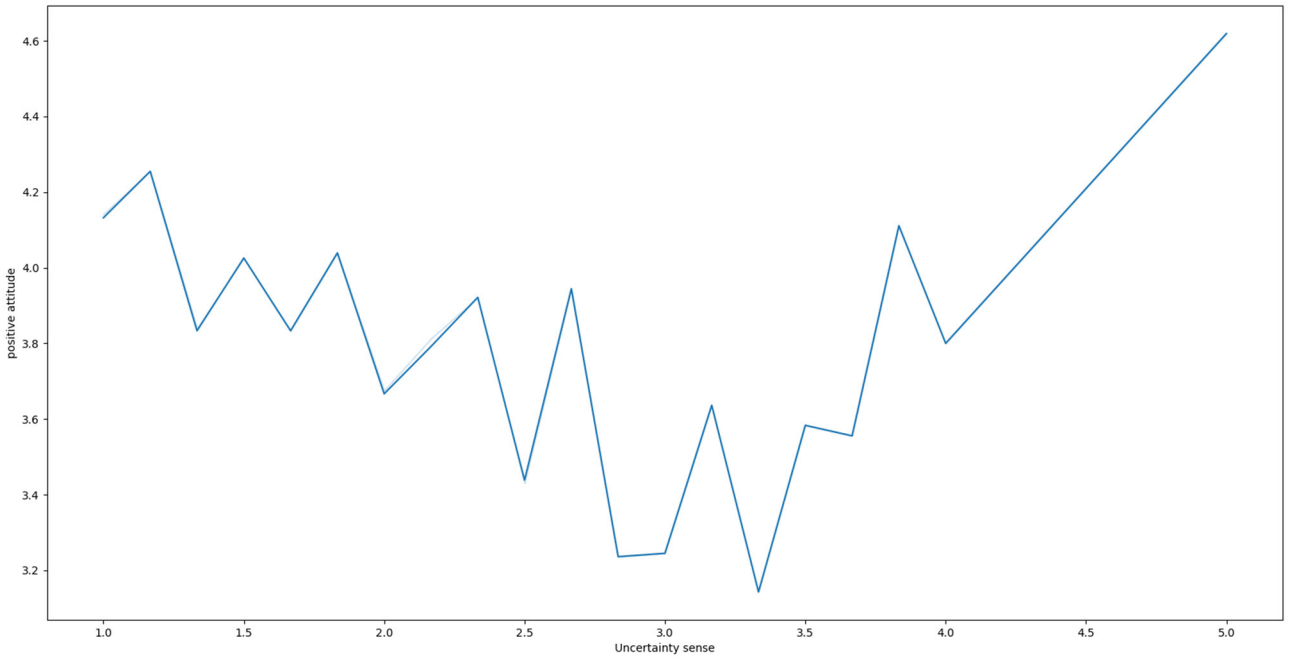


FIGURE 2
The nonlinear relationship between uncertainty sense and positive attitude.

the central area. The difference between the COVID-19 pandemic and other disasters (such as earthquakes) is that there is no fixed disaster center. When individuals feel a strong sense of uncertainty, they perceive the risk of the spread of the pandemic and the risk of being infected themselves to be high. At this time, although individuals are not spatially at the center of the outbreak, they are psychologically closer to the center of the disaster. According to the mere exposure effect (46), this group of individuals has been exposed to high levels of uncertainty for a long time, and over time has developed adaptability to tolerate the great uncertainty and face daily life with a positive attitude. We believe that this nonlinear relationship may be a newly emerged phenomenon in the post-pandemic era. On one hand, the current pandemic is gradually under control. People's uncertainty mainly comes from subjective feelings rather than the huge real threat at the beginning of the outbreak. On the other hand, it takes some time for people to develop adaptability.

These results have given us some insights. First, it's necessary to pay extra attention to those with moderate levels of uncertainty. The depression level of this part of the population is at the medium level, but the life state under the pandemic situation is the most negative. This group is more likely to have serious mental health problems. Although people with higher levels of uncertainty have higher levels of depression, they can face life with a more positive attitude due to adaptability—they may have a stronger tolerance. Second, it may be meaningful to explore the nonlinear relationship between psychological traits. We found an interesting phenomenon during the analysis: the prediction of uncertainty on positive attitude and pandemic preventive behavior intentions was insignificant when group variables and interaction terms were not included, whereas, after inclusion, this effect reached significance levels. This shows that when analyzing as a whole, the influence of each sub-sample is ignored. At the beginning of the pandemic outbreak, people's collective fear and uncertainty entered a higher level. At this point, the samples are relatively homogeneous, and the conclusions obtained from the research are specific to the high group. And it remains uncertain whether these findings can be replicated across groups. Third, it is necessary to define psychological traits according to the different phases of the pandemic and to explore the relationship between psychological traits as they change with the pandemic. It is important to note that concepts such as sense of control and uncertainty, which were widely studied at the beginning of the outbreak, may not be applicable to the current phase of the pandemic. However, defining more relevant psychological characteristics will help us to accurately expose the relationship between the pandemic and people's psychological state. Moreover, we need to pay attention to the changes of this relationship with the development of the pandemic. As mentioned before, we assume that the nonlinear relationship between uncertainty and positive attitude toward life may just appear at the moment. This needs to be verified by further research. On the other hand, it also inspires us to explore whether the relationship between the psychological traits confirmed at the initial stage of the pandemic has changed in the post-pandemic era.

There are some limitations in this research. First, this paper collects data and conducts research in China. Unlike other countries, China has implemented epidemic control measures for a long time, which may lead to the specificity of the results found in China. Thus for future research, we propose to examine the generalizability of the findings through cross-cultural studies and controlling for the objective severity of the pandemic. Second, this study mainly focused on college students in Dalian city. For

the follow-up research, we plan to make use of big data from social media (Weibo) to see if the conclusions can be reproduced, since social media can provide a larger amount of data at a lower cost and helps us to test the robustness of our conclusions in large samples.

5. Conclusion

To explore the nonlinear effects of pandemic uncertainty on depression, pandemic preventive behavior intentions, and positive attitude, this paper first grouped uncertainty high and low and conducted a moderating effect analysis using the group variable as a moderating variable. This study found that the group variable did not significantly regulate the influence of uncertainty on depression, but significantly regulated the influence of uncertainty on positive attitude and pandemic preventive behavior intentions. Further simple slope analyses found that the high group significantly and positively predicted positive attitude and pandemic preventive behavior intentions, while the low group effects were not significant. This research found a nonlinear influence of pandemic uncertainty on people's psychological characteristics, which was rare in the early stages of a pandemic outbreak. This reveals the need to explore the nonlinear relationship of psychological traits under the pandemic, and to observe the relationship of psychological traits with the pandemic.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board of the Institute of Psychology, Chinese Academy of Sciences (H16003). The patients/participants provided their written informed consent to participate in this study.

Author contributions

TZ provided financial support for the study. TZ and AL conceived and planned the article. YL and ZL carried out the study and drafted the manuscript. ZL developed the tools needed for the experiment, executed the whole experiment process, performed all of the statistical analyses, and wrote the manuscript with input from all authors. YL made a great contribution to the revision of the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This study was financially supported by the Strategic Priority Research Program of Chinese Academy of Sciences (No. XDC02060300), the Scientific Foundation of Institute of Psychology, Chinese Academy of Sciences (No. E2CX4735YZ), and Youth Innovation Promotion Association CAS.

Conflict of interest

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

Publisher's note

References

1. Fancourt D, Steptoe A, Bu F. Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: a longitudinal observational study. *Lancet Psychiatry*. (2021) 8:141–9. doi: 10.1016/S2215-0366(20)30482-X

2. Marazziti D. The COVID-19 outbreak: the latest challenge to psychological and psychiatric intervention. *Clinical Neuropsychiatry*. (2020) 17:39. doi: 10.36131/clinicalnpsych20200201

3. Zhu N. O J, Lu HJ, Chang L. Debate: Facing uncertainty with (out) a sense of control–cultural influence on adolescents' response to the COVID-19 pandemic Child and adolescent mental health. *Child Adolesc Ment Health*. (2020) 25:173–4. doi: 10.1111/camh.12408

4. del Rio C, Malani PN. COVID-19 in 2022—The Beginning of the End or the End of the Beginning? *JAMA*. (2022) 327:2389–90. doi: 10.1001/jama.2022.9655

5. Skinner EA, A. guide to constructs of control. *J Pers Soc Psychol.* (1996) 71:549. doi: 10.1037/0022-3514.71.3.549

6. Peluso AM, Pichierri M. Effects of socio-demographics, sense of control, and uncertainty avoidability on post-COVID-19 vacation intention. *Curr Issues Tour*. (2021) 24:2755–67. doi: 10.1080/13683500.2020.1849050

7. Kay AC, Gaucher D, Napier JL, Callan MJ, Laurin K. God and the government: testing a compensatory control mechanism for the support of external systems. *J Pers Soc Psychol.* (2008) 95:18. doi: 10.1037/0022-3514.95.1.18

8. Carleton RN. Into the unknown: A review and synthesis of contemporary models involving uncertainty. *J Anxiety Disord.* (2016) 39:30–43. doi: 10.1016/j.janxdis.2016.02.007

9. Del-Valle MV, López-Morales H, Andrés ML, Yerro-Avincetto M, Gelpi Trudo R, Urquijo S, et al. Intolerance of COVID-19-related uncertainty and depressive and anxiety symptoms during the pandemic: A longitudinal study in Argentina. *J Anxiety Disord.* (2022) 86:102531. doi: 10.1016/j.janxdis.2022.102531

10. Basevitz P, Pushkar D, Chaikelson J, Conway M, Dalton C. Age-related differences in worry and related processes. *Int J Aging Human Dev.* (2008) 66:283–305. doi: 10.2190/AG.66.4.b

11. Brailovskaia J, Margraf J. Predicting adaptive and maladaptive responses to the Coronavirus (COVID-19) outbreak: A prospective longitudinal study. *Int J Clin Health Psychol.* (2020) 20:183–91. doi: 10.1016/j.ijchp.2020.06.002

12. Zhou X, Yao B. Social support and acute stress symptoms (ASSs) during the COVID-19 outbreak: deciphering the roles of psychological needs and sense of control. *Eur J Psychotraumatol.* (2020) 11:1779494. doi: 10.1080/20008198.2020.1779494

13. Millroth P, Frey R. Fear and anxiety in the face of COVID-19: Negative dispositions towards risk and uncertainty as vulnerability factors. *J Anxiety Disord.* (2021) 83:102454. doi: 10.1016/j.janxdis.2021.102454

14. Korkmaz H, Güloglu B. The role of uncertainty tolerance and meaning in life on depression and anxiety throughout Covid-19 pandemic. *Pers Individ Dif.* (2021) 179:110952. doi: 10.1016/j.paid.2021.110952

15. Brailovskaia J, Margraf J. The relationship between burden caused by coronavirus (Covid-19), addictive social media use, sense of control and anxiety. *Comput Human Behav.* (2021) 119:106720. doi: 10.1016/j.chb.2021.106720

16. Niemeyer H, Bieda A, Michalak J, Schneider S, Margraf J. Education and mental health: Do psychosocial resources matter? *SSM PopulHealth.* (2019) 7:100392. doi: 10.1016/j.ssmph.2019.100392

17. Freeston MH, Rhéaume J, Letarte H, Dugas MJ, Ladouceur R. Why do people worry? *Pers Individ Dif.* (1994) 17:791–802. doi: 10.1016/0191-8869(94)90048-5

18. Aknin LB, De Neve J-E, Dunn EW, Fancourt DE, Goldberg E, Helliwell JF, et al. Mental health during the first year of the COVID-19 pandemic: A review and recommendations for moving forward. *Perspect Psychol Sci.* (2022) 17:915–36. doi: 10.1177/17456916211029964

19. Kola L, Kohrt BA, Hanlon C, Naslund JA, Sikander S, Balaji M, et al. COVID-19 mental health impact and responses in low-income and middle-income countries: reimagining global mental health. *Lancet Psychiatry.* (2021) 8:535–50. doi: 10.1016/S2215-0366(21)00025-0

20. Gillman AS, Scharnetzki L, Boyd P, Ferrer RA, Klein WM, Han PK. Perceptions and tolerance of uncertainty: relationship to trust in COVID-19 health information and vaccine hesitancy. *J Behav Med.* (2022) 8:1–14. doi: 10.1007/s10865-022-00302-9

21. Lin D, Friedman DB, Qiao S, Tam CC Li X, Li X. Information uncertainty: a correlate for acute stress disorder during the COVID-19 outbreak in China. *BMC Public Health.* (2020) 20:1–9. doi: 10.1186/s12889-020-09952-3

22. Faeq DK. The effect of positive affectivity on creative performance mediating by quality of work life. *Qalaai Zanist J.* (2022) 7:862–77. doi: 10.25212/lfu.qzj.7.1.33

23. Major BC, Le Nguyen KD, Lundberg KB, Fredrickson BL. Well-being correlates of perceived positivity resonance: evidence from trait and episode-level assessments. *Pers Soc Psychol Bull.* (2018) 44:1631–47. doi: 10.1177/01461672 18771324

24. Waters L, Algoe SB, Dutton J, Emmons R, Fredrickson BL, Heaphy E, et al. Positive psychology in a pandemic: Buffering, bolstering, and building mental health. *J Posit Psychol.* (2022) 17:303–23. doi: 10.1080/17439760.2021.1871945

25. Iqbal N, Dar KA. Coronavirus disease (COVID-19) pandemic: Furnishing experiences from India. *Psychol Trauma Theor Res Pract Policy.* (2020) 12:S33. doi: 10.1037/tra0000770

26. Robinson E, Sutin AR, Daly M, Jones A, A. systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. *J Affect Disord.* (2022) 296:567–76. doi: 10.1016/j.jad.2021.09.098

27. Pierce M, McManus S, Hope H, Hotopf M, Ford T, Hatch SL, et al. Mental health responses to the COVID-19 pandemic: a latent class trajectory analysis using longitudinal UK data. *Lancet Psychiatry.* (2021) 8:610–9. doi: 10.1016/S2215-0366(21)00151-6

28. Huang F, Ding H, Liu Z, Wu P, Zhu M, Li A, et al. How fear and collectivism influence public's preventive intention towards COVID-19 infection: a study based on big data from the social media. *BMC Public Health.* (2020) 20:1707. doi: 10.1186/s12889-020-09674-6

29. Li M, Zhao T, Huang E, Li J. How does a public health emergency motivate people's impulsive consumption? *An* empirical study during the COVID-19 outbreak in China. *Int J Environ Res Public Health.* (2020) 17:5019. doi: 10.3390/ijerph17145019

30. Usher K, Jackson D, Durkin J, Gyamfi N, Bhullar N. Pandemic-related behaviours and psychological outcomes; A rapid literature review to explain COVID-19 behaviours. *Int J Ment Health Nurs.* (2020) 29:1018–34. doi: 10.1111/inm.12790

31. Brailovskaia J, Truskauskaite-Kuneviciene I, Kazlauskas E, Gelezelyte O, Teismann T, Margraf J. Physical activity, mental and physical health during the Covid-19 outbreak: longitudinal predictors of suicide ideation in Germany. *J Public Health.* (2022). doi: 10.1007/s10389-022-01708-0

32. Eaton WW, Smith C, Ybarra M, Muntaner C, Tien A. *Center for Epidemiologic Studies Depression Scale: review and revision (CESD and CESD-R).* (2004). Mahwah, NJ: Lawrence Erlbaum Assoc. Inc.

33. Friedman HS, Kern ML, Reynolds CA. Personality and health, subjective well-being, and longevity. *J Pers.* (2010) 78:179–216. doi: 10.1111/j.1467-6494.2009.00613.x

34. Asebedo SD, Quadria TH, Chen Y, Montenegro-Montenegro E. Individual differences in personality and positive emotion for wealth creation. *Pers Individ Dif.* (2022) 199:111854. doi: 10.1016/j.paid.2022.111854

35. Thielmann I, Spadaro G, Balliet D. Personality and prosocial behavior: A theoretical framework and meta-analysis. *Psychol Bull.* (2020) 146:30. doi: 10.1037/bul0000217

36. Bagby RM, Quilty LC, Ryder AC. Personality and depression. *Can J Psychiatry.* (2008) 53:14–25. doi: 10.1177/070674370805300104

37. Klein DN, Kotov R, Bufferd SJ. Personality and depression: explanatory models and review of the evidence. *Annu Rev Clin Psychol.* (2011) 7:269–95. doi: 10.1146/annurev-clinpsy-032210-104540

38. Tagini S, Brugnera A, Ferrucci R, Mazzocco K, Pievani L, Priori A, et al. Attachment, personality and locus of control: psychological determinants of risk perception and preventive behaviors for COVID-19. *Front Psychol.* (2021) 12:634012. doi: 10.3389/fpsyg.2021.634012

39. Zhang Y, Mathur P, Block L. Personality matters during a pandemic: Implicit theory beliefs influence preparedness and prevention behaviors. *J Assoc Consum Res.* (2021) 6:168–77. doi: 10.1086/711759

40. McCrae RR, John OP. An introduction to the five-factor model and its applications. *J Pers.* (1992) 60:175–215. doi: 10.1111/j.1467-6494.1992.tb00970.x

41. Cunningham MR, Barbee AP. *Social Support.* (2000). Thousand Oaks, CA: Sage Publications, Inc

42. Grey I, Arora T, Thomas J, Saneh A, Tohme P, Abi-Habib R. The role of perceived social support on depression and sleep during the COVID-19 pandemic. *Psychiatry Res.* (2020) 293:113452. doi: 10.1016/j.psychres.2020.113452

43. Marroquín B, Nolen-Hoeksema S, Clark MS, Stanton AL. Social influences on cognitive processing in enacted social support: Effects on receivers' cognitive appraisals, emotion, and affiliation. *Anxiety Stress Coping.* (2019) 32:457–75. doi: 10.1080/10615806.2019.1619702

44. Dai W, Chen L, Tan H, Wang J, Lai Z, Kaminga AC, et al. Association between social support and recovery from post-traumatic stress disorder after flood: a 13–14 year follow-up study in Hunan, China. *BMC Public Health.* (2016) 16:1–9. doi: 10.1186/s12889-016-2871-x

45. Li S, Rao L-L, Ren X-P, Bai X-W, Zheng R, Li J-Z, et al. Psychological typhoon eye in the 2008 Wenchuan earthquake. *PLoS ONE.* (2009) 4:e4964. doi: 10.1371/journal.pone.0004964

46. Wen F, Ma S, Ye H, Qi Y, Zuo B. "Psychological Typhoon Eye Effect" and "Ripple Effect": Double perspective test of risk perception and anxiety characteristics of people in different COVID-19 severity regions. *Acta Psychologica Sinica.* (2020) 52:1087. doi: 10.3724/SP.J.1041.2020.01087

frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 23 February 2023
DOI 10.3389/fpubh.2023.1129322

OPEN ACCESS

EDITED BY
Renato de Filippis,
Magna Græcia University, Italy

REVIEWED BY
Sérgio Arthuro Mota-Rolim,
Federal University of Rio Grande do Norte, Brazil
Bing Xiang Yang,
Wuhan University, China

*CORRESPONDENCE
Jingjing Sun
✉ 705050020@qq.com
Peng Fang
✉ fangpeng@fmmu.edu.cn

†These authors have contributed equally to this work

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

RECEIVED 21 December 2022
ACCEPTED 03 February 2023
PUBLISHED 23 February 2023

CITATION
Peng J, Zhang T, Li Y, Wu L, Peng X, Li C, Lin X, Yu J, Mao L, Sun J and Fang P (2023) Effects of dysfunctional beliefs about sleep on sleep quality and mental health among patients with COVID-19 treated in Fangcang shelter hospitals. *Front. Public Health* 11:1129322. doi: 10.3389/fpubh.2023.1129322

Effects of dysfunctional beliefs about sleep on sleep quality and mental health among patients with COVID-19 treated in Fangcang shelter hospitals

Jiaxi Peng[1†], Tian Zhang[2†], Yijun Li[2†], Lin Wu[2], Xiyuan Peng[2], Chenxi Li[2], Xinxin Lin[2], Jing Yu[3], Li Mao[3], Jingjing Sun[4*] and Peng Fang[2,5,6*]

[1]Mental Health Education Center & College of Teachers, Chengdu University, Chengdu, China, [2]Department of Military Medical Psychology, Air Force Medical University, Xi'an, China, [3]Department of Radiology, 986 Hospital of Air Force Medical University, Xi'an, China, [4]No. 10 Outpatient Department of Internal Medicine, 986 Hospital of Air Force Medical University, Xi'an, China, [5]School of Biomedical Engineering, Air Force Medical University, Xi'an, China, [6]Shaanxi Provincial Key Laboratory of Bioelectromagnetic Detection and Intelligent Perception, Xi'an, China

Introduction: With the COVID-19 pandemic in China, a large number of mild or ordinary confirmed cases have been sent to Fangcang shelter hospitals for treatment. We aimed to investigate the mental health condition of Fangcang patients 2 years after the pandemic when patients knew more about COVID-19 and the virus was less virulent. We focused on the effect of dysfunctional beliefs and attitudes about sleep on depression, anxiety, and insomnia.

Methods: A total of 1,014 patients from two large Fangcang shelter hospitals in Shanghai between 22 April and 8 May 2022 completed a set of questionnaires comprising: the Dysfunctional Beliefs and Attitudes about Sleep scale, the Generalized Anxiety Disorder scale, the Patient Health Questionnaire, and the Insomnia Severity Index scale.

Results: Results show that the positive screening rates for anxiety, depression, and insomnia among tested patients were 55.3, 27.0, and 47.8%, respectively. Patients were more likely to report higher anxiety, depression, and insomnia, and to endorse affective and sleep disorders if they were: female, aged 18–40 years, with undergraduate course or above, white-collar employees, or those who thought the pandemic would have severe economic effects. About 51.4% of the participants had dysfunctional beliefs about sleep to varying degrees. Compared with patients who had accurate beliefs about sleep, the ratios of insomnia, anxiety, and depression were significantly higher among patients with dysfunctional beliefs about sleep.

Discussion: Attention should be paid to the mental health problems of patients in Fangcang shelter hospitals. The results indicate that dysfunctional beliefs about sleep significantly increased anxiety, depression, and insomnia of Fangcang patients.

KEYWORDS

Fangcang shelter hospitals, COVID-19, anxiety, depression, insomnia, dysfunctional beliefs about sleep

Introduction

With the COVID-19 pandemic in China, a large number of mild or ordinary confirmed cases have been sent to Fangcang shelter hospitals for treatment. Fangcang shelter hospitals are rapidly-deployable, temporary hospitals that integrate basic medical services and life safeguarding functions, and can be reconstructed from the existing large architecture facilities in cities, such as gymnasia, exhibition centers, storage warehouses, or large workshops (1, 2). Despite the great contributions to preventing pandemic spread, patients in Fangcang shelter hospitals have suffered depression, anxiety, insomnia, and other psychological problems (3–6). For example, Dai et al. found the positive screening rates for anxiety and depression among patients in Fangcang shelter hospitals were 18.6, and 13.4%, respectively (3). Zhang et al. reported 49.6% of participants had depressive or anxiety symptoms, and the symptoms of both depression and anxiety were highly correlated with the degree of insomnia (6). Gu et al. found 25.2, 50.1, 54.4, 10.2, and 39.7% of patients in Fangcang shelter hospitals reported symptoms of post-traumatic stress, anxiety, depression, insomnia, and perceived stress, respectively (5). So far, however, there are relatively few studies on the mental health of patients in Fangcang shelter hospitals, and the existing relevant research focuses on the effects of demographic variables on the mental health index. There has been no deep discussion into the emotional and individual psychological variables related to sleep disorders among patients in Fangcang shelter hospitals.

Insomnia is one of the main psychological problems caused by the COVID-19 pandemic (7, 8). A meta-analysis showed 35.7% of the general population suffered various sleep problems amid the pandemic, and it went up to 74.8% among COVID-19 patients (9). Stanton et al. found that experience of sleep disorders during the COVID-19 pandemic was highly correlated with anxiety, depression, and stress (10). Lin et al. reported pregnant women easily suffered anxiety and depression during the COVID-19 pandemic, and these were both significantly correlated with their sleeping status (11). Similarly, Zhang et al. found the sleep disorders of patients in Fangcang shelter hospitals were significantly correlated with mental health (6). Thus, in this study, we aimed to discuss the individual factors affecting the mental health of patients in Fangcang shelter hospitals, starting from the factors influencing sleep.

Many empirical studies suggest that improper pre-sleep cognition and views, and worry or fear of probable insomnia may critically affect the occurrence, development, maintenance, and treatment of insomnia (12). These cognitive factors are collectively called "dysfunctional beliefs about sleep" (13). Reportedly, dysfunctional beliefs about sleep can significantly predict insomnia, stress, depression, anxiety, and suicidal ideation (14). Recent sleep quality studies amid the COVID-19 pandemic have shown that individuals' dysfunctional beliefs about sleep are significantly correlated with sleep quality and mental health indicators (15, 16). For instance, Sella et al. found changes in self-reported sleep quality were largely associated with changes in dysfunctional sleep-related beliefs in older adults during COVID-19 lockdowns. Reportedly, 18.6% of Italian adults suffered clinical insomnia, and the severity of insomnia was significantly correlated with dysfunctional beliefs about sleep (17). Idrissi et al. found that 82.3% of people suffered dysfunctional beliefs about sleep to different extents amid the pandemic, and these beliefs were significantly correlated with insomnia, anxiety, and depression (15).

The wave of the COVID-19 pandemic dominated by the Omicron variant started to spread in Shanghai in April 2022. At that point, about 110 Fangcang shelter hospitals are founded in Shanghai, with up to 250,000 beds; these mainly accepted and isolated patients who were asymptomatic or had mild infections (18). This study was targeted at patients treated in some Fangcang shelter hospitals in Shanghai during this period. The insomnia, depression, and anxiety of patients were investigated, and our study was primarily focused on how dysfunctional beliefs about sleep were related with sleep disorders and affective disorders. Compared with previous studies on the mental health of patients in Fangcang shelter hospitals, our data were collected 2 years after the pandemic when patients already knew more about COVID-19. Moreover, the Omicron variant was less virulent than previous variants (19). For these reasons, patients treated during the study period may have had better mental health than patients at early stages of the pandemic. Additionally, previous studies ignored the effects of individual cognitive factors on insomnia and affective disorders. Although the objective realities of Fangcang shelter hospitals—poor living facilities, 24-h lighting, limited personal space, concern about illness status—are major causes for the mental problems of patients, we believe the traits and cognition of patients also play important roles. This is the first study to consider the effects of dysfunctional beliefs about sleep on the insomnia, depression, and anxiety of patients in Fangcang shelter hospitals.

Methods

Participants

Convenience sampling was used to collect data from two large Fangcang shelter hospitals in Shanghai from 22 April to 8 May 2022. The inclusion criteria were: positive COVID-19 status, diagnosed as asymptomatic or mild patients; admission within the previous 2 weeks; age 16–65 years; breathing rate < 30 beats per minute; demonstration of cognizance and self-caring abilities in answering questionnaires; no history of self-reported psychopathy; no use of anti-depression or anti-anxiety drugs within one year; no other chronic diseases (e.g., hypertension, coronary heart diseases). With traditional written tests, some trained nurses informed the patients about the significance of this questionnaire. After the patients signed informed consent forms, they voluntarily participated in the questionnaire.

In total, 1,124 copies of the questionnaire were sent out, and 1,087 copies were returned. Of them, 73 copies were excluded due to their incompleteness. Finally, 1,014 copies were included in the analysis.

Measures

Demographic information

The demographic variables collected included gender (male or female); age (<18 years, 18–40 years, 40–60 years, >60 years); whether the individual was very worried about the economy (yes or no); education level (senior high school and below, technical school

and junior college, undergraduate and above); and occupation (industrial workers, white-collar employees, students, unemployed and others).

Dysfunctional beliefs and attitudes about sleep-16

The DBAS-16, developed by Morin, Vallières, and Ivers, consists of sixteen items that estimate the respondents' beliefs and attitudes about sleep (13). Some example items are "My sleep is unpredictable" and "Insomnia is destroying my life". The DBAS-16 assesses the following four dimensions: consequences of insomnia, worry about sleep, sleep expectation, and prescription of drugs. The DBAS-16 was translated into Chinese and showed good reliability and validity (20). The responses were made using a 5-point Likert scale, ranging from 1 (*Strongly disagree)* to 5 (*Strongly agree).* The summations of all items, and of the items belonging to each dimension, were calculated as the global score and score of each dimension, respectively. The global score ranged from 16 to 80. According to Fu, Ou, and Lu, a total score $\geq$ 48 indicates false beliefs about sleep, whereas scores lower than 48 indicate correct, or accurate, beliefs about sleep (20). The Cronbach's alpha coefficient of the DBAS-16 was 0.89 in the current study.

Generalized anxiety disorder scale

GAD-7, which consists of seven items, was used to estimate the respondents' anxiety (21). Some example items are "I worry too much about different things" and "I become easily annoyed or irritable". The responses were made using a 4-point Likert scale, ranging from 0 (*Not at all)* to 3 (*Nearly every day).* The summation of all items was calculated for the global score, ranging from 0 to 21, which indicated severity of anxiety symptoms: minimal (0–4), mild (5–9), moderate or severe (10–22). The Cronbach's alpha coefficient of GAD-7 was 0.95 in the current study.

Patient health questionnaire-9

PHQ-9, which consists of nine items, was used to estimate patients' depressive symptoms (23). Some example items were "I experience poor appetite or overeating" and "I feel tired or have little energy". The responses were made using a 4-point Likert scale, ranging from 0 (*Not at all)* to 3 (*Nearly every day).* The summation of all items was calculated as the global score, ranging from 0 to 27, which indicated the severity of depression symptoms: minimal (0–9), mild (10–14), moderate or severe (6, 15–27). The Cronbach's alpha coefficient of PHQ-9 was 0.92 in the current study.

The insomnia severity index

The ISI, which consists of five items, was used to estimate the severity of insomnia (24). Some example items were "I have difficulty falling asleep" and "I have difficulty staying asleep". The responses were made using a 5-point Likert scale, ranging from 0 (*None)* to 4 (*Very).* The summation of all items was calculated as the global score, ranging from 0 to 28, which indicated severity of insomnia: minimal (0–7), mild (8–14), moderate or severe (15–28). The Cronbach's alpha coefficient of PHQ-9 was 0.83 in the current study.

Data analysis

Statistical analyses were carried out using SPSS 22.0. Descriptive statistics, correlation analysis, and logistic regression analysis were used to analyze the data collected.

Results

Table 1 lists the demographic information of the participants, and the mental health differences observed in terms of gender, age, education level, economic concern, and occupation. Results showed depression ($F = 12.39$, $P < 0.01$), anxiety ($F = 12.94$, $P < 0.01$), and insomnia ($F = 6.08$, $P = 0.02$) were more severe among females than males. Depression ($F = 12.39$, $P < 0.01$), anxiety ($F = 12.94$, $P < 0.01$), and insomnia ($F = 6.08$, $P = 0.02$) were significantly different among age groups, and the scores were highest among patients aged 18–40 years. Depression ($F = 3.18$, $P = 0.04$), anxiety ($F = 4.38$, $P = 0.01$), and insomnia ($F = 5.04$, $P = 0.01$) were significantly higher in patients with a bachelor's degree or above, compared with other education levels. Those concerned about the economy reported significantly higher depression ($F = 21.23$, $P < 0.01$), anxiety ($F = 15.64$, $P = 0.01$), and insomnia ($F = 21.92$, $P < 0.01$), than those who were not. Significant differences in depression ($F = 3.27$, $P = 0.01$), anxiety ($F = 2.31$, $P = 0.05$) and insomnia ($F = 2.52$, $P = 0.04$) were found among different occupations, and white-collar employees had the worst mental health status.

Table 2 describes the correlations of anxiety, depression, and insomnia with each dimension of dysfunctional beliefs about sleep. Results show strong, positive correlations exist between anxiety, depression, and insomnia, and these three factors are all significantly correlated with all of the dimensions of dysfunctional beliefs about sleep to different degrees.

The screening criteria for depression, anxiety, and insomnia were set at PHQ-9 >10, GAD-7 >5, and ISI >8 respectively. Results showed 27.0, 55.3, and 47.8% of the participants have various degrees of depression, anxiety, and insomnia; and 11.3, 17.2, and 16.8% of the total reported moderate or severe depression, anxiety, and insomnia, respectively. Logistic regression analysis showed that female participants were more likely to report depression (OR = 1.35, $P = 0.04$), anxiety (OR = 1.49, $P < 0.01$), and insomnia (OR = 1.48, $P < 0.01$), compared with male participants. Participants who were concerned about the economy were more likely to report depression (OR = 1.97, $P < 0.01$), anxiety (OR = 1.79, $P < 0.01$), and insomnia (OR = 1.67, $P < 0.01$), compared with those who were not. Education, age, and occupation significantly predicted anxiety and insomnia. Participants with a bachelor's degree or above, aged 18–40, and who had worked at a company were more likely to report anxiety and insomnia, see Table 3.

TABLE 1 Demographic characteristics of patients.

	n (% of total)	Depression	*F*	Anxiety	*F*	Insomnia	*F*
Overall	1,014	6.71 ± 5.91		4.81 ± 5.34		8.75 ± 6.13	
Gender							
Male	594 (58.6)	6.16 ± 5.83	12.39**	4.31 ± 5.21	12.94**	8.35 ± 6.30	6.08*
Female	420 (41.4)	7.48 ± 5.95		5.52 ± 5.44		9.31 ± 5.83	
Age							
<18	35 (3.5)	4.86 ± 4.91	5.14**	2.69 ± 3.73	4.71**	7.17 ± 5.15	7.79*
18–40	584 (57.6)	7.29 ± 5.87		5.27 ± 5.36		9.52 ± 6.12	
40–60	332 (32.7)	6.09 ± 5.93		4.43 ± 5.33		7.81 ± 6.02	
>60	63 (6.2)	5.54 ± 6.09		3.76 ± 5.51		7.30 ± 6.26	
Education							
High school or below	414 (40.8)	6.29 ± 6.06	3.18*	4.63 ± 5.30	4.38**	8.06 ± 6.29	5.04**
Junior college	403 (39.7)	6.71 ± 5.80		4.51 ± 5.23		9.03 ± 6.05	
Bachelor or above	197 (19.4)	7.57 ± 5.75		5.81 ± 5.34		9.62 ± 5.81	
Economic worry							
Yes	521 (51.4)	7.53 ± 5.94	21.23**	5.45 ± 5.46	15.64**	9.61 ± 6.07	21.92**
No	493 (48.6)	5.84 ± 5.76		4.14 ± 5.13		7.83 ± 6.07	
Occupation							
Industrial workers	252 (24.9)	5.83 ± 5.22	3.27**	4.08 ± 4.74	2.31*	8.20 ± 5.53	2.52*
Retirees	93 (9.2)	6.19 ± 6.15		4.69 ± 5.33		7.91 ± 6.31	
Students	55 (5.4)	6.65 ± 6.09		4.71 ± 5.12		8.09 ± 5.58	
Unemployed & others	276 (27.2)	6.68 ± 6.20		4.81 ± 5.34		8.69 ± 6.39	
White-collar employees	338 (33.3)	7.54 ± 5.97		5.42 ± 5.63		9.54 ± 6.32	

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

TABLE 2 Pearson correlation analysis among all variables.

	1	2	3	4	5	6
1. Sleep expectation						
2. Assignment of drug	0.44**					
3. Consequences of insomnia	0.74**	0.69**				
4. Worry about sleep	0.65**	0.77**	0.85**			
5. Depression	0.28**	0.42**	0.42**	0.50**		
6. Anxiety	0.28**	0.42**	0.42**	0.49**	0.86**	
7. Insomnia	0.34**	0.44**	0.46**	0.55**	0.74**	0.69**

**$p < 0.01$.

Statistical analyses showed 51.4% of the participants had false beliefs about sleep. Table 4 summarizes the prevalence of depression, anxiety, and insomnia according to beliefs about sleep among patients with COVID-19 who were treated in Fangcang shelter hospitals. Accurate beliefs about sleep protect respondents from experiencing depression ($\chi^2 = 107.31$, $P < 0.01$), anxiety ($\chi^2 = 180.30$, $P < 0.01$), and insomnia ($\chi^2 = 168.48$, $P < 0.01$).

Discussion

In the current study, we investigated the anxiety, depression, and insomnia among patients treated in Fangcang shelter hospitals during the wave of the COVID-19 pandemic that was dominated by the Omicron variant. The effects of dysfunctional beliefs about sleep on the insomnia, depression, and anxiety of patients in Fangcang shelter hospitals were also explored.

TABLE 3 Prevalence of depression, anxiety and insomnia according to the demographic variables.

	No. of cases (%)	Adjusted OR (95% CI)	*P*		No. of cases (%)	Adjusted OR (95% CI)	*P*		No. of cases (%)	Adjusted OR (95% CI)	*P*
Depression	274 (27.0)			**Anxiety**	453 (44.7)			**Insomnia**	529 (52.2)		
Gender				Gender				Gender			
Male	146 (24.6)	1 [Reference]		Male	146 (24.6)	1 [Reference]		Male	286 (48.1)	1 [Reference]	
Female	128 (30.5)	1.35 (1.02–1.78)	0.04	Female	212 (50.5)	1.49 (1.16–1.92)	<0.01	Female	243 (57.9)	1.48 (1.14–1.90)	<0.01
Age				Age				Age			
<18	5 (14.3)	1 [Reference]		<18	11 (31.4)	1 [Reference]		<18	14 (40.0)	1 [Reference]	
18–40	175 (30.0)	2.57 (0.98–6.73)	0.06	18–40	290 (49.7)	2.15 (1.03–4.47)	0.04	18–40	338(57.9)	1.03 (1.03–4.13)	0.04
40–60	82 (24.7)	1.97 (0.74–5.24)	0.18	40–60	133 (40.1)	1.49 (0.69–3.08)	0.32	40–60	152 (45.8)	1.27 (0.62–2.58)	0.51
>60	12 (19.0)	1.41 (0.45–4.34)	0.55	>60	19 (30.2)	0.94 (0.39–2.30)	0.90	>60	25 (39.7)	0.99 (0.42–2.30)	0.97
Education				Education				Education			
HSB	105 (25.4)	1 [Reference]		HSB	177 (42.8)	1 [Reference]		HSB	189 (45.7)	1 [Reference]	
JC	112 (27.8)	1.13 (0.83–1.55)	0.43	JC	169 (41.9)	0.97 (0.73–1.28)	0.83	JC	228 (56.6)	1.55 (1.17–2.04)	<0.01
BA	57 (28.9)	1.20 (0.82–1.75)	0.35	BA	107 (54.3)	1.59 (1.13–2.24)	0.01	BA	112 (56.9)	1.57 (1.11–2.21)	0.01
EW				EW				EW			
Yes	174 (33.4)	1 [Reference]		Yes	269 (51.6)	1 [Reference]		Yes	304 (58.3)	1 [Reference]	
No	100 (20.3)	0.51 (0.38–0.68)	<0.01	No	184 (37.3)	0.56 (0.43–0.71)	<0.01	No	225 (45.6)	0.60 (0.47–0.77)	<0.01
Occupation				Occupation				Occupation			
IW	61 (24.2)	1 [Reference]		IW	101 (40.1)	1 [Reference]		IW	129 (51.2)	1 [Reference]	
Retirees	20 (21.5)	0.86 (0.48–1.52)	0.18	Retirees	41 (44.1)	1.18 (0.73–1.91)	0.50	Retirees	46 (49.5)	1.01 (0.64–1.65)	0.91
Students	13 (23.6)	0.97 (0.49–1.92)	0.25	Students	25 (45.5)	1.25 (0.69–2.24)	0.46	Students	25 (45.5)	0.87 (0.49–1.57)	0.65
UE & others	78 (28.3)	1.23 (0.84–1.82)	0.13	LP	119 (43.1)	1.13 (0.80–1.60)	0.48	LP	141 (51.1)	1.10 (0.78–1.54)	0.60
WCE	102 (30.2)	1.35 (0.93–1.96)	0.11	WCE	167 (49.4)	1.46 (1.05–2.03)	0.03	WCE	194 (57.4)	1.41 (1.02–1.96)	0.04

HSB, High school or below; JC, Junior college; BA, Bachelor or above; IW, Industrial workers; UE, Unemployed; WCE, White-collar employees.

10.3389/fpubh.2023.1129322

TABLE 4 Prevalence of depression, anxiety and insomnia according to respondents' BAS.

Variable	Accurate BAS N (%)	False BAS N (%)	χ^2	p
Depression				
Yes	60 (12.2)	214 (41.1)	107.31	<0.01
No	433 (87.8)	307 (58.9)		
Anxiety				
Yes	114 (23.1)	339 (65.1)	180.30	<0.01
No	379 (76.9)	182 (34.9)		
Insomnia				
Yes	154 (31.2)	375 (72.0)	168.48	<0.01
No	339 (68.8)	146 (28.0)		

BAS, beliefs about sleep.

The positive screening rates for anxiety, depression, and insomnia among the tested patients were 55.3, 27.0, and 47.8%, respectively. Amid the pandemic, the positive screening rates of anxiety, depression, and insomnia among the general Chinese adult population were 35.1, 20.1, and 18.2% respectively (25). Of the participants, 11.3, 17.2, and 16.8% reported moderate or severe depression, anxiety, and insomnia. Gu et al. reported 50.1, 54.4, and 10.2% of patients in Fangcang shelter hospitals had moderate or severe symptoms of anxiety, depression, and insomnia, respectively, in 2020 (4), showing significant less participants have moderate or severe affective disorders in our study, compared with patients at the early stages of the pandemic. On the one hand, although the virulence of the Omicron variant is significantly weaker, the proportions of affective and sleep disorders among patients treated in Fangcang shelter hospitals were still higher than those of healthy people. On the other hand, although many patients reported depression, anxiety, or sleep problems to different degrees, the majority of them were mild cases, and the incidence of moderate or severe disorders was significantly reduced compared with patients at the early stages of the pandemic. These facts indicate that attention should be paid to the mental health problems of patients in Fangcang shelter hospitals.

Analysis of variance, and logistic regression analysis of anxiety, depression, and insomnia all demonstrated that patients who were female, aged 18–40 years, had a bachelor's degree or above, were white-collar employees, or those who thought the pandemic would have severe economic effects, reported higher anxiety, depression, and insomnia, and were more likely to report affective and sleep disorders. In particular, those with high education levels were more prone to affective and sleep disorders, which was the opposite result to that of a survey of patients treated in Fangcang shelter hospitals of Wuhan in 2020, conducted by Gu et al., who found patients with lower education levels were more likely to suffer anxiety and depression (4). Possible explanations for this were that during the early pandemic, patients were more worried about their illness status, probable fatality rates, and sequellae (26, 27). As patients with higher education levels had more channels to acquire correct information about the disease, they felt less anxiety or tension (28). Then, 2 years after the pandemic, especially when the low virulence and fatality rates of the Omicron variant were widely reported, the majority of patients were well acquainted with COVID-19 (19). On the contrary, patients with higher education levels were more worried about the sociometric impacts of the pandemic. Our study showed that the proportion of patients with higher education levels who thought the pandemic would have severe economic impacts was significantly higher than that of patients with lower education levels (42.8% of participants with a high school education reported they were very worried about the economy; and the rates were 55.1 and 62.9% for participants in the current study with a junior college education and with bachelors' degree or above, respectively). Thus, patients with higher education levels reported higher anxiety, depression, and insomnia.

Our study showed the dimensions of dysfunctional beliefs about sleep were all significantly positively correlated with insomnia, anxiety, and depression. About 51.4% of participants had dysfunctional beliefs about sleep to varying degrees. Compared to patients with accurate beliefs about sleep, the ratios of insomnia, anxiety, and depression were significantly higher among patients with dysfunctional beliefs about sleep. This result was consistent with a study on Moroccan adults during the pandemic (15). Dysfunctional beliefs about sleep (e.g., unreasonable expectations of the duration of sleep and over-estimation of possible impacts of insomnia) will affect sleep execution (29). The cognitive model of sleep states that dysfunctional beliefs about sleep will drive individuals to conduct some sleep-related protective behaviors, which may induce secondary insomnia. Because of persistent insomnia, their self-feedback about sleep quality and insomnia will promote individuals to strengthen their personal dysfunctional beliefs (30). Patients in Fangcang shelter hospitals may have low-quality sleep due to the unfavorable living environment, and if they hold some dysfunctional beliefs about sleep, such as "I must sleep for a certain length of time so as to maintain energy"; such unrealistic expectations will arouse negative emotions (15). In particular, the worry and sense of helplessness related to insomnia and nightmares will easily arouse anxiety and depression, which may cause difficulty falling asleep, or nocturnal awakening (31–33). At the same time, sleep disorders are significantly and positively correlated with affective disorders (anxiety, depression). This has been extensively shown in many previous studies, as well as in some recent studies during the COVID-19 pandemic (14, 34, 35). So, accurate beliefs about sleep can prevent patients in Fangcang shelter hospitals from depression, anxiety, and insomnia.

Given that dysfunctional beliefs about sleep play a key role in inducing and maintaining insomnia and negative emotions, our findings may imply that we can improve the sleep and mental health condition of patients in Fangcang shelter hospitals by altering their dysfunctional beliefs about sleep. For instance, Edinger et al. thought the dysfunctional beliefs about sleep and attitudes of individuals could be altered by cognitive behavioral therapy (12). It was found that scores of dysfunctional beliefs and attitudes were significantly lowered after the intervention, and participants' sleep quality indices were also largely improved, including: time taken to fall asleep, subjective sleep quality, duration of sleep, and times of awakening at night (12, 36). Thus, we suggest that COVID-19 patients, especially those in Fangcang shelter hospitals, should be kept apprised of correct sleep information and be helped to form

correct beliefs about sleep, which, critically, may help maintain their mental health.

This study has several limitations. First, convenience sampling was used, and moderate and severe patients were not investigated. Additionally, all data were collected only in two Fangcang shelter hospitals, so it is impossible to make any inferences about larger populations of COVID-19 patients. Second, due to the time and workload pressure, we failed to collect data on healthy adults for this period of time as a comparable control group. Third, this is a cross-sectional study, and we cannot determine any causal relationships among the variables.

Conclusions and perspectives

Attention should be paid to the mental health problems of patients in Fangcang shelter hospitals. We recommend giving patients in Fangcang shelter hospitals more psychological support, and helping them to form correct beliefs about sleep, which may help maintain their mental health.

Data availability statement

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

Ethics statement

This study was approved by the Clinical Trial Ethics Committee of the First Affiliated Hospital of Air Force Medical University and is registered at the Chinese Clinical Trial Registry, with the registration number CHiCTR1800019761. The patients/participants provided their written informed consent to participate in this study.

Author contributions

JP and YL were responsible for the writing of this manuscript. LW, XP, CL, XL, JY, and LM were responsible for the data collection. JP and PF were responsible for the data analysis. PF and JS were responsible for the experimental design. TZ was responsible for the revision. All authors approved the final manuscript.

Funding

This study was financially supported by the National Natural Science Foundation of China (31900791), China Postdoctoral Science Foundation (2019M653963), the Scientific and technological research projects for major problems in aviation medicine (2020ZTD01), and Air Force Medical University Everest project (2020cyjhfp).

Conflict of interest

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

Publisher's note

References

1. Wang X, Fang J, Zhu Y, Chen L, Ding F, Zhou R, et al. Clinical characteristics of non-critically ill patients with novel coronavirus infection (COVID-19) in a Fangcang Hospital. *Clin Microbiol Infect.* (2020) 26:1063–8. doi: 10.1016/j.cmi.2020.03.032

2. Yuan Y, Qiu T, Wang T, Zhou J, Ma Y, Liu X, et al. The application of Temporary Ark Hospitals in controlling COVID-19 spread: the experiences of one Temporary Ark Hospital, Wuhan, China. *J Med Virol.* (2020) 92:2019–26. doi: 10.1002/jmv.25947

3. Dai LL, Wang X, Jiang TC, Li PF, Wang Y, Wu SJ, et al. (2020). Anxiety and depressive symptoms among COVID-19 patients in Jianghan Fangcang Shelter Hospital in Wuhan, China. *PloS ONE.* 15, e0238416. doi: 10.1371/journal.pone.0238416

4. Gu Y, Zhu Y, Xu F, Xi J, Xu G. Factors associated with mental health outcomes among patients with COVID-19 treated in the Fangcang shelter hospital in China. *Asia-Pacific Psychiatry.* (2021) 13:e12443. doi: 10.1111/appy.12443

5. Gu Y, Zhu Y, Xu G. Factors associated with mental health outcomes among health care workers in the Fangcang shelter hospital in China. *Int J Soc Psychiatry.* (2022) 68:64–72. doi: 10.1177/00207640209 75805

6. Zhang GY, Liu Q, Lin JY, Yan L, Shen L, Si TM, et al. (2021). Mental health outcomes among patients from Fangcang shelter hospitals exposed to coronavirus disease 2019: an observational cross-sectional study. *Chronic Dis Transl Med.* 7, 57–64. doi: 10.1016/j.cdtm.2020.12.001

7. Brandão LEM, Martikainen T, Merikanto I, Holzinger B, Morin CM, Espie CA, et al. Social jetlag changes during the COVID-19 pandemic as a predictor of insomnia–a multi-national survey study. *Nat Sci Sleep.* (2021) 1711–22. doi: 10.2147/NSS.S3 27365

8. Cénat JM, Blais-Rochette C, Kokou-Kpolou CK, Noorishad PG, Mukunzi JN, McIntee SE, et al. (2021). Prevalence of symptoms of depression, anxiety, insomnia, posttraumatic stress disorder, and psychological distress among populations affected by the COVID-19 pandemic: a systematic review and meta-analysis. *Psychiatry Res.* 295, 113599. doi: 10.1016/j.psychres.2020.113599

9. Jahrami H, BaHammam AS, Bragazzi NL, Saif Z, Faris M, Vitiello MV. (2021). Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. *J Clin Sleep Med.* 17, 299–313. doi: 10.5664/jcsm.8930

10. Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, et al. Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. *Int J Environ Res Public Health.* (2020) 17:4065. doi: 10.3390/ijerph171 14065

11. Lin W, Wu B, Chen B, Lai G, Huang S, Li S, et al. Sleep conditions associate with anxiety and depression symptoms among pregnant women during the epidemic of COVID-19 in Shenzhen. *J Affect Disord.* (2021) 281:567–73. doi: 10.1016/j.jad.2020. 11.114

12. Edinger JD, Wohlgemuth WK, Radtke RA, Marsh GR, Quillian RE. Does cognitive-behavioral insomnia therapy alter dysfunctional beliefs about sleep? *Sleep.* (2001) 24:591–9. doi: 10.1093/sleep/24.5.591

13. Morin CM, Vallières A, Ivers H. Dysfunctional beliefs and attitudes about sleep (DBAS): validation of a brief version (DBAS-16). *Sleep.* (2007) 30:1547–54. doi: 10.1093/sleep/30.11.1547

14. Blake MJ, Trinder JA, Allen NB. Mechanisms underlying the association between insomnia, anxiety, and depression in adolescence: implications for behavioral sleep interventions. *Clin Psychol Rev.* (2018) 63:25–40. doi: 10.1016/j.cpr.2018.05.006

15. Idrissi AJ, Lamkaddem A, Benouajjit A, El Bouaazzaoui MB, El Houari F, Alami M, et al. (2020). Sleep quality and mental health in the context of COVID-19 pandemic and lockdown in Morocco. *Sleep Med.* 74, 248–253. doi: 10.1016/j.sleep.2020.07.045

16. Sella E, Carbone E, Toffalini E, Borella E. Self-reported sleep quality and dysfunctional sleep-related beliefs in young and older adults: changes in times of COVID-19 lockdown. *Sleep Med.* (2021) 81:127–35. doi: 10.1016/j.sleep.2021.02.017

17. Bacaro V, Chiabudini M, Buonanno C, De Bartolo P, Riemann D, Mancini F, et al. (2020). Insomnia in the Italian population during Covid-19 outbreak: a snapshot on one major risk factor for depression and anxiety. *Front Psychiatry* 11, 579107. doi: 10.3389/fpsyt.2020.579107

18. Xu Z, Lu H, Zhou J, Feng X, Hambly B, Fan J, et al. Implementation of emergency general practitioner management of patients during the complete lockdown consequent to the COVID-19 Omicron outbreak in Shanghai. *Hypertension.* (2022) 1:0–0001. doi: 10.31128/AJGP-COVID-51-5

19. Brüssow H. COVID-19: Omicron–the latest, the least virulent, but probably not the last variant of concern of SARS-CoV-2. *Microb Biotechnol.* (2022) 15:1927–39. doi: 10.1111/1751-7915.14064

20. Fu S, Ou H, Lu S. Reliability and validity of the brief version of dysfunctional beliefs and attitudes about sleep. *Chin J Behav Med Brain Sci.* (2014) 23:369–71. doi: 10.3760/cma.j.issn.1674-6554.2014.04.024

21. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med.* (2006) 166:1092–7. doi: 10.1001/archinte.166.10.1092

22. Ruiz MA, Zamorano E, García-Campayo J, Pardo A, Freire O, Rejas J, et al. Validity of the GAD-7 scale as an outcome measure of disability in patients with generalized anxiety disorders in primary care. *J Affect Disord.* (2011) 128:277–86. doi: 10.1016/j.jad.2010.07.010

23. Manea L, Gilbody S, McMillan D. A diagnostic meta-analysis of the Patient Health Questionnaire-9 (PHQ-9) algorithm scoring method as a screen for depression. *Gen Hosp Psychiatry.* (2015) 37:67–75. doi: 10.1016/j.genhosppsych.2014.09.009

24. Bastien CH, Vallières A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Med.* (2001) 2:297–307. doi: 10.1016/S1389-9457(00)00065-4

25. Galea S, Merchant RM, Lurie N. The mental health consequences of COVID-19 and physical distancing: the need for prevention and early intervention. *JAMA Intern Med.* (2020) 180:817–8. doi: 10.1001/jamainternmed.2020.1562

26. Kavakli M, Ak M, Uguz F, Türkmen OO. The mediating role of self-compassion in the relationship between perceived COVID-19 threat and death anxiety. *J Clin Psychiatry.* (2020) 23:15–23. doi: 10.5505/kpd.2020.59862

27. Özgüç S, Kaplan Serin E, Tanriverdi D. Death anxiety associated with coronavirus (COVID-19) disease: a systematic review and meta-analysis. *OMEGA J Death Dying.* (2021) 8:00302228211050503. doi: 10.1177/00302228211050503

28. Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, et al. (2021). The prevalence of depressive symptoms, anxiety symptoms and sleep disturbance in higher education students during the COVID-19 pandemic: a systematic review and meta-analysis. *Psychiatry Res.* 301, 113863. doi: 10.1016/j.psychres.2021.113863

29. Garland SN, Campbell T, Samuels C, Carlson LE. Dispositional mindfulness, insomnia, sleep quality and dysfunctional sleep beliefs in post-treatment cancer patients. *Pers Individ Dif.* (2013) 55:306–11. doi: 10.1016/j.paid.2013.03.003

30. Harvey AG, Tang NKY, Browning L. Cognitive approaches to insomnia. *Clin Psychol Rev.* (2005) 25:593–611. doi: 10.1016/j.cpr.2005.04.005

31. Calkins AW, Hearon BA, Capozzoli MC, Otto MW. Psychosocial predictors of sleep dysfunction: the role of anxiety sensitivity, dysfunctional beliefs, and neuroticism. *Behav Sleep Med.* (2013) 11:133–43. doi: 10.1080/15402002.2011.643968

32. Jin L, Zhou J, Peng H, Ding S, Yuan H. Investigation on dysfunctional beliefs and attitudes about sleep in Chinese college students. *Neuropsychiatr Dis Treat.* (2018) 14:1425–32. doi: 10.2147/NDT.S155722

33. Scarpelli S, Nadorff MR, Bjorvatn B, Chung F, Dauvilliers Y, Espie CA, et al. Nightmares in people with COVID-19: did coronavirus infect our dreams? *Nat Sci Sleep.* (2022) 14:93. doi: 10.2147/NSS.S344299

34. Johnson EO, Roth T, Breslau N. The association of insomnia with anxiety disorders and depression: exploration of the direction of risk. *J Psychiatr Res.* (2006) 40:700–8. doi: 10.1016/j.jpsychires.2006.07.008

35. Morin CM, Bjorvatn B, Chung F, Holzinger B, Partinen M, Penzel T, et al. (2021). Insomnia, anxiety, and depression during the COVID-19 pandemic: an international collaborative study. *Sleep Med.* 87, 38–45. doi: 10.1016/j.sleep.2021.07.035

36. Thakral M, Von Korff M, McCurry SM, Morin CM, Vitiello MV. Changes in dysfunctional beliefs about sleep after cognitive behavioral therapy for insomnia: a systematic literature review and meta-analysis. *Sleep Med Rev.* (2020) 49:101230. doi: 10.1016/j.smrv.2019.101230

frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 23 February 2023
DOI 10.3389/fpsyt.2023.1123356

OPEN ACCESS

EDITED BY
Mohammadreza Shalbafan,
Iran University of Medical Sciences, Iran

REVIEWED BY
Tina Peraica,
University Hospital Dubrava, Croatia
Ah Yusuf,
Airlangga University, Indonesia
Gianluca Serafini,
San Martino Hospital (IRCCS), Italy

*CORRESPONDENCE
Ismail Rammouz
✉ i.rammouz@uiz.ac.ma

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

RECEIVED 13 December 2022
ACCEPTED 25 January 2023
PUBLISHED 23 February 2023

CITATION
Rammouz I, Lahlou L, Salehddine Z, Eloumary O, Laaraj H, Ouhamou M, Mouhadi K, Doufik J, Aalouane R and Boujraf S (2023) Religiosity, stress, and depressive symptoms among nursing and medical students during the middle stage of the COVID-19 pandemic: A cross-sectional study in Morocco. *Front. Psychiatry* 14:1123356. doi: 10.3389/fpsyt.2023.1123356

Religiosity, stress, and depressive symptoms among nursing and medical students during the middle stage of the COVID-19 pandemic: A cross-sectional study in Morocco

Ismail Rammouz[1,2,3]*, Laila Lahlou[2], Zineb Salehddine[3], Omar Eloumary[3], Hicham Laaraj[3], Mina Ouhamou[3], Khalid Mouhadi[2], Jalal Doufik[2,3], Rachid Aalouane[1] and Said Boujraf[1]

[1]Clinical Neurosciences Laboratory, Faculty of Medicine, Sidi Mohamed Ben Abdellah University, Fez, Morocco, [2]Clinical Neuroscience, Innovation and Ethic (NICE) Laboratory REGNE, Medical School of Agadir, Ibn Zohr University, Agadir, Morocco, [3]Departement of Psychiatry, Faculty of Medicine, Ibn Zohr University, Agadir, Morocco

Background: Recent studies on nursing and medical students showed a higher prevalence of depression and stress than the general population. Religiosity and spirituality are common in Muslim countries and are usually used as a means of coping strategy for psychological and mental disorders.

Objective: Our objective was to evaluate the association between religious actions, depressive symptoms, and stress among students of nursing education lasting 3 years and students from the first 3 years of medical education lasting 7 years. The study was conducted at Ibn Zohr University of Agadir, Morocco.

Method: A sample of different stages of nursing and medical students was recruited. Religiosity was assessed by Muslim Belief into Action (M.BIAC) scale. The depressive symptoms and stress were, respectively, assessed by the Beck Depression Inventory (BDI-II) and Perceived Stress Scale (PSS).

Results: Four hundred and thirteen students participated in this study. Our results showed a high prevalence of depressive symptoms (62.2%) and stress (66.8%). The depression scores were higher in the following subsample categories: students in the first 2 years of studies, female medical students, and nursing students with significant differences. The recorded religiosity was greater among students without depression compared to students with depression ($p < 0.001$). In the multivariate regression, the BIAC score demonstrated religiosity as neither a risk factor nor a protective factor of depression.

Conclusion: Religiosity constitutes a protective factor of depression and stress among nursing and medical students. This should improve the student's ability to cope with stressful situations during their training. Prospective studies are needed to further investigate this association and how religiosity improves mental health. This would contribute to improved academic performance and wellbeing among medical and nursing students.

KEYWORDS

religiosity, spirituality, stress, depression, students

Introduction

Medical education is one of the most demanding training programs in both academic and emotional dimensions (1). Previous studies have reported higher rates of poor mental health among nursing students (1–6).

A recent meta-analysis reported a global prevalence of anxiety of 33.8% among medical students, which is significantly higher compared to the general population (1). An earlier review of 11 studies reported a prevalence of anxiety among medical students outside North American countries, ranging between 7.7 and 65.5% (4).

In addition, a systematic review by Rotenstein et al. reported an estimate of depression prevalence or depressive symptoms among medical students of 27.2%, while suicidal ideation represented 11.1% (3).

In addition, studies reported conflicting findings about whether depression and suicidality vary according to undergraduate year, sex, or other demographic and educational characteristics (2, 3).

Felicilda-Reynaldo et al. measured the quality of life and examined the predictive roles of religiosity and spirituality coping among nursing students from four countries. Their findings showed that frequent attendance to organized and non-organized religious activities leads to better physical and environmental domains; in addition, using non-organized religious activities frequently leads to improved psychological health. The same study concluded that more frequent use of religious coping strategies was associated with better physical, psychological, and environmental health, with improved social relationships (7).

The last two meta-analyses reported in 2022 obtained similar outcomes. Thus, the first meta-analysis done in China by Jin et al. included all cross-sectional studies on the prevalence of depression among Chinese medical students. The prevalence of depression among medical students in China was 27%. Sleep quality was an important heterogeneous source of depression. Medical students with sleep disorders were more likely to report depression more than three times compared with students without sleep disorders (8).

Additionally, the second meta-analysis was done by Li et al. (9). They analyzed a total of 64 studies, including 100,187 individuals. The common prevalence of depression and anxiety symptoms among college students was 33.6%. The highest prevalence of symptoms of depression was reported in Africa (40.1%), lower middle-income countries (42.5%), and medical students (39.4%). While the prevalence of anxiety symptoms was the highest in North America (48.3%), lower middle-income countries (54.2%), and among medical students (47.1%). The same meta-analysis found that the prevalence of depression and anxiety symptoms was higher in post-COVID-19 disease stages studies, especially after the global stage of lockdown (9). Another meta-analysis analyzed a total of 27 cross-sectional studies involving 8,918 nursing students and reported a high prevalence of depression of 34.0%. Significant differences in the prevalence of depression were noted for different age subgroups. The highest prevalence of depression among young students was 41.0%; the different geographic areas such as Asian nursing students demonstrated a higher prevalence of depression of 43.0% (10).

Many risk factors are reported and included the high competitiveness of medical school, simultaneous hospital training and lectures, overnight shift work, the large volume of knowledge, and the growth of medical, paramedical, logistical, and relational responsibilities (11–13).

Individuals have used a variety of coping strategies to deal with stressors, such as seeking support from social relationships, ruminating, venting, distraction, problem-solving, substance use, humor, and religion (14, 15).

Over the past two decades, studies focused on the potential impact of religion and spirituality in coping with stress. People often turn to prayer and other forms of religious or spiritual observance in sickness stages, death, and other types of adversity. They often report retrieving a sense of comfort in assets such as religious and spiritual resources (16–18). Indeed, worldwide studies have reported that various aspects of religiosity/spirituality are improving depression symptoms and decreasing the incidence of suicide (13). Studies conducted in Muslim countries focused on the context and why religiosity should be considered a valid coping strategy for mental health issues (19, 20). In the literature, the terms religiosity and spirituality are commonly used. Religiosity is usually considered to include three dimensions including organizational religious activities (Mosque attendance), non-organizational activities (private religious activities), and intrinsic or subjective religiousness, while spirituality often includes a sense of transcendence beyond one's immediate circumstances and meaning in life (21, 22).

To achieve the objectives of our study, we used a measurement of religiosity that emphasizes religious actions more than the concept of spirituality; hence, we often use the term religiosity in our manuscript. Sociologists typically measure religiosity using indicators of belief, behavior, and belonging. However, the socio-religious history of the Islamic world is complex, and a renewed examination of the dimensions of religiosity is necessary.

In Morocco, Islam is the dominant religion. It is practiced according to the Sunni tradition of Islam Religion. Nevertheless, spirituality coping has never been studied among Moroccan students. Our goal was to estimate the religiosity level, stress, and depression and to find the correlation between religiosity and reported psychological disorders among nursing and medical students in the very specific middle stage of the COVID-19 pandemic after the global lockdown. We hypothesized that religious actions might constitute an alternative coping strategy for affective disorders in the context of Arabic Islamic countries during the global COVID-19 pandemic context. A hypothesis was contrived by focusing on the indices of stress, depression, and religiosity, each following the appropriate and validated measuring scale in the same context. In addition, two negative hypotheses were considered in our study. First, there is no significant relationship between religiosity and the stress of students in the context of the COVID-19 pandemic, and second, there is no significant difference between the behavioral dimensions of religiosity and depression of students during the COVID-19 pandemic stage.

Methods

The study population

The data were collected from two schools of the Ibn Zohr University of Agadir, Morocco including a Medical School and a Nursing School. Data collection was conducted between February and May 2021, i.e., 1 year after the national global COVID-19 lockdown and 8 months after the restricted COVID-19 opening. Medical education lasts for 7 years and is typically divided into three stages: the first stage with the first 2 years is mainly of fundamental sciences, the second stage with 3 years is fully dedicated to clinical sciences and hospital training, and the third stage with 2 years is fully dedicated to an internship program. The nursing education pathway requires 3 years of both 50% of academic courses and 50% of supervised clinical practice in a hospital.

Data collection and inclusion criteria

The level of depression variable error acceptable was 5% (d = 0.05). In addition, the expected proportion of the population was 0.27 ($P = 0.27$) (8). Type I error rate was 5% ($\alpha = 0.05$), and the minimal sample size of the survey was 303 (23, 24). Furthermore, we have accomplished weighting of the number of nursing students and medical students. The inclusion criteria of students were living in Agadir city, being Muslim, born in Morocco, speaking the Arabic language, being older than 18 years, and being free of any significant mental, neurological, and cognitive disorders. The collected data covered a representative sample of the first 3 years of medical studies and all semesters of nursing studies including 3 years. Our sample participants were randomly recruited without targeting a sex ratio of 1:1. In fact, the rates of female students in nursing and medical schools are high, ranging from 65 to 70%.

Data collection process

Data collection was done during class time, not before or after educational activities. The questionnaire, objectives of the study, and confidentiality of data were well-explained by the investigators. All students participating in the study were informed of the study details including the protection of anonymous personal data and then gave their written informed consent. Administrative approval was obtained from the president of Ibn Zohr University to perform this study within the department of medical and nursing schools.

Our questionnaire initially targeted sociodemographic aspects such as age, sex, year of study, socioeconomic level of parents, marital status of parents and place of life, repetition of the classes' levels, and sources of study finance.

Religiosity assessment

Religiosity was assessed using Muslim BIAC (M.BIAC) scale (25). The original study of BIAC in English was conducted on female caregivers living in the Southeastern and Western USA. This study demonstrated that BIAC has solid psychometric properties with excellent internal consistency, test–retest reliability, and convergent validity (26).

The BIAC consists of 10 questions, with each rated on a scale ranging from 1 to 10, except the first question which is scored 1 or 10 depending on the response. The total scale score ranges from 10 to 100. Item 1 directly asked respondents to choose their highest priority in life, with common priorities among the response options ranging from their health to their family (including God). The remaining items assess attendance at religious services, religious social involvement besides attending religious services, decision to place life under God's requirements, percentage of annual income given two religious causes, time spent listening/viewing religious media, time spent reading religious books and scriptures, time spent in prayer or meditation, time spent in religious volunteering, and the degree to which life is being conformed to one's religious teachings (27). The Arabic version of BIAC was published in 2016 (28).

Rammouz et al. (25) studied the Moroccan Arabic version of the Muslim BIAC on a sample of 132 students at Ibn Zohr University, Agadir, Morocco. The Cronbach's alpha for internal reliability was 0.81, with the alpha for removed items ranging from 0.77 to 0.82. Test–retest reliability by intra-class correlation coefficient (ICC) was 0.87 (95% CI = 0.83–0.91). Discriminant validity indicated relatively weak correlations between depressive symptoms ($r = -0.06$) and perceived stress ($r = 0.08$) (25).

Depression assessments

Depression was assessed using the Beck Depression Inventory short version (BDI-II) (29). The short form of the Beck Depression Inventory (BDI-13) is useful for screening and assessing depression in clinical and research conditions. The BDI-13 assesses the symptoms including depressed mood, pessimism, sense of failure, lack of satisfaction, self-guilt, self-hate, self-harm, social withdrawal, distorted body image, indecisiveness, work difficulty, fatigue, and loss of appetite. Abdel-Khalek translated BDI-II and studied the coefficient of alpha among samples of male and female undergraduates recruited from Egypt, Saudi Arabia, Kuwait, and Lebanon ($n = 100, 80, 100, 100$, respectively). Values of Cronbach's alpha were 0.77, 0.82, 0.89, and 0.67, respectively (30). The total score varies from 0 to 39. We considered the interpretation of the scores as follows: 0–3: no depression, 4–7: mild depression or light depression, 8–15: moderate depression, and 16 and above: severe depression. We recorded the BDI-II score into a dichotomous variable: without depression for the categories no and mild depression and the presence of depression for the categories moderate and severe depression.

Stress assessments

The Perceived Stress Scale (PSS) was used in the sample (31). The PSS consists of 10 items and allows for assessing the stress perceptions over the past month for each participant. Each item is scored on 5 key choices of the Likert scale (0 = never to 4 = very often). A higher total score indicates higher levels of perceived stress. The translation and validation into the Moroccan

Arabic dialect of PSS were completed by Ben Loubir et al. on 535 participants aged over 18 years and belonging to different social categories. The Moroccan version of the PSS showed good internal reliability (Cronbach's alpha = 0.80) and test–retest reliability (ICC = 0.87) (32).

Data analyses

The statistical analysis was performed using Jamovi (open statistical software for the desktop and cloud software). All statistical methods used were two-tailed, with an alpha level of 0.05. Descriptive analysis was conducted by number (population) and percentage for categorical variables including students' sociodemographic data, perceived stress, and BDI-II severity. Cross-tabulation for factors associated with depression symptoms among students was determined using Pearson's chi-square test for significance and Fischer's exact test for small frequency distributions. Results are reported in Table 1. The mean of BIAC scores was compared with a *t*-test for 2 independent samples or ANOVA. For more than 2, a Tukey's test was carried out using *post-hoc* analysis. Prevalence and confidence intervals were estimated by the esci jamovi module. A multiple logistic regression model was used to determine the factors associated with depressive symptoms. The adjusted calculated odds ratio was statistically significant, with a p-value ≤ 0.05. All variables included in the multivariate analysis were statistically significant in the univariate analysis. They have also forced the model to introduce the BIAC score.

Results

Sociodemographic results

The achieved sample of the study consisted of 452 participants including 39 participants that did not complete the questionnaires. Thus, the final data to be analyzed consisted of 413 questionnaires collected from Muslims during the COVID-19 pandemic and represented a 28% higher sample compared to the initially calculated minimal representative sample. The mean age was 20.3 ± 1.68 years. The sample studied was predominantly women (70%), and 70.2% had medium family income. The details of the sociodemographic data are reported in Table 1.

Depression and stress assessment results

The depression assessment reported 26.4% of respondents with scores of moderate depression and 35.8% reported severe depression. In addition, 49.6% of students reported moderate stress and 17.2% reported severe stress. Details of these assessments are presented in Table 2. The mean score of M.BIAC was 43.8 ± 14, and the median was 44, ranging between 35 and 52. More details are provided according to school affiliation, severity, and significance in Table 2.

Depression scores were higher in girls and nursing students, and in the first 2 years of studies at both nursing and medical schools, respectively with p-value < 0.05. Religiosity was shown to be higher in students without depression compared to students expressing depression ($p < 0.001$). Initial correlation analysis was done to characterize the relationship between depression and sociodemographic data. The detailed results are presented in Table 3.

Indeed, the most achieved correlations of studied variables were found to be not statistically significant; except for depression which was found to be highly correlated with studying a nursing program vs. a medical program ($p < 0.001$). In addition, studying in the 2nd year was highly correlated with depression ($p < 0.001$). Details of these aspects are presented in Table 3. The difference between mean depression and mean stress was significant ($p < 0.001$). The religious scores were positively correlated with stress and depression scores. Therefore, we noticed an important finding; the religious scores were higher in students with either severe depression or without depression. In contrast, students with moderate depression have demonstrated the lowest religiosity scores (Figure 1). Moreover, the association between stress and religiosity did not reveal any significant difference between different levels of stress scores and religiosity scores (Figure 1).

A binary multivariate logistic regression was done to examine the risk factors of depression symptoms among nursing and medical students (Table 3) found that nursing students have almost six times more risk for depression symptoms compared with medical students (OR = 6.52; 95% CI: 3.15–13.5) and students in the first (OR = 4.12; 95% CI: 2.13–8) or second year of study (OR = 3.01; 95% CI: 1.68–5.39) compared with the third year. In addition, the levels of depression and religiosity revealed in the study sample vs. severe (OR = 8.08; 95% CI: 3.47–18.8) and moderate (OR = 6.47; 95% CI: 3.78–11.07) perceived stress during the COVID-19 pandemic (Figure 2).

Discussion

In fact, religiosity is probably used as a resilience factor by studied students with severe depression to fight against negative emotions and negative cognitions during the COVID-19 pandemic. Consistently, religiosity was higher among students without depression, indicating the potential use of religiosity as a defensive means against affective disorder during the COVID-19 pandemic. More explicitly,

i) Students with severe depression have expressed higher religiosity during the COVID-19 pandemic, and people with intense negative emotions are mostly indicating the style of religious coping.

ii) Students without depression during the COVID-19 pandemic have expressed higher religiosity, which could be explained by the preventive role of religiosity.

iii) Students with moderate depression during the COVID-19 pandemic have shown less religiosity; which could be explained by the fact that despite the presence of moderate negative emotions, these people do not feel a great need to have rescue remedy resources in religion.

BIAC is a tool for measuring religious behavior rather than any emotional or cognitive aspect of religion. Thus, our study has examined the religious actions with Islamic traditions during the COVID-19 pandemic. Indeed, religious coping is

10.3389/fpsyt.2023.1123356

TABLE 1 Comparison of depression with sociodemographic data, religiosity, depression, and stress scores (BIAC).

Variables	Total ($n = 156413$)	With depression $n = 156257$	Without depression $n = 156$	*P*-value
Age (years)	20.3 ± 1.68	20.2 ± 1.3	20.4 ± 2.1	0.08
Sex				<0.001
Female	289 (70)	196 (76.3)	93 (59.6)	
Male	124 (26)	61 (23.7)	63 (40.4)	
Repeated class	34 (8.3)	18 (8)	16 (10.4)	0.2
Students				<0.001
Medical students	92 (22.3)	38 (14.8)	54 (34.6)	
Nursing students	321 (77.7)	219 (85.2)	102 (65.4)	
Living				0.173
Alone	31 (7.5)	16 (6.2)	15 (9.6)	
With family	255 (61.7)	167 (65)	88 (56.4)	
With parents	121 (29.3)	69 (26.8)	52 (33.3)	
Campus	6 (1.5)	5 (1.9)	1 (0.6)	
Year of study				<0.001
First	102 (25.2)	79 (27)	23 (14.8)	
Second	174 (42.5)	112 (43.6)	62 (40.0)	
Third	133 (32.5)	64 (25.0)	69 (44.5)	
Marital statues				0.6
Single	403 (97.6)	251 (97.7)	152 (97.4)	
Married	7 (1.7)	5 (1.9)	2 (1.3)	
Divorced	3 (0.7)	1 (0.4)	2 (1.3)	
Parents situation				0.9
Married	366 (88.6)	227 (88.3)	139 (89.1)	
Divorced	17 (4.1)	11 (4.3)	6 (3.8)	
One dead	30 (7.3)	19 (7.4)	11 (7.1)	
Financing studies				0.01
Totally	244 (59.1)	166 (64.6)	78 (50)	
Partially	144 (34.9)	79 (30.7)	65 (41.7)	
No thing	25 (6.1)	12 (4.7)	13 (4.7)	
Socio-Economic				0.139
High	61 (14.9)	44 (17.1)	17 (11.1)	
Medium	288 (70.2)	172 (66.9)	116 (75.8)	
Low	61 (14.9)	41 (18)	20 (13.1)	
M.BIAC score	43.8 ± 14	43.6 ± 12	44.2 ± 16.6	0.6
Perceived stress				<0.001
Low	137 (33.2)	54 (24)	83 (53.2)	
Moderate	205 (49.6)	158 (61.5)	47 (30.1)	
Severe	71 (17.2)	45 (17.5)	26 (16.7)	

highly variable from one item to another. In Muslim countries, some people use their religious beliefs mostly within a cognitive framework, while others are involved in religious actions compared to general spirituality. These dimensions are supporting the concept of behavioral religiosity in opposition to emotional or/and cognitive religiosity, which is equivalent to the concept of spirituality. Reported studies have shown the link between spirituality/religiosity and affective disorders. The religiosity was

TABLE 2 Levels of depression, stress, and religiosity among the study sample (BIAC).

Variables	Total ($n = 413$)	Prevalence (CI95%) for nursing students	Prevalence (CI95%) for medical students	Nursing students ($n = 321$)	Medical students ($n = 91$)	*P*-value
M.BIAC score	43.8 ± 14* 44 [35–52]^			43.1 ± 11.8	46.8 ± 19.3	0.025
Perceived stress score						<0.001
Low	137 (33.2)	38 (32.8–43.4)	16.5 (10.3–25.4)	122 (9)	15 (16.5)	
Moderate	205 (49.6)	53.9 (48.4–59.3)	35.2 (26.1–45.5)	173 (53.9)	32 (35.2)	
Severe	71 (17.2)	8.1 (5.5–11.6)	48.4 (38.4–58.5)	26 (8.1)	44 (48.4)	
Beck depression score						<0.001
No depression	97 (23.5)	21.2 (19–22, 24, 25, 28–31)	30.8 (22.2–40.8)	68 (21.2)	28 (30.8)	
Mild depression	59 (14.3)	10.6 (76.8–14.4)	27.5 (19.3–37.4)	34 (10.6)	25 (27.5)	
Moderate depression	109 (26.4)	23.1 (18.7–28)	38.5 (29.1–48.7)	74 (23.1)	35 (38.5)	
Severe depression	148 (35.8)	45.2 (39.8–50.6)	3.3 (1.1–9.2)	145 (45.2)	3 (3.3)	

*Mean ± SD. ^Median [IQR]. CI, confidence interval.

TABLE 3 Binary multivariate logistic regression of factors associated with depression symptoms among medical and nursing students at Ibn Zohr University, Morocco, 2022.

	ORa	CI (95%)	*P*-value
Nursing-medical student	6.52	3.15–13.50	<0.001*
Female	1.55	0.90–2.63	0.054
Year of study			
First-third	4.13	2.13–7.99	<0.001*
Second-third	3.01	1.68–5.39	<0.001*
Perceived stress			
Moderate-low	6.47	3.78–11.07	<0.001*
Severe-low	8.08	3.47–18.81	<0.001*
Financing studies			
Partially-totally	0.70	0.43–1.15	0.1
Nothing-totally	0.61	0.21–1.77	0.3
BIAC score	0.99	0.98–1.01	0.92

* Means statistically significant values.

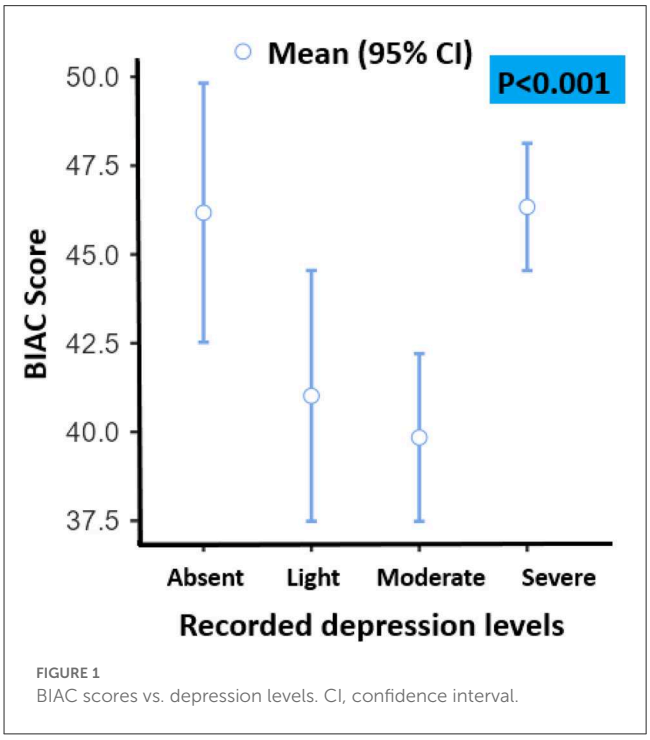


FIGURE 1
BIAC scores vs. depression levels. CI, confidence interval.

associated with lower levels of anxiety, depressive symptoms, and demand for mental health services among black men on a college Campus (6) outside the COVID-19 pandemic context, while in our study, religiosity was shown to be significantly higher among students without depression and among students with severe depression.

Other studies have analyzed the potential protective factor of religiosity from suicidal behaviors (33, 34). In Tunisia, a Muslim country similar to Morocco, Romdhane et al. have studied Tunisian Muslim youth religiosity after the 2010 Revolution and found a strong negative correlation between suicidal ideations and the three sub-scores of religiosity after controlling for the associations between psychosocial variables and suicidal ideations scores (33). Jin Kim et al. studied college students who did not engage in religious meetings and private religious activities and showed to have elevated depressive symptoms and a higher risk of suicidal ideation (34). In addition, students are shown to have more confidence in an immense God rather than adhering to a given hard line of spirituality (35).

The relationship between religiosity and mental health is complex, and other intermediate factors may be crucial, such as personality features, resilience capabilities, social and family support, self-esteem, and many other potential factors.

Indeed, the different dimensions of religiosity are not equal regarding their perception and positive impact on mental health.

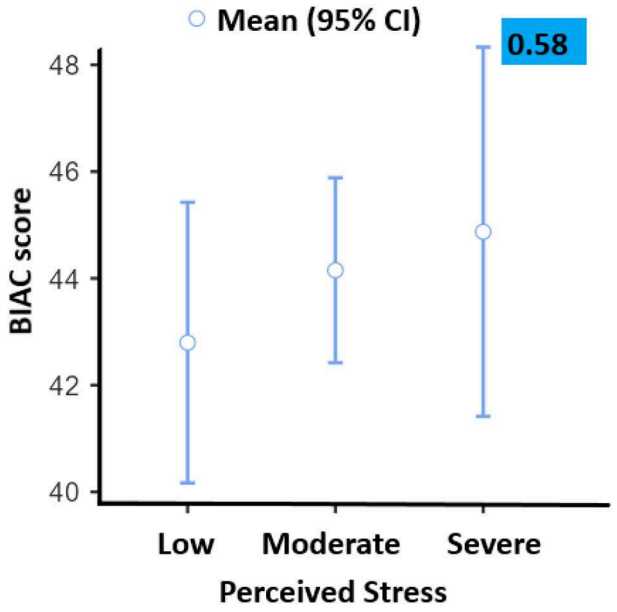


FIGURE 2
BIAC scores vs. stress levels. CI, confidence interval.

Hence, the emotional dimension of religiosity approaching spirituality would be more crucial than the behavioral dimension.

Kendler et al. considered religiosity as a complex, multidimensional construct with substantial association with mental health. Some dimensions of religiosity are related to reducing the risks of mental disorders, especially impacting the potential of internalizing disorders, and others contribute to reduced risk, specifically in the sense of externalizing disorders. Kendler et al. (36) identified seven religious factors that impact mental health and the quality of psychological health, including general religiosity, social religiosity, involved God, forgiveness, God as judge, unvengefulness, and thankfulness.

In fact, the aspects of religiosity consist of behavioral dimensions, such as religious worship attendance and charity for religious matters; cognitive dimensions, such as thinking God has a big value in the person's life or thinking God as a judge; and emotional dimensions, such as meditation and feeling of fear of God, while the general spirituality is a concept integrating all these dimensions. In addition, the religious coping pattern is not always present, and it is used in different modes from one person to another. The coping mechanism depends on varying personality backgrounds, characteristics, and attitudes (35). Sultan et al. studied the effects of personality features on moderating the relationship between religiosity and the mental health of university students. They demonstrated that openness to experience and agreeableness as traits of students' personalities are significantly moderating the relationship between religiosity and mental health (37). In contrast, religious identity, self-esteem, positivity, and the presence of meaning in life are all involved in this complex relationship (38). Sakellari et al. performed a correlation analysis among the students of Cypriot University and found that greater levels of self-esteem were associated with lower depression levels and that stronger religious and spiritual beliefs correlated negatively with depression (39). Furthermore, Sakellari et al. investigated the correlation between health behaviors and dispositional optimism among nursing students in Poland, Spain, and Slovakia during the COVID-19 pandemic. This study showed that characteristic optimism is an important predictor of students' health behaviors (40). Further studies have reported that extra-curricular activities such as membership in hobbies clubs, cultural clubs, and sports clubs were shown to play a key role in developing interest and reducing stress in a student's life (35, 36). Belvederi Murri et al. (41) summarized a narrative review of relevant literature to address the aforementioned misperceptions and to provide practical recommendations for prescribing exercise to individuals with major depression. Indeed, a common misperception is that exercise is beneficial for depression mostly because of its positive effects on the body ("from the neck down"), whereas its effectiveness in treating core features of depression ("from the neck up") is underappreciated.

Other factors might be also involved in the affective disorders among students, such as lifestyle. A study among nursing students in Ontario (Canada) showed that increased sitting time, poor sleep quality, and low dairy consumption were associated with higher scores of depression, anxiety, and psychological stress (13).

In our study, the depression scores were higher in the first 2 years of studies among both female medical students and nursing students with significant differences. Religiosity was greater among students without depression than those with depression, while the association between stress and religiosity showed no significant difference. Our results and reported literature suggested setting up a formal mental health prevention strategy for students in general and medical and nursing students in particular. In addition, stigma is also a major concern of such prevention settings consideration, treatment, and recovery from mental illness. Therefore, prospective studies must be carried out to analyze all measures in order to assess the efficiency of interventions and reduce stigma. Knowledge of the lines of research was carried out in various research institutions. The synergy between the different researchers and further multicenter studies within the framework of consortia would play an important role in reducing the stigma and improving care provided to nursing students with psychiatric diagnoses, considering the inclusion aspects (42). Sakellari et al. investigated the barriers to mental healthcare among nursing, pharmacy, and medical trainees in Nigeria and concluded that the co-existence of spiritual beliefs and biomedical and psychological models of mental health is a key factor that would allow reducing any effective stigma (12).

Finally, an integrative review has explored the vision and role in addressing students' mental health in nursing school students. Indeed, nurses do esteem their role as trusted members of the medical school community. The students perceived highly important their practice standards as an integral part of their position and recognized competence in mental health care. Future nurses, doctors, and healthcare students are not protected against mental disorders. Hence, helping students in an emergency, especially during the COVID-19 pandemic, has added supplementary stress to the already stressful context of

education and work. Hence, different tools that allow confronting the challenges of the medical curriculum are obvious in general and in the COVID-19 pandemic context, and equivalent contexts. In addition, it is essential to facilitate asking help for students, which is often not possible due to factors such as the stigma of mental illness, confidentiality of the medical file, cost of psychiatric care, and lack of time (43). It is recommended to set up monitoring facilities and education resources throughout the nursing education period and introduce preventive practices for students' mental health (11). Practice recommendations should include providing the nursing school with evidence-based training on managing the mental health needs of students, as well as supporting access to nursing schools that can provide mental health supervision within the community (44).

The limitations of this study consist of a small study sample and less effectiveness of medical students and nursing students (medical school enrolled 459 students, whereas nursing school included 713 students). In addition, the rate of medical students was lower compared to the investigated rate of nursing students, with the medical students' recruitment limited to the first 3 years of the medical program, ensuring better matching to the nursing students dealing with an educational program of 3 years.

In addition, the female student population is over-represented, and as a result, there was an over-representation of women in the sample recruited; this is because the rate of female students in nursing and medical schools is high, ranging from 65 to 70%.

This final limitation is that all anxiety and depressive manifestations occurring within the last years of the medical student program population have not been considered.

Future studies should be carried out after the COVID-19 pandemic relapse to find the isolated effect of COVID-19 on stress and depression in medical and nursing students. This would allow to cover the need to find the effect of the medical and nursing environments on the psychological profile and religiosity in the Muslim community, especially those not yet enough studied.

Conclusion

Religiosity constitutes a protective factor of depression and stress among nursing and medical students. Further studies of the effectiveness of religiosity in improving mental health, particularly among youth and university students, have to be supported. This will improve the student's ability to cope with stressful situations during their training. Otherwise, the stress and depression levels of nursing and medical students should be monitored and support should be oriented to help reduce these risk factors, in order to find the right place and the right people to treat their psychological suffering. More attention should be granted to religiosity coping with the prospective integration of psychological interventions by mental healthcare providers. Why not integrate religiosity coping in the future guidelines of the treatment of affective disorders? We suggest including in future nursing and medical schools' educational reforms a systematic and continuous screening of psychological/psychiatric disorders impairing integrating health studies among students.

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 Fez Ethical commitee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

IR, JD, RA, and SB: concept and design and review. LL, ZS, OE, HL, MO, and KM: data collection, data analysis, and literature review. All authors contributed to the article and approved the submitted version.

Conflict of interest

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

Publisher's note

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

References

1. Tian-Ci Quek T, Wai-San Tam W, Tran BX, Zhang M, Zhang Z, Su-Hui C, et al. The global prevalence of anxiety among medical students: a meta-analysis. *Public Health.* (2019) 16:2735. doi: 10.3390/ijerph16152735

2. Yang F, Meng H, Chen H, Xu XH, Liu Z, Luo A, et al. FengInfluencing factors of mental health of medical students in China. *J Huazhong Univ Sci Technolog Med Sci.* (2014) 34:443–9. doi: 10.1007/s11596-014-1298-9

3. Rotenstein LS, Marco A, Ramos MA, Torre M, Segal JB, Peluso MJ, et al. Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis. *JAMA*. (2016) 316:2214–36. doi: 10.1001/jama.2016.17324

4. Hope V, Hendersony M. Medical student depression, anxiety and distress outside North America: a systematic review. *Med Educ.* (2014) 48:963–79. doi: 10.1111/medu.12512

5. Mayer MF, Santos IS, Silveira PS, Itaqui Lopes MH, Navarro Dias de, et al. Factors associated to depression and anxiety in medical students: a multicenter study. BMC Med Educ. (2016) 16:1–9. doi: 10.1186/s12909-016-0791-1

6. Botan V, Williams N, Law GR, Siriwardena AN. The effect of specific learning difficulties on general practice written and clinical assessments. *Med Educ.* (2022) 14. doi: 10.1111/medu.15008. [Epub ahead of print].

7. Felicilda-Reynaldo RF, Cruz JP, Papathanasiou IV, Helen Shaji JC, Kamau SM, et al. Quality of life and the predictive roles of religiosity and spiritual coping among nursing students: a multi-country study. *J Relig Health*. (2019) 58:1573–91. doi: 10.1007/s10943-019-00771-4

8. Jin T, Sun Y, Wang H, Qiu F, Wang X. Prevalence of depression among Chinese medical students: a systematic review and meta-analysis. *Psychol Health Med*. (2022) 27:2212–28. doi: 10.1080/13548506.2021.1950785

9. Li W, Zhao Z, Chen D, Peng, Y, Lu, ZJ. Prevalence and associated factors of depression and anxiety symptoms among college students: a systematic review and meta-analysis. *Child Psychol Psychiatry*. (2022) 63:1222–30. doi: 10.1111/jcpp.13606

10. Tung YJ, Lo KK, Ho RC, Tam WS. Prevalence of depression among nursing students: asystematic review and meta-analysis. *Nurse Educ Today*. (2018) 63:119–29. doi: 10.1016/j.nedt.01009

11. Karaca A, Yildirim N, Cangur S, Acikgoz F, Akkus D. Relationship between mental health of nursing students and coping, self-esteem and social support. *Nurse Educ Today*. (2019) 76:44–50. doi: 10.1016/j.nedt.01029

12. Pederson AB, Konadu Fokuo J, Thornicroft G, Bamgbose O, Ogunnubi OP, Ogunsola K, et al. Perspectives of university health care students on mental health stigma in Nigeria: qualitative analysis. *Transcult Psychiatry*. (2022) 5:13634615211055007. doi: 10.1177/13634615211055007

13. Lee CT, Ting GK, Bellissimo N, Khalesi S. The associations between lifestyle factors and mental wellbeing in baccalaureate nursing students: an observational study. *Nurs Health Sci.* (2022) 24:255–64. doi: 10.1111/nhs.12923

14. Pargament KI, Smith BW, Koenig HG, Perez L. Patterns of positive and negative religious coping with major life stressors. *J Sci Study Relig.* (1998) 37:710–24. doi: 10.2307/1388152

15. Wolf TM. Stress, coping and health: enhancing well-being during medical school. *Med Educ*. (1994) 28:8–17. doi: 10.1111/j.1365-1994tb02679.x

16. Carlozzi BL, Winterowd C, Harrist RS, Thomason N, Bratkovich K, Worth S, et al. Spirituality, anger, and stress in early adolescents. *J Relig Health.* (2010) 49:445–59. doi: 10.1007/s10943-009-9295-1

17. Koenig HG, Nelson B, Shaw SF, Saxena S, Cohen HJ. Religious involvement and adaptation in female family caregivers. *J Am Geriatr Soc.* (2016) 64:578–83. doi: 10.1111/jgs.13929

18. Gonzalez AL. Measuring religiosity in a majority muslim context: gender. religious, salience, and religious experience among kuwaiti college students—A research note. *J Scient Study Rel.* (2011) 50:339–50. doi: 10.1111/j.1468-5906.2011.01571.x

19. Khaki A, Sadeghi Habibabad A. Investigating the Effect of Religious and Islamic Teachings on the Calmness and Mental Health in Educational Spaces. *J Relig Health.* (2021) 60:2632–45. doi: 10.1007/s10943-020-01022-7

20. Abdel-Khalek AM. Subjective well-being and religiosity in Egyptian college students. *Psychol Rep*. (2011) 108:54–8. doi: 10.2466/07.17.PR0.108.1.54-58

21. Koenig HG, McCullough ME, Larson DB. *Handbook of Religion and Health*. OU: Oxford Editions (2001).

22. Koenig HG. *Handbook of Religion and Mental Health*. San Diego: Academic Press (1998).

23. Cochran WG. *Sampling Techniques*. John, Wiley, and Sons. (1977).

24. Kotrlik JWK, Higgins CC. Organizational research: determining appropriate sample size in survey research appropriate sample size in survey research. *Inform Technol Learn Perform J.* (2001) 19:43.

25. Rammouz I, Aalouane R, El Fakir S, El Ghazi M, Bennoudi H, Trimasse N, et al. Cultural adaptation and validation of the moroccan arabic version of the muslim belief into action (BIAC) scale. *J Relig Health.* (2021) 60:549–62. doi: 10.1007/s10943-020-01111-7

26. Rammouz I, Aalouane R, El Fakir S, El Ghazi M, Bennoudi H, Trimasse N, et al. Belief into action scale: a brief but comprehensive measure of religious commitment. *Open J Psychiatry*. (2015) 5:66–77. doi: 10.4236/ojpsych.2015.51010

27. Koenig HG, Wang Z, Al Zaben F, Adi A. Belief into action scale: a comprehensive and sensitive measure of religious involvement. *Religions.* (2015) 6:1006–16. doi: 10.3390/rel6031006

28. Alakhdhaira S, Sheetsa V, Geibb R, Alkhuwaildic A, Koenig HG. Psychometric properties of the Arabic version of the belief into action scale. *Mental Health Relig Cult.* (2016) 19:846–57. doi: 10.1080/13674676.2016.1266471

29. Beck AT, Steer RA, Brown GK. *Beck Depression Inventory-II*. San Antonio: Psychological Corporation (1996).

30. Abdel-Khalek AM. Internal consistency of an Arabic adaptation of the beck depression inventory in four Arab countries. *Psychol Rep*. (1998) 82:264–6. doi: 10.2466/pr0.821.264

31. Cohen S, Williamson GM. Perceived stress in a probability sample of the United States. In Spacapan S, Oskamp S (Eds.). *The Social Psychology of Health, Claremont Symposium on Applied Social Psychology*. Newbury Park, CA: Sage (1988) (Pp. 31–67).

32. Ben Loubir D, Serhier Z, Otmani N, Housbane S, Mouddene NA, Agoub M, et al. Assessment of quality and readability of internet-based health information related to commonly prescribed angiotensin receptor blockers. *Pan Afr Med J.* (2015) 12:280. doi: 10.11604/pamj.21280.6430

33. Romdhane FF, Tounsi A, Ben Rejeb R, Cheour M. Is religiosity related to suicidal ideation among tunisian muslim youth after the January 14th revolution? *Community Ment Health J.* (2020) 56:165–73. doi: 10.1007/s10597-019-00447-z

34. Jin Kim JY, Crutchfield J, Kyoung Kim Y. Effects of church attendance vs. private religious activities on suicidal ideation: a study of rural us college students. *J Relig Health.* (2021) 60:2560–72. doi: 10.1007/s10943-021-01224-7

35. Yadav P, Bhattacharyya D, Srivastava K, Salhotra N. Study of personality traits, individual coping resources, and their association in HIV-seropositive males. *Ind Psychiatry J*. (2017) 26:45–51. doi: 10.4103/ipj.ipj_34_17

36. Kendler KS, Liu XQ, Gardner MS. CO. McCullough, ME, Larson, D, Prescott, CA, Dimensions of religiosity and their relationship to lifetime, psychiatric, and substance use, disorders. *Am J Psychiatry.* (2003) 160:496–503. doi: 10.1176/appi.ajp.160.3.496

37. Sultan S, Kanwal F, Hussain I. Moderating effects of personality traits in relationship between religious practices and mental health of university students. *J Relig Health*. (2020) 59:2458–68. doi: 10.1007/s10943-019-00875-x

38. Davis RF, Kiang L. Religious identity, religious participation, and psychological wellbeing in asian American adolescents. *J Youth Adolesc.* (2016) 45:532–46. doi: 10.1007/s10964-015-0350-9

39. Sakellari E, Psychogiou M, Georgiou A, Papanidi M, Vlachou V, Sapountzi-Krepia D, et al. Exploring religiosity, self-esteem, stress, and depression among students of a cypriot university. *J Relig Health.* (2018) 57:136–45. doi: 10.1007/s10943-017-0410-4

40. Kupcewicz E, Mikla M, Kadučáková H, Schneider-Matyka D, Grochans E. Health behaviours and the sense of optimism in nursing students in Poland, Spain, and Slovakia during the COVID-19 pandemic. *Int J Environ Res Public Health*. (2022) 19:2388. doi: 10.3390/ijerph19042388

41. Belvederi Murri M, Ekkekakis P, Magagnoli M, Zampogna D, Cattedra S, Capobianco L, et al. Physical exercise in major depression: reducing the mortality gap while improving clinical outcomes front. *Psychiatry*. (2019) 9:762. doi: 10.3389/fpsyt.2018.00762

42. Martínez-Martínez C, Esteve-Claramunt F, Prieto-Callejero B, Ramos-Pichardo JD. Stigma towards mental disorders among nursing students and professionals: a bibliometric analysis. *Int J Environ Res Public Health.* (2022) 19:1839. doi: 10.3390/ijerph1903183933

43. Roberts LW, Warner TD, Lyketsos C, Frank E, Ganzini L, Carter D, et al. Perceptions of academic vulnerability associated with personal illness: a study of 1,027 students at nine medical schools. *Compr Psychiatry*. (2001) 42:1–15. doi: 10.1053/comp.2001.19747

44. Kaskoun J, McCabe E. Perceptions of school nurses in addressing student mental health concerns: an integrative review. *J Sch Nurs*. (2022) 38:35–47. doi: 10.1177/10598405211046223

frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 09 March 2023
DOI 10.3389/fpubh.2023.1129123

OPEN ACCESS

EDITED BY
Mohammadreza Shalbafan,
Iran University of Medical Sciences, Iran

REVIEWED BY
Gianluca Serafini,
San Martino Hospital (IRCCS), Italy
Ling Wang,
King's College London, United Kingdom
Antonia Aguirre Velasco,
Pontifical Catholic University of Chile, Chile

*CORRESPONDENCE
Zhi Yang
✉ yangz@smhc.org.cn
Wenhong Cheng
✉ chengwhb@aliyun.com

†These authors have contributed equally to this work

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

RECEIVED 21 December 2022
ACCEPTED 13 February 2023
PUBLISHED 09 March 2023

CITATION
Liu W, Hu Z, Liu Z, Zhang F, Ding Y, Shui Y, Yang Z and Cheng W (2023) Age- and sex-dependent increase in self-harm among adolescents with mental health problems in East China during COVID-19 related society-wide isolation. *Front. Public Health* 11:1129123. doi: 10.3389/fpubh.2023.1129123

Age- and sex-dependent increase in self-harm among adolescents with mental health problems in East China during COVID-19 related society-wide isolation

Wenjing Liu[1†], Zhishan Hu[2,3†], Zhen Liu[1], Fang Zhang[4], Yue Ding[2,3], Ying Shui[1], Zhi Yang[2,3]* and Wenhong Cheng[1,4]*

[1]Department of Child and Adolescent Psychiatry, Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [2]Laboratory of Psychological Heath and Imaging, Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Institute of Psychological and Behavioral Science, Shanghai Jiao Tong University, Shanghai, China, [4]Department of Psychological Medicine, Shanghai General Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Objective: The COVID-19 pandemic has raised concerns about child and adolescent mental health issues, such as self-harm. The impact of society-wide isolation on self-harming behaviors among adolescents in China is unclear. In addition, adolescents of different ages and sexes have varying abilities to cope with environmental changes. However, these differences are rarely considered in self-harm studies. We aimed to characterize the age- and sex-dependent effects of COVID-19-related society-wide isolation on self-harm among adolescents in East China.

Methods: We collected 63,877 medical records of children and adolescents aged 8–18 who had an initial visit to Shanghai Mental Health Center in China between 2017 and 2021 and charted annual self-harm rates for each age and sex. Using interrupted time series analysis, we modeled global and seasonal trends and the effect of COVID-19-related society-wide isolation on self-harm rates.

Results: Females aged 10–17 and males aged 13–16 exhibited significantly increasing trends in self-harm rate ($p_{fdr} < 0.05$) in the past 5 years. Eleven-year-old females in 2020 showed a self-harm rate (37.30%) that exceeded the peak among all ages in 2019 (age 13, 36.38%). The COVID-19-related society-wide isolation elevated self-harm rates in female patients aged 12 [RR 1.45 (95% CI 1.19–1.77); $p_{fdr} = 0.0031$] and 13 years [RR 1.33 (95% CI 1.15–1.5); $p_{fdr} = 0.0031$], while males were less affected. Further, females with emotional disorders dominated the increased self-harm rates.

Conclusion: Society-wide isolation has had a significant impact on early adolescent females in East China, especially for those with emotional disturbances, and has brought forward the peak in adolescent self-harm rates. This study calls for attention to the risk of self-harm in early adolescents.

KEYWORDS

self-harm, COVID-19, adolescent, society-wide isolation, emotional disorder

1. Introduction

Self-harm among adolescents has rapidly increased over the last decade (1–3). Adolescents with self-harm behaviors are 30 times more at risk for suicide than those without (4) and typically consume more medical resources (5). Mental health problems are remarkable risk factors for self-harm in children and adolescents. Among children and adolescents with major depressive disorder, the prevalence of self-harm is 55.2–64.1% (6, 7). Self-harm is also commonly comorbid with autism spectrum disorders and eating disorder in children and adolescents (8, 9). Previous studies have also associated self-harm with anxiety and depression symptoms (10–12).

The COVID-19 pandemic and related prevention measures have induced substantial changes in the social environment that have affected everyone's life and mental health (13–15). However, while there is a consensus that children and adolescents are vulnerable to social environment change (16), the impact of the COVID-19 pandemic on self-harm in children and adolescents is unclear. Previous studies have reported inconsistent findings regarding the impact of the COVID-19 pandemic on self-harm among children and adolescents worldwide (17–21). In particular, cultural, racial, and sex differences significantly affect the incidence of self-harm and the impact of the pandemic.

The social environment changes accompanying the nationwide home-study measures in China, which began in March 2020, may increase adolescents' stress and worsen their mental health problems. The term "society-wide isolation" in this study represents the combined effect of COVID-19 prevention measures characterized by society-wide isolation. The social isolation, home-study, and other preventive measures have severely impacted adolescents' emotional state and social activity levels, especially for those with psychiatric disorders (22–25). Studies have found significantly increased levels of anxiety and depression in adolescents following COVID-19 (26–28), which is an essential risk factor of self-harm. Thus, environmental changes associated with COVID-19 are expected to exacerbate self-harm among Chinese adolescents with mental health problems. However, studies in China are rare.

Furthermore, most studies on the effects of COVID-19 on self-harm treat the children and adolescent population as a whole (20, 21, 29). However, as a transitional stage from childhood to adulthood, the social needs of adolescents change rapidly with age, such that adolescents of different ages respond differently to social and environmental stressors (30). Thus, age and sex should be comprehensively considered in understanding the vulnerability of self-harm under the major environmental changes.

Here, we aim to determine the age- and sex-specific effects of COVID-19-related prevention measures, with the primary form of society-wide isolation, on self-harm among children and adolescents in East China. Using medical records of children and adolescents aged 8–18 years (n = 60,870), we charted year-to-year changes in the prevalence of self-harm of each age and sex. The effects of society-wide isolation on self-harm detection rate was disentangled from global temporal trends and seasonal variations. The result presents a fine-grained picture of recent trends in self-harm in children and adolescents with mental health problems and the extent to which they are influenced by COVID-19 in China.

TABLE 1 Age and sex distributions of the sample.

Age	N	Male (%)	Female (%)	χ^2	p_{fdr}
8	2,030	543 (26.7)	543 (73.3)	438.98	<0.0001
9	1,985	583 (29.4)	583 (70.6)	337.91	<0.0001
10	1,816	607 (33.4)	607 (66.6)	199.56	<0.0001
11	2,553	1,091 (42.7)	1,091 (57.3)	53.91	<0.0001
12	4,452	2,476 (55.6)	2,476 (44.4)	56.15	<0.0001
13	6,638	4,204 (63.3)	4,204 (36.7)	471.96	<0.0001
14	8,328	5,186 (62.3)	5,186 (37.7)	501.67	<0.0001
15	8,727	5,238 (60)	5,238 (40)	350.52	<0.0001
16	10,155	6,029 (59.4)	6,029 (40.6)	356.61	<0.0001
17	9,556	5,525 (57.8)	5,525 (42.2)	233.57	<0.0001
18	4,630	2,655 (57.3)	2,655 (42.7)	99.87	<0.0001

2. Method

2.1. Data source

Retrospective data were obtained from electronic medical records from Shanghai Mental Health Center (SMHC), China, from January 2017 to September 2021. In total, 63,877 records of the initial visits of child and adolescent aged 8–18 were acquired. Three thousand and seven records were excluded due to missing critical information (main complaint, history of present illness, psychiatric interview, and information to confirm age and sex), remaining 60,780 records (female = 34,137, male = 26,733, Table 1). The majority of these patients (85.7%) resided in East China, including Shanghai, Shandong, Jiangsu, Anhui, Zhejiang, Jiangxi, and Fujian provinces. The acquisition and analysis of the data was approved by the Institutional Review Board at SMHC.

2.2. Measurements and clinical coding

The text in the main complaint, history of present illness, and psychiatric interview were pooled to generate a term dictionary in which we searched for terms related to self-harm without suicidal intent (31, 32). A portion of the search terms were extracted from the Chinese version of the Ottawa Self-Injury Scale (33), and additional terms were selected from the term dictionary, which indicate self-harm or suicide attempt (Supplementary Table S1 lists all search terms). Records matching at least one of the search terms were identified as representing self-harm behavior. Terms referred to in a negative way, such as "no self-harm", were not considered self-harm terms.

2.3. Data analysis

We calculated self-harm detection rates for each sex and age group in each year, as well as annual changes in self-harm rates, i.e., rates that differed from 1 year to the next. Annual changes across years were compared using a bootstrap approach. We first resampled individuals from each sex and age group using the bootstrap method (sampling by replacement while keeping the sample size constant). Then, based on the resampling, annual changes in self-harm rates were recalculated. This procedure was repeated 1,000 times to obtain the sampling distribution of annual changes in self-harm rates for each year since 2018. Finally, we compared the annual change for each year since 2019 with the sampling distribution from previous years. Exceeding the 95th percentiles (i.e., $p < 0.05$) of all previous years' sampling distributions of annual changes was considered a significant change in self-harm rates.

To better quantify the impact of COVID-19-related society-wide isolation, which is marked by the implementation of home-study in most cities in China from March 2020, we further examined monthly self-harm rates. We used interrupted time series (ITS) analysis to disentangle the effects of COVID-19-related society-wide isolation from the global temporal and seasonal trends in self-harm rates (34, 35). The "interruption" here refers to March 2020, from which time point the home-study begins. This model fits monthly self-harm incidence data for each age and sex group. The data for September 2021 were removed from further analysis because we only had data for the first 10 days of this month. The ITS model can be formulated as:

$$\begin{aligned}\log(\text{nHarm}) &= \log(\text{nCount}) + \text{COVID} \\ &+ \text{Slope} + \text{harmonic}(\text{Month}, 2, 12) + \text{Global}\end{aligned}$$

This model assumes that the count of patients with self-harm behavior (nHarm) has a Poisson distribution, and we used a quasi-Poisson distribution to deal with the overdispersion problem (36). Specifically, the "nHarm" denotes the monthly count of patients who engaged in self-harm behavior, and the "COVID" denotes whether the recorded month is before (January 2017 to Feb 2020) or after the declaration of national-wide home study (March 2020 to August 2021). The COVID-19 control measures quickly reached to a peak and were gradually eased till September 2021, though not removed. The "Slope" encodes the elapsed time since the implementation of national-wide home-study, which captures the slope change caused by the society-wide isolation and the gradual ease of the control measures. We used the "harmonic" terms (two pairs of sine and cosine functions) to model the potential influence of the seasonality (37). In addition, monthly patient counts (nCount) were modeled as an offset variable in order to transform the counts of self-harm incidents back to rates. The "Global" is the elapsed time from the first day of the medical records we analyzed, and it captures the global change in self-harming behavior. All the analyses were performed using R (Version 4.1.2).

With this model, we examined whether there was an overall trend of increasing self-harm rates over time and at which age this trend would occur. Further, we investigated the effect of COVID-19-related society-wide isolation on self-harm rates and at which age groups children and adolescents were most affected.

We further hypothesized that emotional disorders are an important contributing factor to the increased self-harm rate associated with COVID-19. We categorized patients into emotional disorders and non-emotional disorders by clinical diagnosis, with depressive and bipolar disorder, anxiety disorder, post-traumatic stress disorder, obsessive compulsive disorder and childhood emotional disorder classified as emotional disorders. The rest, including developmental disorders, schizophrenia, and other behavioral problems, were categorized as non-emotional disorders.

3. Results

Between 2017 and 2021, the self-harm rates among children patients aged 10–17 increased remarkably over time (Figure 1A). This upward trend started at age 12 among males (Figure 1B) and as early as 10 among females (Figure 1C). In addition, comparing before and after the implementation of COVID-19 prevention and control measures, i.e., from 2019 to 2020, there was a significant jump ($p < 0.05$) in self-harm rates among children aged 12–13 years (Figure 1D). The increase in self-harm rates in these two age groups was 15.39 and 15.02%, respectively, driven mainly by the self-harm rate in female patients (Figure 1F, 17.76 and 17.95%). In contrast, for male children, no significant increase was observed for all age groups from 2019 to 2020 (Figure 1E).

Notably, the self-harm rate for 11-year-old females increased alarmingly from 23.84% in 2019 to 37.30% in 2020 and 44.78% in 2021 (Figure 1C). Following the COVID-19 outbreak, the annual self-harm rate for 11-year-old females in 2020 (37.30%) already exceeded the peak self-harm rate among all ages in 2019 (occurring at age 13, 36.38%). This phenomenon represents a younger trend in self-harm incidents.

Visualization of the monthly data further suggests an association between the COVID-19 society-wide isolation period (start from March 2020) and changes in self-harm rates (Figure 2). The overall self-harm rate among adolescents aged 11 to 16 years increased after March 2020 (Figure 2A). This trend was more pronounced among females (Figure 2C).

The ITS quantitatively disentangled the effect of COVID-19 society-wide isolation on self-harm rates from seasonal and global temporal trends. We found a clear global trend of increasing self-harm rates over time among males aged 13–17 years and females aged 10–17 years (Supplementary Table S2, $p_{\text{fdr}} < 0.05$). More importantly, after adjusting for global and seasonal temporal trends, COVID-19-related society-wide isolation significantly increased self-harm rates at specific ages and sexes (Figure 3; Supplementary Figure S1). Specifically, the society-wide isolation showed no significant effect in males, but significantly elevated self-harm rates in female patients at age 12 [RR 1.45 (95% CI 1.19–1.77); $p_{\text{fdr}} = 0.0031$] and 13 [RR 1.33 (95% CI 1.15–1.5); $p_{\text{fdr}} = 0.0031$, Supplementary Table S3]. In addition, the "slope" of the self-harm rate, representing alterations of the COVID-19 effect after March 2020, was significantly negative for females aged 12–16 years ($p < 0.05$, Supplementary Table S4). Combined with the "COVID-19" effect, the results suggest an overall increase in the self-harm rate after March 2020, but with a trend toward a slower

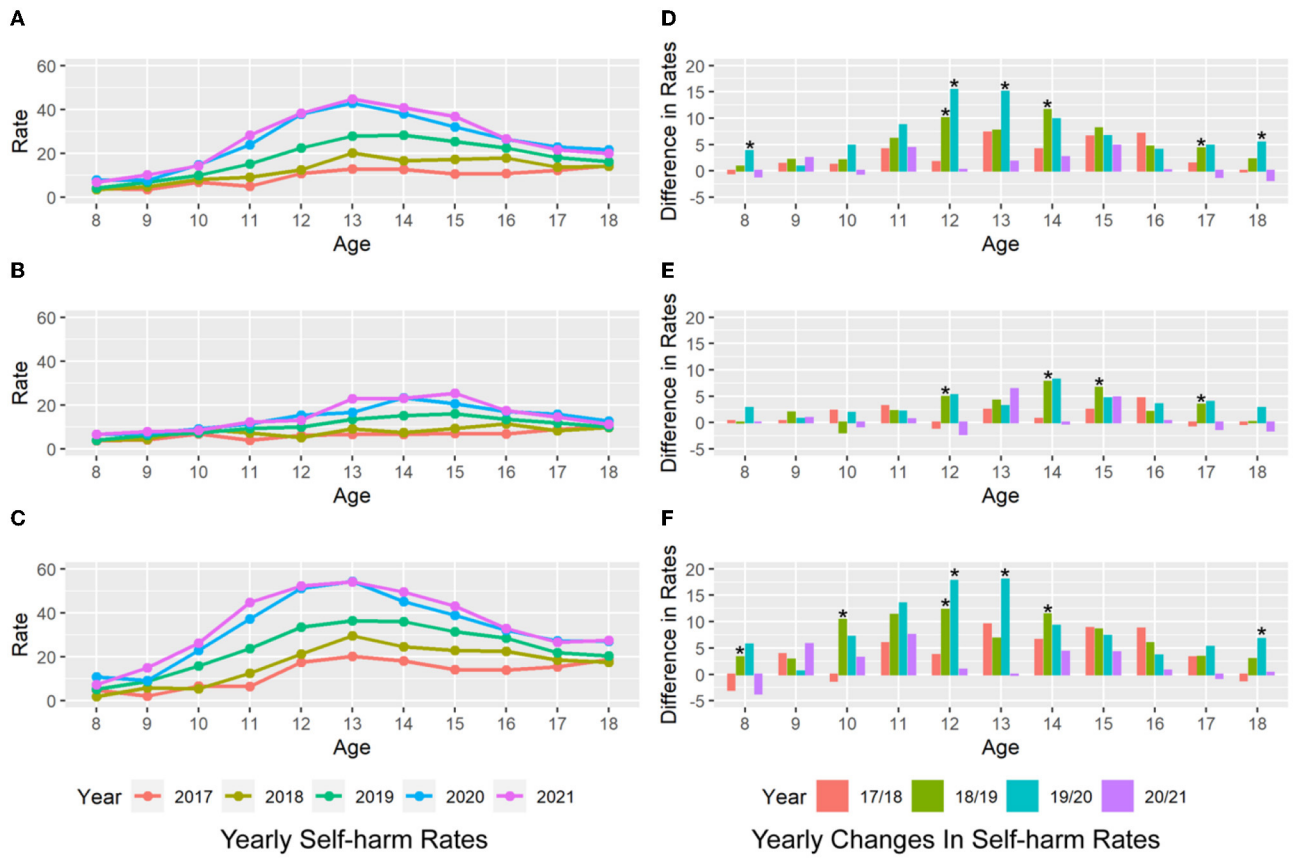


FIGURE 1
Self-harm rates at different ages. The left panel shows the annual self-harm rates for the entire sample **(A)** of male **(B)** and female patients **(C)** at different ages. The colors indicate the different years of data. Females show an increasing trend in self-harm rates starting at age 10. The right panels show the annual change in self-harm rates for the full sample **(D)**, male **(E)**, and female patients **(F)** at different ages. Females aged 12–13 years show a significantly greater change in self-harm rates between 2019 and 2020 than in previous years ("*" represents significance in bootstrapping).

increase in females aged 12–16 years. No significant slope change was found for male patients.

Compared to other mental disorders, we found more pronounced increases in self-harm rates in females with emotional disorders (Figure 4). In the ITS analysis, we focused on patients (with psychiatric diagnoses) aged 11–13 because of their significant COVID-19-related changes (Figure 3). Females with emotional disorders at 12 years [RR 1.37 (95% CI 1.1–1.7); p_{fdr} = 0.041] and 13 years [RR 1.31 (95% CI 1.11–1.53); p_{fdr} = 0.021] were significantly affected by the COVID-19 society-wide isolation (Supplementary Figures S2–S3; Supplementary Table S5). In contrast, this phenomenon was not significant in females with other mental disorders and all males.

4. Discussion

By modeling large-scale medical record data, we found that 10–17 year-old females and 13–16 year-old males with mental health problems showed alarmingly elevated self-harm rates in recent years. Further, after adjusting for global and seasonal variation in self-harm rates, we confirmed that the COVID-19-related society-wide isolation significantly elevated self-harm rates in females aged 12–13 years. Furthermore, for the first time, this study shows the peak age for the prevalence of self-harm among children and adolescents with mental health problems in East China, suggesting that it is earlier than the high prevalence age of 15–17 years among general population reported in the literature of other countries (38, 39). This study alerts clinicians to the need for concern about the risk of self-harm in early adolescents with mental health problems in clinical practice.

One of our key findings is that the society-wide isolation due to COVID-19 selectively increases the risk of self-harm in female patients aged 12–13 years. Previous studies have reported an increase in the rate of health care visits for self-harm in adolescent populations during the COVID-19 pandemic, such as the UK population aged 10–17 years (21), a 10-country European and West Asian population under 18 years of age (29), an Australian population aged 12–17 years (20, 40), and a Chinese psychiatric inpatient sample under 18 years of age (41). The current study differs from the previous studies in revealing the age-dependence of the effects of COVID-19-related prevention measures, adjusting for overall temporal trends and seasonal variations. The fine-grained controls for confounding variables support the solidity of the results. The precise year-to-year analyses revealed environmental impacts and age-specific characteristics of self-harming behaviors

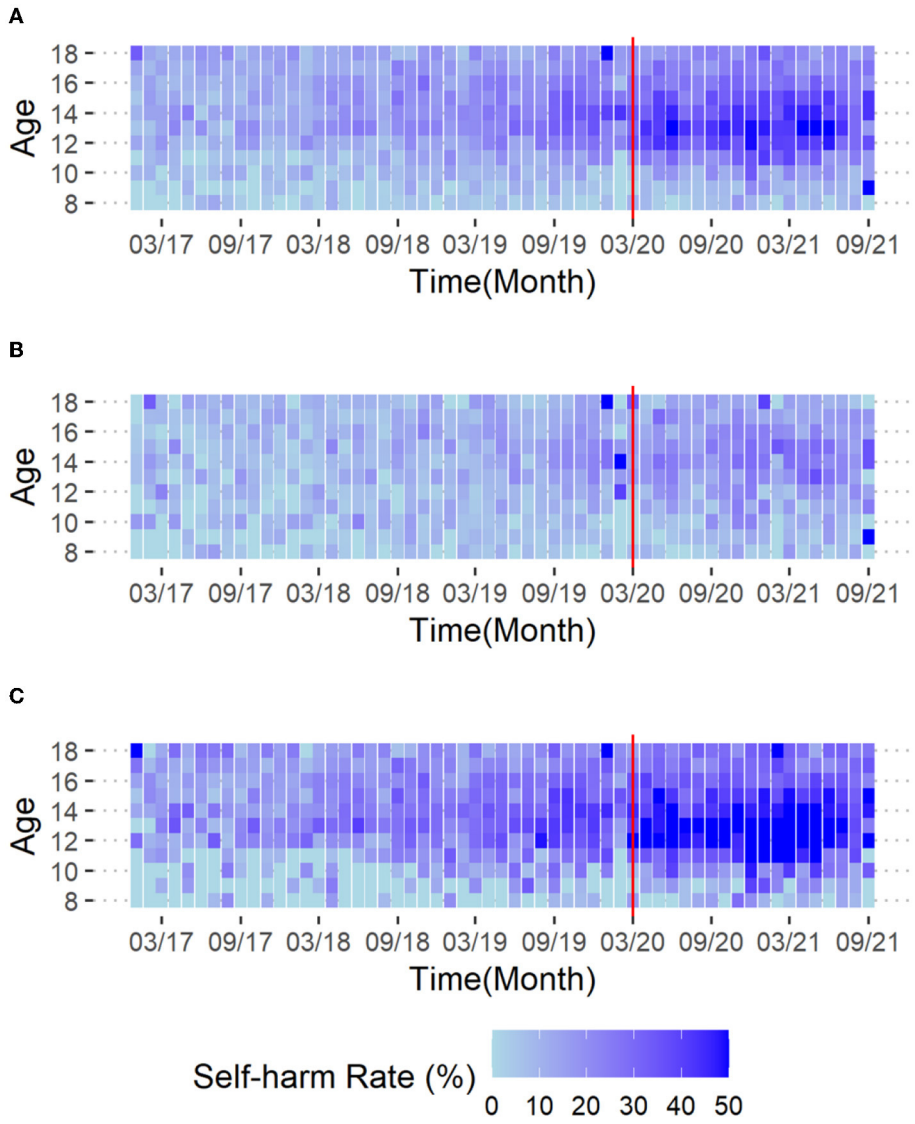


FIGURE 2
Heat map of self-harm rates. **(A)** Entire sample, **(B)** male, and **(C)** female patients. The colors in the cells represent the self-harm rate for each age group in each month. The red vertical line indicates March 2020, from which time the adolescent's social environment was affected (nation-wide home study started).

among adolescents with mental health problems in East China. The findings suggest that self-harming behaviors of females aged 12–13 years are sensitive to the society-wide isolation.

Beyond changes in social relationships, multiple factors attributed to the society-wide isolation can explain the increase of self-harm in early adolescents in China. First, the quarantine and home study measures have increased early adolescents' exposure to electronic devices (42), cyberbullying (43), and parent-child conflict (44), but led to decreased peer interaction. These environmental changes exacerbated anxiety and depression in children and adolescents. This pathway is a dominant cause for self-harming behaviors (45). Furthermore, in China, ages 11–13 are the transition period from elementary to middle school, when students need to compete academically to gain admission to more advanced schools. Students only have one chance to choose a better school, so there is considerable stress on students and families (46). Coupled with school closures during the pandemic, students may experience a decline in academic achievement and thus experience increased psychological stress (47). Therefore, the biological vulnerability combined with the stressors associated with COVID-19 may contribute to a greater risk of self-harm behaviors in early adolescence (48).

Another insight of the findings is that COVID-19-related society-wide isolation has increased the risk of self-harm among adolescents toward a younger age. Our data showed a 37.3–44.78% detection rate of self-harming behaviors among 11-year-old female children after the onset of pandemic-associated society-wide isolation. This value exceeded the peak level across all ages before the pandemic (36.38%), suggesting the need to focus on the occurrence and factors influencing self-harm behaviors from

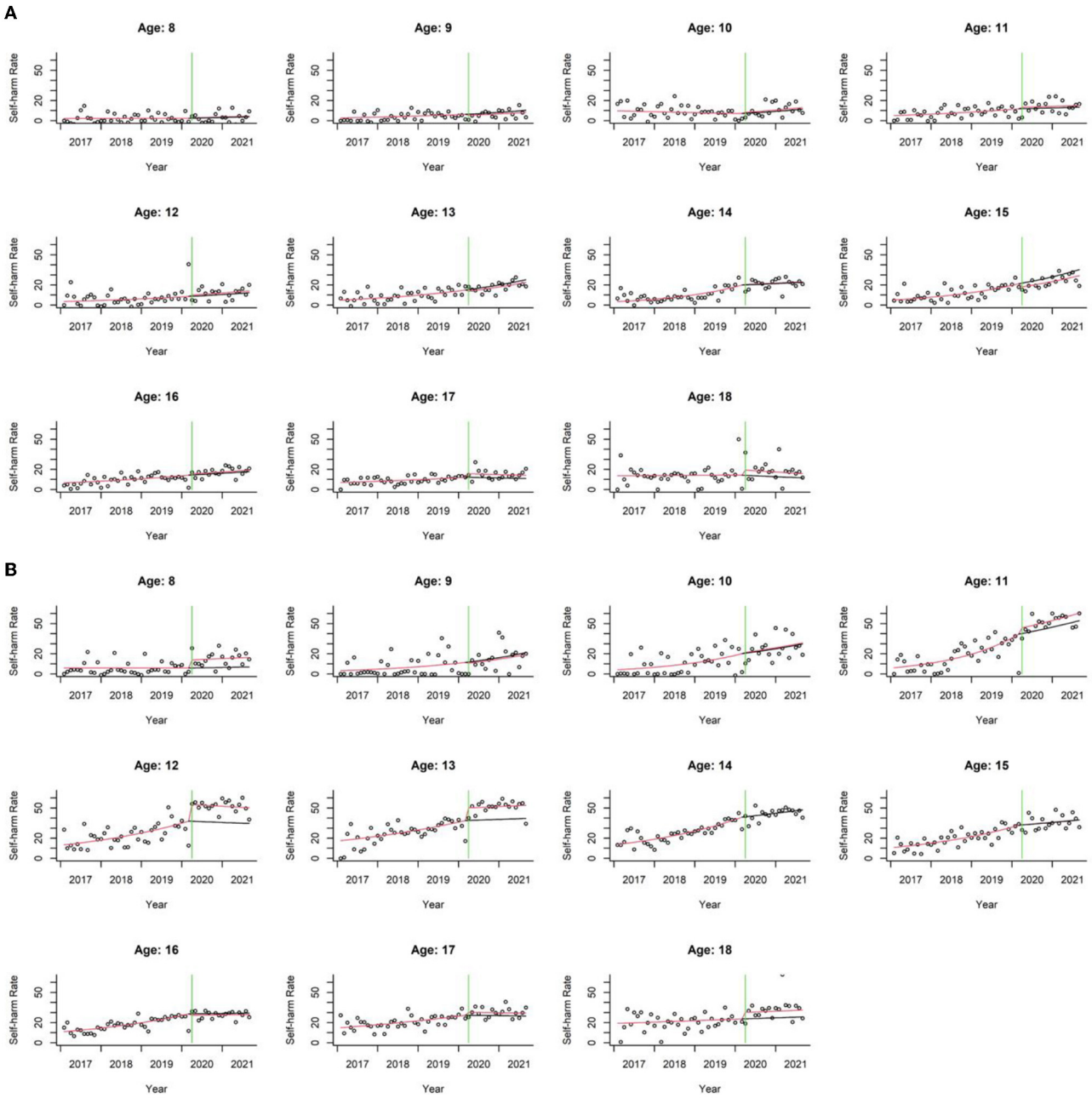


FIGURE 3
Scatter plots of self-harm rates over time for male **(A)** and female patients **(B)** in each age group. Seasonality was removed from the observed and predicted data (see Supplementary Figure S1 for the scatter plots of data containing the seasonality). The dots represent the observed monthly self-harm rates. The red line represents the predicted self-harm rate according to the ITS model, while the black line represents the predicted self-harm rate if COVID-19 society-wide isolation (starting from the green line) did not occur.

a younger age. These findings are in contrast with a recent paper that reported negative findings on the associations between excess of self-harm requiring health care and the COVID-19 pandemic (19). This difference can be explained by the fact that the two studies sampled populations with different levels of severity of self-harming behaviors. While the present study included all self-harming behaviors that could be of concern to psychiatrists and documented in the medical record, the Ray et al. study focused on self-harming behaviors that were severe enough to require emergency department management. Thus, self-harm in children and adolescents may require more attention from the mental health field.

Multiple factors help explain the sex dependence of self-harm rates. First, females are more likely to adopt emotion-focused coping strategies in early adolescence (49). In this context, self-harm can be seen as a negative strategy or symptoms of adolescents'

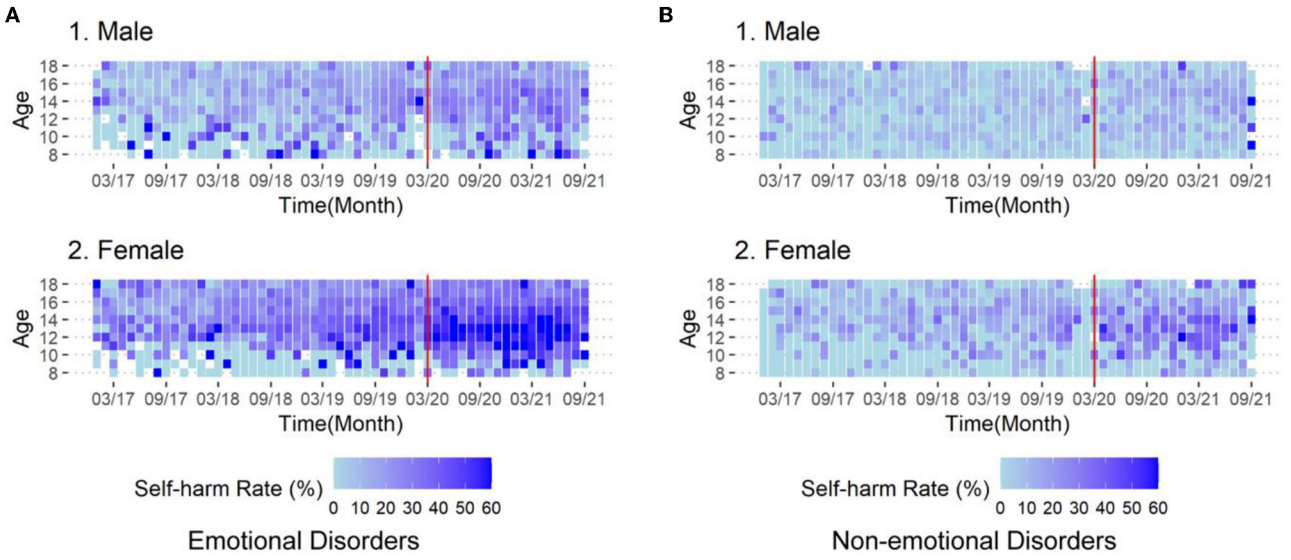


FIGURE 4
Heat map of self-harm rates for (1) male and (2) female patients with **(A)** emotional disorders and **(B)** non-emotional disorders. The colors in the cells represent the self-harm rate for each age group in each month. The red vertical line indicates March 2020, from which time the adolescent's social environment was affected (national-wide home study started). Emotional disorders include depressive and bipolar disorder, anxiety disorder, post-traumatic stress disorder, obsessive compulsive disorder and childhood emotional disorder.

coping method with stress or suffering (12). Second, sex differences in brain developmental processes (50) and hormonal changes related to neural activity (51) also make females more vulnerable in early adolescence to emotional distress and in need of peer feedback and companionship (52). Social isolation is more likely to lead to abnormal emotional experiences and depressive symptoms (53). In addition, some studies have found that female adolescents are more susceptible to the impact of the self-harming behaviors of their peers (54).

In addition, our study found that the rate of self-harm was significantly higher after the pandemic in patients with diagnoses of emotional disorders compared with those with other mental disorders (including developmental disorders, schizophrenia, and other behavioral problems). To our knowledge, this is the first report of the differences in the detection rate of self-harm among patients with different mental disorders in the pandemic. This finding calls for more attention to self-harm behaviors in adolescents with emotional disorders.

This study has some limitations. First, the sample was from a large mental health center in Shanghai. Due to divergence in socioeconomic development and personal preferences, the population is not representative of the less developed or rural areas in China. Second, medical records usually present a single-question inquiry for self-harming behaviors, and the detection rate of this approach was generally lower than that of the scale findings, because self-harm behavior information received from patients and caregivers was within a limited time and may have been neglected or denied (55). Therefore, potential measurement error needs to be considered when using the specific values. Third, the retrospective nature of the data may be an additional source of error.

5. Conclusion

The prevalence of self-harm among children and adolescents with mental health problems in East China has alarmingly increased in the past 5 years and exhibits remarkable age- and sex-dependence. The society-wide isolation due to COVID-19 selectively increased the risk of self-harm among female adolescents in early adolescents, especially in those with emotional disorders. Prevention and early identification and intervention may need to move forward from mid-adolescence to early adolescence, with particular attention to females with mental health problems in early adolescence.

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 Shanghai Mental Health Center. Written informed consent was not required by the participants' legal guardian/next of kin.

Author contributions

WL and ZH wrote the initial analysis plan, conducted the analysis, and produced figures. WL, ZH, ZY, and WC wrote the

first draft of the manuscript. All authors conceptualized the study and contributed to its design and contributed to editing and commenting on the final version. All authors contributed to the article and approved the submitted version.

Funding

WC has received funding from STI 2030—Major Projects (2022ZD0209100), Clinical Research Project of Shanghai Mental Health Center (CRC2019ZD04), and Shanghai Commission of Science and Technology (20Y11906700). ZY has received funding from National Natural Science Foundation of China (81971682), Natural Science Foundation of Shanghai (20ZR1472800), Shanghai Clinical Research Center for Mental Health (19MC1911100), and Shanghai Commission of Science and Technology (18JC1420305). WL has received funding from Shanghai Municipal Commission of Health and Family Planning (20214Y0162). ZH has received funding from National Natural Science Foundation of China (62007002). YD has received funding from Shanghai Sailing Program (20YF1442000) and National Natural Science Foundation of China (62101324).

Acknowledgments

We are grateful to the excellent work and commitment to the staffs in Department of Information and Statistics and Department of Child and Adolescent Psychiatry at Shanghai Mental Health Center.

Conflict of interest

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

Publisher's note

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

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1129123/full#supplementary-material

References

1. Borschmann R, Kinner SA. Responding to the rising prevalence of self-harm. *Lancet Psychiatry*. (2019) 6:548–9. doi: 10.1016/S2215-0366(19)30210-X

2. Gillies D, Christou MA, Dixon AC, Featherston OJ, Rapti I, Garcia-Anguita A, et al. Prevalence and characteristics of self-harm in adolescents: meta-analyses of community-based studies 1990-2015. *J Am Acad Child Adolesc Psychiatry*. (2018) 57:733–41. doi: 10.1016/j.jaac.2018.06.018

3. Zetterqvist M, Jonsson LS, Landberg Å, Svedin CG. A potential increase in adolescent nonsuicidal self-injury during covid-19: a comparison of data from three different time points during 2011 - 2021. *Psychiatry Res*. (2021) 305:114208. doi: 10.1016/j.psychres.2021.114208

4. Hawton K, Bale L, Brand F, Townsend E, Ness J, Waters K, et al. Mortality in children and adolescents following presentation to hospital after non-fatal self-harm in the Multicentre Study of Self-harm: a prospective observational cohort study. *Lancet Child Adolesc Health*. (2020) 4:111–20. doi: 10.1016/S2352-4642(19)30373-6

5. Goldman-Mellor S, Phillips D, Brown P, Gruenewald P, Cerdá M, Wiebe D. Emergency department use and inpatient admissions and costs among adolescents with deliberate self-harm: a five-year follow-up study. *Psychiatr Serv*. (2020) 71:136–43. doi: 10.1176/appi.ps.201900153

6. Kang B, Hwang J, Woo SI, Hahn SW, Kim M, Kim Y, et al. The mediating role of depression severity on the relationship between suicidal ideation and self-injury in adolescents with major depressive disorder. *Soa Chongsonyon Chongsin Uihak*. (2022) 33:99–105. doi: 10.5765/jkacap.220014

7. Taş Torun Y, Gul H, Yaylali FH, Gul A. Intra/interpersonal functions of nonsuicidal self-injury in adolescents with major depressive disorder: The role of emotion regulation, alexithymia, and childhood traumas. *Psychiatry*. (2022) 85:86–99. doi: 10.1080/00332747.2021.1989854

8. Handen BL, Mazefsky CA, Gabriels RL, Pedersen KA, Wallace M, Siegel M. Risk factors for self-injurious behavior in an inpatient psychiatric sample of children with autism spectrum disorder: A naturalistic observation study. *J Autism Dev Disord*. (2018) 48:3678–88. doi: 10.1007/s10803-017-3460-2

9. Warne N, Heron J, Mars B, Moran P, Stewart A, Munafò M, et al. Comorbidity of self-harm and disordered eating in young people: Evidence from a UK population based cohort. *J Affect Disord*. (2021) 282:386–90. doi: 10.1016/j.jad.2020.12.053

10. Ma Z, Wang D, Zhao J, Zhu Y, Zhang Y, Chen Z, et al. Longitudinal associations between multiple mental health problems and suicidal ideation among university students during the COVID-19 pandemic. *J Affect Disord*. (2022) 311:425–31. doi: 10.1016/j.jad.2022.05.093

11. Poudel A, Lamichhane A, Magar KR, Khanal GP. Non suicidal self injury and suicidal behavior among adolescents: co-occurrence and associated risk factors. *BMC Psychiatry*. (2022) 22:96. doi: 10.1186/s12888-022-03763-z

12. Taylor PJ, Jomar K, Dhingra K, Forrester R, Shahmalak U, Dickson JM. A meta-analysis of the prevalence of different functions of non-suicidal self-injury. *J Affect Disord*. (2018) 227:759–69. doi: 10.1016/j.jad.2017.11.073

13. Ambrosetti J, Macheret L, Folliet A, Wullschleger A, Amerio A, Aguglia A, et al. Impact of the COVID-19 pandemic on psychiatric admissions to a large swiss emergency department: an observational study. *Int J Environ Res Public Health*. (2021) 18:1174. doi: 10.3390/ijerph18031174

14. Amerio A, Lugo A, Stival C, Fanucchi T, Gorini G, Pacifici R, et al. COVID-19 lockdown impact on mental health in a large representative sample of Italian adults. *J Affect Disord*. (2021) 292:398–404. doi: 10.1016/j.jad.2021.05.117

15. Nobari H, Fashi M, Eskandari A, Villafaina S, Murillo-Garcia Á, Pérez-Gómez J. Effect of COVID-19 on health-related quality of life in adolescents and children: a systematic review. *Int J Environ Res Public Health*. (2021) 18:4563. doi: 10.3390/ijerph18094563

16. Peek L. Children and disasters: understanding vulnerability, developing capacities, and promoting resilience—An introduction. *Child Youth Environ*. (2008) 18:1–29. Available online at: https://www.jstor.org/stable/10.7721/chilyoutenvi.18.1.0001

17. Carr MJ, Steeg S, Webb RT, Kapur N, Chew-Graham CA, Abel KM, et al. Effects of the COVID-19 pandemic on primary care-recorded mental illness and self-harm episodes in the UK: a population-based cohort study. *Lancet Public Health*. (2021) 6:e124–35. doi: 10.1016/S2468-2667(20)30288-7

18. Kapur N, Clements C, Appleby L, Hawton K, Steeg S, Waters K, et al. Effects of the COVID-19 pandemic on self-harm. *Lancet Psychiatry*. (2021) 8:e4. doi: 10.1016/S2215-0366(20)30528-9

19. Ray JG, Austin PC, Aflaki K, Guttmann A, Park AL. Comparison of self-harm or overdose among adolescents and young adults before vs during the COVID-19 pandemic in Ontario. *JAMA Netw Open.* (2022) 5:e2143144. doi: 10.1001/jamanetworkopen.2021.43144

20. Sara G, Wu J, Uesi J, Jong N, Perkes I, Knight K, et al. Growth in emergency department self-harm or suicidal ideation presentations in young people: comparing trends before and since the COVID-19 first wave in New South Wales, Australia. *Aust N Z J Psychiatry.* (2023) 57:58–68. doi: 10.1177/00048674221082518

21. Steeg S, Bojanić L, Tilston G, Williams R, Jenkins DA, Carr MJ, et al. Temporal trends in primary care-recorded self-harm during and beyond the first year of the COVID-19 pandemic: Time series analysis of electronic healthcare records for 2.8 million patients in the Greater Manchester Care Record. *EClinicalMedicine.* (2021) 41:101175. doi: 10.1016/j.eclinm.2021.101175

22. Doyle AE, Colvin MK, Beery CS, Koven MR, Vuijk PJ, Braaten EB. Distinct patterns of emotional and behavioral change in child psychiatry outpatients during the COVID-19 pandemic. *Child Adolesc Psychiatry Ment Health.* (2022) 16:12. doi: 10.1186/s13034-022-00441-6

23. Elbogen EB, Lanier M, Blakey SM, Wagner HR, Tsai J. Suicidal ideation and thoughts of self-harm during the COVID-19 pandemic: the role of COVID-19-related stress, social isolation, and financial strain. *Depress Anxiety.* (2021) 38:739–48. doi: 10.1002/da.23162

24. Hawton K, Lascelles K, Brand F, Casey D, Bale L, Ness J, et al. Self-harm and the COVID-19 pandemic: a study of factors contributing to self-harm during lockdown restrictions. *J Psychiatr Res.* (2021) 137:437–43. doi: 10.1016/j.jpsychires.2021.03.028

25. Lee J. Mental health effects of school closures during COVID-19. *Lancet Child Adolesc Health.* (2020) 4:421. doi: 10.1016/S2352-4642(20)30109-7

26. Chen J, Yang K, Cao Y, Du Y, Wang N, Qu M. Depressive symptoms among children and adolescents in China during the coronavirus disease-19 epidemic: a systematic review and meta-analysis. *Front Psychiatry.* (2022) 13:870346. doi: 10.3389/fpsyt.2022.870346

27. Racine N, McArthur BA, Cooke JE, Eirich R, Zhu J, Madigan S. Global prevalence of depressive and anxiety symptoms in children and adolescents during COVID-19: a meta-analysis. *JAMA Pediatr.* (2021) 175:1142–50. doi: 10.1001/jamapediatrics.2021.2482

28. Sniadach J, Szymkowiak S, Osip P, Waszkiewicz N. Increased depression and anxiety disorders during the COVID-19 pandemic in children and adolescents: a literature review. *Life.* (2021) 11:1188. doi: 10.3390/life11111188

29. Ougrin D, Wong BH, Vaezinejad M, Plener PL, Mehdi T, Romaniuk L, et al. Pandemic-related emergency psychiatric presentations for self-harm of children and adolescents in 10 countries (PREP-kids): a retrospective international cohort study. *Eur Child Adolesc Psychiatry.* (2022) 31:1–13. doi: 10.1007/s00787-021-01741-6

30. Blakemore SJ, Mills KL. Is adolescence a sensitive period for sociocultural processing? *Annu Rev Psychol.* (2014) 65:187–207. doi: 10.1146/annurev-psych-010213-115202

31. National Collaborating Centre for Mental Health (UK). *Self-Harm: Longer-Term Management. Leicester: British Psychological Society* (2012). Available online at: https://www.ncbi.nlm.nih.gov/books/NBK126787/

32. Knipe D, Padmanathan P, Newton-Howes G, Chan LF, Kapur N. Suicide and self-harm. *Lancet.* (2022) 399:1903–16. doi: 10.1016/S0140-6736(22)00173-8

33. Nixon MK, Levesque C, Preyde M, Vanderkooy J, Cloutier PF. The Ottawa self-injury inventory: evaluation of an assessment measure of nonsuicidal self-injury in an inpatient sample of adolescents. *Child Adolesc Psychiatry Ment Health.* (2015) 9:26. doi: 10.1186/s13034-015-0056-5

34. Leske S, Kõlves K, Crompton D, Arensman E, de Leo D. Real-time suicide mortality data from police reports in Queensland, Australia, during the COVID-19 pandemic: an interrupted time-series analysis. *Lancet Psychiatry.* (2021) 8:58–63. doi: 10.1016/S2215-0366(20)30435-1

35. Pirkis J, John A, Shin S, DelPozo-Banos M, Arya V, Analuisa-Aguilar P, et al. Suicide trends in the early months of the COVID-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries. *Lancet Psychiatry.* (2021) 8:579–88. doi: 10.1016/S2215-0366(21)00091-2

36. Ver Hoef JM, Boveng PL. Quasi-Poisson vs. negative binomial regression: how should we model overdispersed count data? *Ecology.* (2007) 88:2766–72. doi: 10.1890/07-0043.1

37. Lopez Bernal JA, Gasparrini A, Artundo CM, McKee M. The effect of the late 2000s financial crisis on suicides in Spain: an interrupted time-series analysis. *Eur J Public Health.* (2013) 23:732–6. doi: 10.1093/eurpub/ckt083

38. Plener PL, Schumacher TS, Munz LM, Groschwitz RC. The longitudinal course of non-suicidal self-injury and deliberate self-harm: a systematic review of the literature. *Borderline Personal Disord Emot Dysregul.* (2015) 2:2. doi: 10.1186/s40479-014-0024-3

39. Steinhoff A, Ribeaud D, Kupferschmid S, Raible-Destan N, Quednow BB, Hepp U, et al. Self-injury from early adolescence to early adulthood: age-related course, recurrence, and services use in males and females from the community. *Eur Child Adolesc Psychiatry.* (2021) 30:937–51. doi: 10.1007/s00787-020-01573-w

40. Corrigan C, Duke G, Millar J, Paul E, Butt W, Gordon M, et al. Admissions of children and adolescents with deliberate self-harm to intensive care during the SARS-CoV-2 outbreak in Australia. *JAMA Netw Open.* (2022) 5:e2211692. doi: 10.1001/jamanetworkopen.2022.11692

41. Du N, Ouyang Y, Xiao Y, Li Y. Psychosocial factors associated with increased adolescent non-suicidal self-injury during the COVID-19 pandemic. *Front Psychiatry.* (2021) 12:743526. doi: 10.3389/fpsyt.2021.743526

42. Trott M, Driscoll R, Irlado E, Pardhan S. Changes and correlates of screen time in adults and children during the COVID-19 pandemic: a systematic review and meta-analysis. *EClinicalMedicine.* (2022) 48:101452. doi: 10.1016/j.eclinm.2022.101452

43. Shin SY, Choi YJ. Comparison of cyberbullying before and after the COVID-19 pandemic in Korea. *Int J Environ Res Public Health.* (2021) 18:10085. doi: 10.3390/ijerph181910085

44. Russell BS, Hutchison M, Tambling R, Tomkunas AJ, Horton AL. Initial challenges of caregiving during COVID-19: caregiver burden, mental health, and the parent-child relationship. *Child Psychiatry Hum Dev.* (2020) 51:671–82. doi: 10.1007/s10578-020-01037-x

45. Uh S, Dalmaijer ES, Siugzdaite R, Ford TJ, Astle DE. Two pathways to self-harm in adolescence. *J Am Acad Child Adolesc Psychiatry.* (2021) 60:1491–500. doi: 10.1016/j.jaac.2021.03.010

46. Evans D, Borriello GA, Field AP. A Review of the academic and psychological impact of the transition to secondary education. *Front Psychol.* (2018) 9:1482. doi: 10.3389/fpsyg.2018.01482

47. Hammerstein S, König C, Dreisörner T, Frey A. Effects of COVID-19-related school closures on student achievement-a systematic review. *Front Psychol.* (2021) 12:746289. doi: 10.3389/fpsyg.2021.746289

48. Demmler JC, Hill RA, Rahman MA, Bandyopadhyay A, Healy MA, Paranjothy S, et al. Educational attainment at age 10-11 years predicts health risk behaviors and injury risk during adolescence. *J Adolesc Health.* (2017) 61:212–8. doi: 10.1016/j.jadohealth.2017.02.003

49. Akbari Kamrani M, Farid M. Chronological age and puberty coping strategy among Iranian adolescent females. *Int J Sch Health.* (2017) 4:1–6. doi: 10.5812/intjsh.14526

50. Pfeifer JH, Allen NB. Puberty initiates cascading relationships between neurodevelopmental, social, and internalizing processes across adolescence. *Biol Psychiatry.* (2021) 89:99–108. doi: 10.1016/j.biopsych.2020.09.002

51. Bingham B, McFadden K, Zhang X, Bhatnagar S, Beck S, Valentino R. Early adolescence as a critical window during which social stress distinctly alters behavior and brain norepinephrine activity. *Neuropsychopharmacology.* (2011) 36:896–909. doi: 10.1038/npp.2010.229

52. Ladouceur CD, Kerestes R, Schlund MW, Shirtcliff EA, Lee Y, Dahl RE. Neural systems underlying reward cue processing in early adolescence: the role of puberty and pubertal hormones. *Psychoneuroendocrinology.* (2019) 102:281–91. doi: 10.1016/j.psyneuen.2018.12.016

53. Loades ME, Chatburn E, Higson-Sweeney N, Reynolds S, Shafran R, Brigden A, et al. Rapid systematic review: the impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. *J Am Acad Child Adolesc Psychiatry.* (2020) 59:1218–39. doi: 10.1016/j.jaac.2020.05.009

54. Prinstein MJ, Heilbron N, Guerry JD, Franklin JC, Rancourt D, Simon V, et al. Peer influence and nonsuicidal self injury: longitudinal results in community and clinically-referred adolescent samples. *J Abnorm Child Psychol.* (2010) 38:669–82. doi: 10.1007/s10802-010-9423-0

55. DeVille DC, Whalen D, Breslin FJ, Morris AS, Khalsa SS, Paulus MP, et al. Prevalence and family-related factors associated with suicidal ideation, suicide attempts, and self-injury in children aged 9 to 10 years. *JAMA Netw Open.* (2020) 3:e1920956. doi: 10.1001/jamanetworkopen.2019.20956

frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 05 April 2023
DOI 10.3389/fpsyt.2023.1105662

OPEN ACCESS

EDITED BY
Mohammadreza Shalbafan,
Iran University of Medical Sciences,
Iran

REVIEWED BY
Roberta Ciuffini,
University of L'Aquila,
Italy
Georgia Nektaria Porfyri,
National and Kapodistrian University of Athens,
Greece

*CORRESPONDENCE
Débora Marques de Miranda
✉ debora.m.miranda@gmail.com

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

RECEIVED 22 November 2022
ACCEPTED 23 February 2023
PUBLISHED 05 April 2023

CITATION
Marques da Rocha MC, Malloy-Diniz LF, Romano-Silva MA, Joaquim RM, Serpa ALdO, Paim Diaz A, de Paula JJ, Costa DS, Silva AGd, Pinto ALdCB and de Miranda DM (2023) Decision-making styles during stressful scenarios: The role of anxiety in COVID-19 pandemic.
Front. Psychiatry 14:1105662.
doi: 10.3389/fpsyt.2023.1105662

Decision-making styles during stressful scenarios: The role of anxiety in COVID-19 pandemic

Mariana Castro Marques da Rocha[1,2], Leandro Fernandes Malloy-Diniz[1,3], Marco Aurélio Romano-Silva[3], Rui Mateus Joaquim[1], Alexandre Luiz de Oliveira Serpa[1], Alexandre Paim Diaz[1], Jonas Jardim de Paula[1,3], Danielle Souza Costa[1], Antônio Geraldo da Silva[1,2], André Luiz de Carvalho Braule Pinto[1,2] and Débora Marques de Miranda[1,4]*

[1]SAMBE - Instituto de Saúde Mental Baseada em Evidências, Rio de Janeiro, Brazil, [2]Post Graduation Department in Molecular Medicine, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, [3]Department of Psychiatry, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, [4]Department of Pediatrics, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

Introduction: Decision-making is not purely rational but highlighted by the influence of intuitive and emotional processes. Recently, researchers have focused more attention on understanding which environmental and personal features influence decision-making processes, and how.

Objective and methods: On this study, we investigate whether Trait Anxiety moderates the impact of Post-Traumatic Stress (PTS) symptoms reported during COVID-19 pandemic on decision-making styles.

Results: The study included 1,358 Brazilian participants (80% women) aged between 20 and 74 (M=41.11; SD=11.23) who responded to an online survey between May and August of the year 2021 of COVID-19 pandemic to The State–Trait Anxiety Inventory, The Decisions Styles Scale, The Impact of Event Scale – Revised and questions related to COVID-19. Through moderation analysis, we observed that experiencing PTS is associated with a higher tendency to biased/heuristic decision-making processes.

Discussion: Trait Anxiety seems to influence how people respond to PTS symptoms on decision-making related processes. Subjects with higher Trait Anxiety reported lower tendency to appeal to rationality, especially under higher reported levels of PTS. Meanwhile, lower Trait Anxiety subjects exhibited more reason-based decision-making under higher rates of PTS. This work contributes to a deeper understanding of the interplay among environmental and individual differences on decision-making styles and helps to identify factors of vulnerability for poorer cognitive functioning on stressful scenarios.

KEYWORDS

decision making, trait anxiety, post traumatic symptoms, decision strategies, psychological distress, COVID-19

Highlights

- Anxious individuals report lower levels of rationality and intuition on decision-making.
- Post-traumatic symptomatology is associated with more intuitive decision-making strategies.
- Individuals with higher Trait Anxiety tend to be less rational decision-makers under higher display of post-traumatic symptoms.
- Meanwhile, people with lower Trait Anxiety tend to display higher levels of rationality when higher rates of post-traumatic stress are presented.
- Anxiety trait might be considered a vulnerability factor for cognitive functioning in contexts of post-traumatic symptomatology.

1. Introduction

On decision-making theories' crib, choices were described as the result of a conscious, deliberative, process in which known alternatives and their consequences would be analyzed and compared. According to classical theories of decision-making, people chose the most advantageous available option and considered the availability of their own resources (e.g., budget) to handle the consequences of their choices (1, 2). Later, theories started to acknowledge that human behavior, including choice behavior, was not purely rational and highlighted the influence of intuitive and emotional processes (2–7), a proposition now widely accepted.

A growing body of research has proposed people present personal tendencies to rely on either rational or intuitive processes when making decisions. This tendency may be described as "the typical manner by which individuals make decisions" and it is argued that it is built upon personality traits and habit-based inclinations (8). Intuitive and rational decision styles are not mutually exclusive (9) and may work together to provide better outcomes (8). Each one of them presents pros and cons that might be better suited for different contexts. To Payne (10), the efficacy and the expression of each decision style depends on contextual characteristics, in a way that personal tendencies be overrode by situational specificities, leading an individual to be more intuitive than usual, for example.

It is well established that decision-making is influenced by both environmental/contextual factors and individual differences, but, so far, researchers have focused on the study of direct/main effects rather than looking into interactions among them. On this paper, we seek to investigate whether Post-Traumatic Stress (PTS) symptoms reported during COVID-19 pandemic in Brazil impacts on measures of rational and intuitive decision-making styles. Post-Traumatic Stress Disorder (PTSD) is the most frequent and the most investigated psychiatric disorder on population exposed to disasters (11). Several studies associates PTSD to deficits on cognitive performance (12–19), including decision-making (20, 21). Neuroimaging studies suggest that brain regions associated with decision-making are sensitive to changes induced by stress response and behavioral research supports the hypothesis that stress influences decision processes [for a review, see (22)]. Uncertainty related to an unknown disease coursing with socioeconomic implications and frequent deaths seem to amplify the risk perception. So, COVID-19 pandemic can be characterized as a period higher than typical rates of perceived risk (23, 24) and psychological distress (23, 25–28). The rates of post traumatic symptoms and disorders in mixed populations reached 15% of prevalence during SARS and the COVID-19 pandemic including the health care professionals in Brazil (29, 30).

Trait Anxiety (TA) belongs to the neuroticism x emotional stability personality trait and "refers to the stable tendency to attend to, experience, and report negative emotions such as fears, worries and anxiety across many situations" (31: p. 1,989). Hartley and Phelps (32) point out that Pre-Frontal Cortex (PFC)-dependent cognitive and affective functions may be impaired in anxiety disorders. One of the impaired functions would be decision-making since anxiety and decision-making ability share neural substrates. Additionally, PFC activity may reduce susceptibility to biases and promote more rational decision-making (5, 33), which supports the hypothesis that more anxious individuals could make less rational choices. Studies that investigate the relationship between decision-making and anxiety point out that anxious individuals tend to have greater risk aversion, showing preference for safer choices in contexts of uncertainty. They would also exhibit a more pessimistic assessment of the situation (34). Other studies also suggest that anxiety is associated with higher levels of loss aversion (35, 36). As pointed by (37), the relationship between TA and decision-making only recently received attention and little is known about the impact of anxiety on specific decision-making variables (32).

Here we analyze whether TA affects the relationship between PTS symptoms and decision-making during COVID-19 pandemic. Building upon the literature about the impact of stress response on cognitive functioning, and considering TA's cognitive characteristics, we hypothesize that more anxious individuals might display different patterns of response to PTS symptoms on decision-making strategies when compared to less anxious people. Specifically, we predict that TA might be associated with the use of more intuitive and less rational decision-making strategies.

2. Materials and methods

2.1. Participants

This study was part of a larger longitudinal online survey, which was approved by the National Commission of Ethics in Research (CONEP) on May 2nd, 2020 (CAAE #: 30823620.6.0000.5149). The recruitment was made through "capture" promotions managed by the Brazilian Psychiatry Association and directed to people across the

whole country. On total, 3,341 subjects agreed to participate. Of them, 1,390 declared to have lived a traumatic life event and were included on this study's sample. Finally, 32 subjects were excluded because they did not completely fill out the questions that assessed this study's variables of interest or because they failed to inform information regarding sex and age. Data was collected from May to August 2021. The final sample consisted of 1,358 subjects. Sample characterization is presented on Table 1.

2.2. Instruments

Impact of Event Scale - Revised (IES-R): was created to provide a more complete assessment of responses to traumatic events, being able to cover domains that the Impact of Event Scale (IES) did not yet cover (38). The IES-R is a self-report likert-type scale in which the individual answers the questions based on the 7 days prior to the application of the scale. The Brazilian Portuguese version scale consists of 22 items distributed into 3 subscales: avoidance, intrusion and hyperarousal that include the post-traumatic stress disorder assessment criteria published in DSM-IV [(39), p. 598]. For this study, IES-R shows reliability good reliability using McDonald's omega 0.96 for Intrusion, 0.93 for avoidance, and 0.94 for hyperarousal.

State–Trait Anxiety Inventory (STAI-T): is an instrument developed to measure anxiety across different cultures (40), and was originally created by Spielberger et al. (41). It consists of two subscales: one for state anxiety (STAI-S, item example: "I am tense; I am worried") and another for trait anxiety (STAI-T, item example: "I worry too much over something that really does not matter") (40). In the case of our research, we opted for the STAI-T version, which has 20 items in Brazilian Portuguese and is based on a 4-point likert scale (40). On our sample, STAI-T shows a McDonald's omega of 0.87.

Decisions Styles Scale (*DSS*) is a self-report instrument developed by Hamilton et al. (8) adapted to the Brazilian context by Mouta et al. (42). DSS assess two decision-making styles: rational (guided by a deliberative and conscious assessment of options' pros and cons; item example: "I prefer to gather all the necessary information before committing to a decision") and intuitive (based on quick and automatic processes, such as "gut" feeling; item example: "When making decisions, I rely mainly on my gut feelings"). The scale consists of 10 items, which are answered on a 5-point likert scale. For our study, DSS shows a McDonalds omega of 0.88 for rational style, and 0.81 for intuitive style.

Participants were asked to inform their biological sex and date of birth, from which their age (in years) were calculated. Participants were also asked to indicate whether their traumatic life event was related to the COVID-19 pandemic, according to the following options: (a) directly associated with COVID-19 pandemic, (b) indirectly associated with COVID-19 pandemic, (c) not associated with COVID-19 pandemic, and (d) not able to answer.

2.3. Statistical procedures

First, simple linear regressions were conducted for each one of the dependent variables (rational decision-making style and intuitive decision-making style). Predictors (PTS and TA) were entered separately on individual models to verify each predictor's main effect. Then, moderation analysis (model 1) was run using Process v3.5 by Hayes (43). Variables were entered as follows: PTS was entered as x (predictor), TA was entered as w (moderator) and decision-making styles (both intuitive and rational) were entered, on distinct analysis, as y (dependent variable). All analysis were run using SPSS 20th version, and we used $p < 0.05$ as a cut-off.

TABLE 1 Demographic characteristics.

	Total sample (*n*=1,358)			Low trait anxiety (*n*=721)			High trait anxiety (*n*=637)		
	Mean (SD)	*n* (%)	Min–max	Mean (SD)	*n* (%)	Min–max	Mean (SD)	*n* (%)	Min–max
Sex									
Male		271 (20.0)			186 (25.8)			85 (13.3)	
Female		1,087 (80.0)			535 (74.2)			552 (86.7)	
Age	41.11 (11.234)		20–74	44.39 (11.307)		21–74	37.40 (9.928)		20–67
Post-traumatic stress	3.17 (2.913)		0–12	2.12 (2.251)		0–12	4.35 (3.118)		0–12
Trait anxiety	14.19 (4.187)		0–24	10.91 (2.245)		0–14	17.90 (2.385)		15–24
Decision style scale (DSS)									
Rational style	20.26 (3.253)		5–25	20.80 (2.908)		10–25	19.65 (3.508)		5–25
Intuitive style	15.10 (3.496)		5–25	15.10 (3.666)		5–25	15.10 (3.296)		5–25
COVID associated distress									
Directly associated		120 (8.8)			54 (7.5)			66 (10.4)	
Indirectly associated		59 (4.3)			23 (3.2)			36 (5.7)	
Not associated		1,097 (80.8)			616 (85.4)			481 (75.5)	
Not able to respond		70 (5.2)			21 (2.9)			49 (7.7)	

TABLE 2 Simple regression analysis predicting rational and intuitive decision-making style.

Decision making style	Model	Predictor	*b*	*b* 95% CI (LL–UL)	*β*	*t*	*p*	R^2
Rational style	1	*Constant*	20.571	[20.316; 20.825]		155.317	**<0.0001**	
		Post-traumatic stress	−0.099	[−0.158; −0.040]	−0.089	−3.279	**<0.0001**	0.008
	2	*Constant*	20.796	[20.562; 21.030]		174.307	**<0.0001**	
		Trait anxiety	−1.149	[−1.49; −0.808]	−0.176	−6.598	**<0.0001**	0.030
Intuitive style	3	*Constant*	14.647	[14.374; 14.920]		105.238	**<0.0001**	
		Post-traumatic stress	0.143	[0.079; 0.206]	0.119	4.414	**<0.0001**	0.014
	4	*Constant*	15.096	[14.840; 15.351]		115.903	**<0.0001**	
		Trait anxiety	0.006	[−0.367; 0.379]	0.001	0.033	0.973	0.000

The bold indicates significant at $p<0.05$.

TABLE 3 Results from a regression analysis examining the moderation of the effect of PTS on rational and intuitive decision-making style by trait anxiety.

Decision making style	Predictor	*b*	*b* 95% CI (LL, UL)	SE B	*T*	*p*
Rational Style	Constant	208.761	[20.6183; 21.1338]	0.1314	1.588.936	**<0.0001**
	Post-traumatic stress	0.0763	[−0.0276; 0.1802]	0.0530	14.412	0.1497
	Trait anxiety	−11.236	[−1.4940; −0.7533]	0.1888	−59.518	**<0.0001**
	Post-traumatic stress*Trait anxiety	−0.1644	[−0.2964; −0.0344]	0.0668	−24.774	**0.0134**
Intuitive style	Constant	152.632	[14.9834; 15.5429]	0.1426	1.070.358	**<0.0001**
	Post-traumatic stress	0.1598	[0.0471; 0.2726]	0.0575	27.808	**0.005**
	Trait anxiety	−0.3639	[−0.7658; 0.0381]	0.2049	−17.759	0.076
	Post-traumatic stress*Trait anxiety	0.0111	[−0.1310; 0.1533]	0.0725	0.1538	0.878

For rational style $R^2=0.036$, MSE = 10.2262, $F(3,1,354)=16.8546$, $p<0.001$; for intuitive style $R^2=0.0165$, MSE = 12.0464, $F(3,1,354)=7.5792$, $p<0.001$. The bold indicates significant at $p<0.05$.

3. Results

Demographic data is presented in Table 1, consisted of mostly by women in middle age reporting stress not related to COVID-19.

To test the hypothesis that decision-making style varies as a function of multiple factors and, more specifically, whether trait anxiety moderates the relationship between PTS and decision-making, simple linear regression and simple moderator analysis were conducted. In the first step, a simple linear regression was calculated to predict rational decision-making style based on PTS (Table 2, model 1). A significant regression equation was found [$F(1,1,356)=10.752$, $p=0.001$; $R^2=0.008$]. The results of the regression indicated that PTS significantly predicted rational decision-making style ($\beta=-0.089$, p = 0.001). Then, a simple linear regression was run to verify whether rational decision-making style varied as a function of TA (Table 2, model 2). Results indicated that TA significantly predicted rational decision-making style ($\beta=-0.176$, $p<0.001$), accounting for approximately 3% of the variance on rational decision-making style reports [$F(1,1,356)=43.531$, $p<0.001$].

A similar process was conducted for the intuitive decision-making variable. Simple linear regression results (Table 2, model 3) suggest PTS is a valid predictor of intuitive decision-making style ($\beta=0.119$, $p<0.001$) on a model where [$F(1,1,356)=19.481$, $p<0.001$, $R^2=0.014$]. Another simple linear regression equation was tested to verify whether intuitive decision-making style varied as a function of TA (Table 2, model 4). The equation was not significant [$F(1,1,356)=0.001$, $p=0.973$] and TA was not pointed as a significant predictor of intuitive decision-making style ($\beta=0.001$, $p=0.973$).

A simple moderator analysis performed to investigate conditional effects of PTS on rational decision-making style (Table 3) showed that the interaction between PTS and TA was statistically significant ($b=-0.1654$, 95% C.I. = −0.2964, −0.0344, $p<0.05$). According to the results, the conditional effect of PTS on rational decision-making style was only significant when TA was high (TA scale score ≥ 15), with effect = −0.0891, (95% C.I. = −0.1689, −0.0093, $t=-2.1907$, $p<0.05$). When TA was low (TA scale score < 15), (conditional effect was 0.0763, 95% C.I. = −0.0276, 0.1802, $t=1.4412$, $p=0.1479$). These results suggest TA acts as a negative moderator of the relationship between PTS and rational decision-making style. Conditional effects for rational decision-making are represented on Figure 1A. Results also suggest PTS' impact on rational decision-making is only significant when TA is high.

Results from the simple moderator analysis performed to investigate conditional effects of PTS on intuitive decision-making style (Table 3) showed that the interaction between PTS distress and

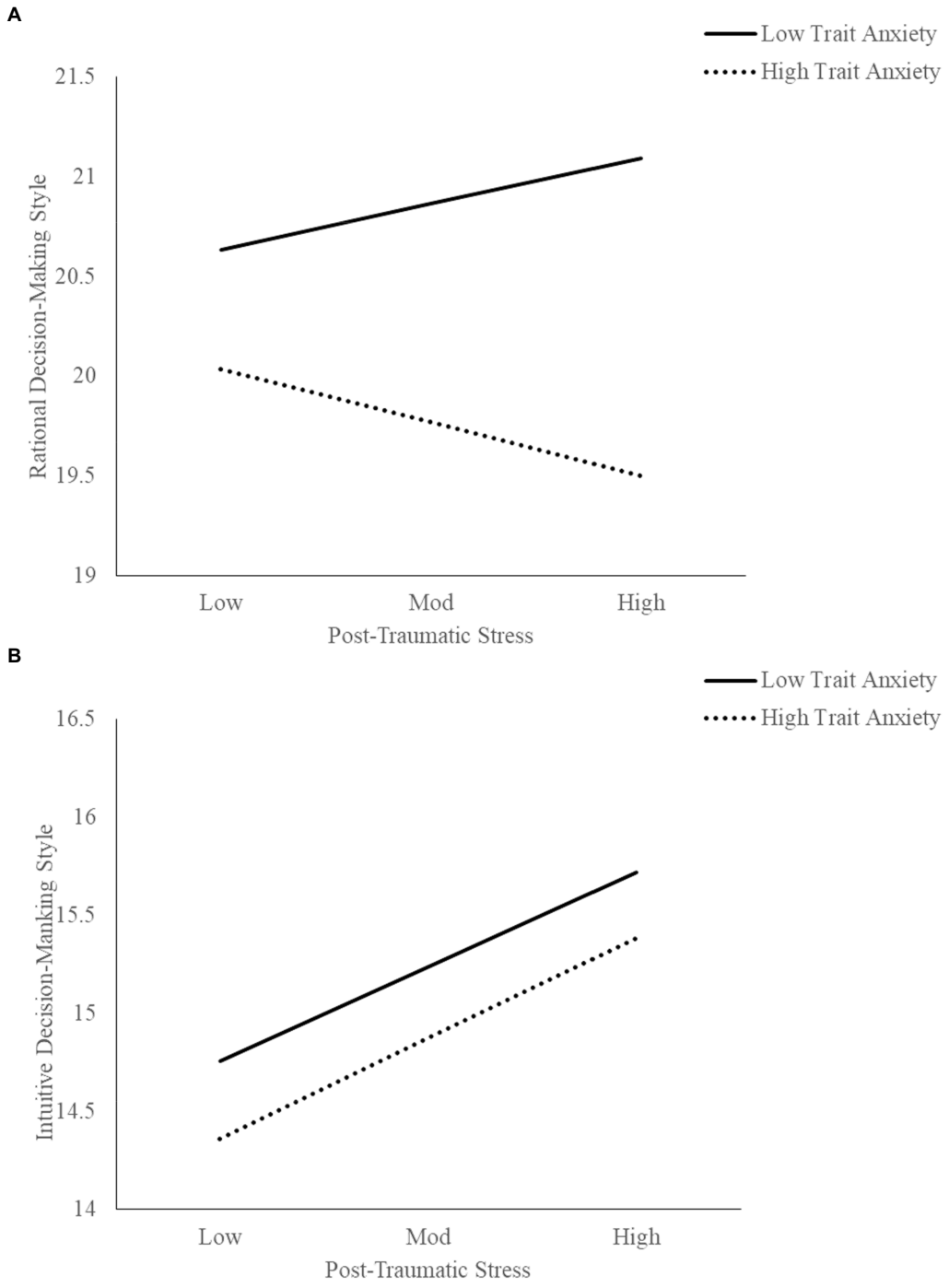


FIGURE 1
Decision-making style as a function of trait anxiety and post-traumatic stress. **(A)** Corresponds to rational decision-making style and **(B)** corresponds to intuitive decision-making style. Low and high levels of Trait Anxiety were set according to the median value displayed by the sample: Low Trait Anxiety contemplates values under the median value and High Trait Anxiety covers values equal or higher than the median value.

TA was not statistically significant ($b = 0.0111$, 95% C.I. = −0.1310, 0.1533, $p = 0.8778$). Regression analysis with mean-centered variables showed that only PTS was a significant main predictor of intuitive decision-making ($b = 0.1598$, 95% C.I. = 0.0471, 0.2726, $t = 2.7808$, $p = 0.0055$). There was a trend for the main effect of TA on intuitive decision-making ($b = -0.3639$, 95% C.I. = −0.7658, 0.0381, $t = -1.7759$, $p = 0.076$). These results suggest no moderation effect of TA on the relationship between PTS and intuitive decision-making style. Effects for intuitive decision-making are visually displayed at Figure 1B.

Taken together, results suggest the direction of the impact of PTS on rational decision-making style depends on TA level.

4. Discussion

This study investigated the relationship between Post-Traumatic Stress and decision-making styles, and whether Trait Anxiety moderates it. Our findings suggest that the impact of exposure to stressful contexts, measured by PTS, may change how people make decisions. Furthermore, the direction of this change depends on how vulnerable to anxiety people are. People who reported higher TA exhibited lower levels of both rational and intuitive decision-making styles when compared to subjects who reported lower tendency to anxiety. More importantly, on contexts of trauma, the more anxious people adopted a less rational decision-making style while subjects with lower TA displayed more reason-based strategies.

Some mechanisms might be behind the observed results. The first one is cognitive overload hypothesis. Literature on decision-making suggests that, in uncertain scenarios, our mental resources, necessary for self-control, are drained, which leads to an increase of the preference for "wants" over "shoulds" (44). The cognitive overload hypothesis is also present in the reasoning used to explain why people exposed to contexts of poverty, debt and other stressful scenarios have worse cognitive functioning when compared to other populations and themselves in less challenging contexts (45, 46). TA might compromise the ability to use effort-based strategies under stress *via* cognitive depletion due to heightened mental activity toward anxiety-influenced processes, such as worry, catastrophizing and planning for hypothetical scenarios.

Uncertainty is also a factor that might influence the observed results. With the beginning of the COVID-19 pandemic, the world experienced the biggest periods of uncertainty of the recent history. In Brazil, the scenario is aggravated by factors such as government misinformation through contradictory directions by authorities responsible for coordinating actions to deal with the current health crisis (47). Brazilians were therefore immersed in uncertainties that encompass the economic, political, social, and health spheres. We suggest it is plausible to consider that the general context of uncertainty might play a part on how people experienced stress response. In a study of two different stressful scenarios, such as in medical activities after earthquake and in COVID-19, a population also composed mostly by women perceive stress as anxiety, somatization, and depression acutely. The organization and participation on work related to the response to the event were important to perception of distress to improve health and wellbeing of professionals (48).

According to our analysis, PTS was positively associated to a more intuitive decision-making style. This observation is consistent with the findings that suggest uncertainty elicits intuitive/automatic processes of decision-making (22). It is possible to argue that TA's heightened vulnerability to uncertainty might be part of the mechanism through which PTS decreases the use of analytical/rational decision-making strategies on high TA individuals.

Another point that might be helpful on the interpretation of our results concerns the heightened sensitivity to internal sensation associated to the experience of emotions exhibited by high TA individuals (49). Baradell and Klein (50) conducted a study in which subjects with higher inner body consciousness showed increased susceptibility to experience impact of critical life events and daily struggles on decision-making. It is possible to argue that TA increases subjective perception of stress through sensitivity to emotion-related inner body sensations, therefore modulating the impact of distress on decision-making processes.

One of the greatest limitations of this study is the conceptualization on decision-making styles and its influence on results interpretation. While some authors understand decision-styles as crystalized constructs (primarily defined by personality traits and, therefore, constant throughout life), others highlight the influence of habit-based learning on personal tendencies on how to approach decision tasks. However, as pointed earlier, authors believe decision styles might be influenced by acute contextual factors, such as time pressure (7, 10). Our work tries to attend earlier recommendation to try identifying such factors. Finally, this study presents limitations regarding its sample. Subjects who participated on this research were self-selected and had to be able to assess the internet, which might create a sampling bias toward subjects with higher socioeconomic condition.

In conclusion, this work results suggest that people with higher tendency to display more frequent, intense, and dysfunctional levels of anxiety may suffer greater cognitive impact on stressful scenarios. Our findings align with and may contribute to the theory of differential sensitivity to context, which proposes that people with different levels of environmental vulnerability experience different outcomes when exposed to stress (51). Our work might contribute to the understanding of how stress impacts cognitive functioning and help to identify the most vulnerable individuals.

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 Universidade Federal de Minas Gerais - CONEP. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MR: designed the study, wrote the draft, revised literature, and analyzed data. LM-D, AS, and DM: supervision, work on project design and search for funding. RJ, AS, APa, JP, DC, and MR-S: help on data collect and study design and discussions. APi: analyzed data and revise the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This study was funded by governmental funding by the agencies: CAPES, CNPq, OPAS, MS-Brasil, and FAPEMIG.

Conflict of interest

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

Publisher's note

References

1. Gigerenzer G, Gaissmaier W. Decision making: nonrational theories In: . *International encyclopedia of the social & behavioral sciences*. Amsterdam: Elsevier (2015)

2. Von Neumann J, Morgenstern O. Theory of games and economic behavior. *Bull Amer Math Soc*. (1945) 51:498–5. doi: 10.1090/S0002-9904-1945-08391-8

3. Damasio H, Grabowski T, Frank R, Galaburda AM, Damasio AR. The return of Phineas gage: clues about the brain from the skull of a famous patient. *Science*. (1994) 264:1102–5. doi: 10.1126/science.8178168

4. Kahneman D. A perspective on judgment and choice: mapping bounded rationality. *Am Psychol*. (2003) 58:697–0. doi: 10.1037/0003-066X.58.9.697

5. De Martino B, Kumaran D, Seymour B, Dolan RJ. Frames, biases, and rational decision-making in the human brain. *Science*. (2006) 313:684–7. doi: 10.1126/science.1128356

6. Kahneman D, Tversky A. Prospect theory: an analysis of decision under risk In: LC MacLean and WT Ziemba, editors. *Handbook of the fundamentals of financial decision making: Part I*. Singapore: World Scientific (2013)

7. Bechara A, Damasio H, Damasio AR. Role of the amygdala in decision-making. *Ann N Y Acad Sci*. (2003) 985:356–9. doi: 10.1111/j.1749-6632.2003.tb07094.x

8. Hamilton K, Shih SI, Mohammed S. The development and validation of the rational and intuitive decision styles scale. *J Pers Assess*. (2016) 98:523–5. doi: 10.1080/00223891.2015.1132426

9. Sadler-Smith E. The intuitive style: relationships with local/global and verbal/visual styles, gender, and superstitious reasoning. *Learn Individ Differ*. (2011) 21:263–0. doi: 10.1016/j.lindif.2010.11.013

10. Payne JW. Contingent decision behavior. *Psychological Bulletin*. (1982) 92:382–402. doi: 10.1037/0033-2909.92.2.382

11. Galea S, Nandi A, Vlahov D. The epidemiology of post-traumatic stress disorder after disasters. *Epidemiol Rev*. (2005) 27:78–91. doi: 10.1093/epirev/mxi003

12. Brandes D, Ben-Schachar G, Gilboa A, Bonne O, Freedman S, Shalev AY. PTSD symptoms and cognitive performance in recent trauma survivors. *Psychiatry Res*. (2002) 110:231–8. doi: 10.1016/S0165-1781(02)00125-7

13. Burri A, Maercker A, Krammer S, Simmen-Janevska K. Childhood trauma and PTSD symptoms increase the risk of cognitive impairment in a sample of former indentured child laborers in old age. *PLoS One*. (2013) 8:e57826. doi: 10.1371/journal.pone.0057826

14. Leskin LP, White PM. Attentional networks reveal executive function deficits in posttraumatic stress disorder. *Neuropsychology*. (2007) 21:275–4. doi: 10.1037/0894-4105.21.3.275

15. Qureshi SU, Long ME, Bradshaw MR, Pyne JM, Magruder KM, Kimbrell T, et al. Does PTSD impair cognition beyond the effect of trauma? *J Neuropsychiatry Clin Neurosci*. (2011) 23:16–28. doi: 10.1176/appi.neuropsych.23.1.16

16. Twamley EW, Allard CB, Thorp SR, Norman SB, Cissell SH, Berardi KH, et al. Cognitive impairment and functioning in PTSD related to intimate partner violence. *J Int Neuropsychol Soc*. (2009) 15:879–7. doi: 10.1017/S135561770999049X

17. Roos LE, Knight EL, Beauchamp KG, Berkman ET, Faraday K, Hyslop K, et al. Acute stress impairs inhibitory control based on individual differences in parasympathetic nervous system activity. *Biol Psychol*. (2017) 125:58–63. doi: 10.1016/j.biopsycho.2017.03.004

18. Roozendaal B. Stress and memory: opposing effects of glucocorticoids on memory consolidation and memory retrieval. *Neurobiol Learn Mem*. (2002) 78:578–5. doi: 10.1006/nlme.2002.4080

19. Vedhara K, Hyde J, Gilchrist ID, Tytherleigh M, Plummer S. Acute stress, memory, attention and cortisol. *Psychoneuroendocrinology*. (2000) 25:535–9. doi: 10.1016/S0306-4530(00)00008-1

20. Morgado P, Sousa N, Cerqueira JJ. The impact of stress in decision making in the context of uncertainty. *J Neurosci Res*. (2014) 93:839–7. doi: 10.1002/jnr.23521

21. Sailer U, Robinson S, Fischmeister FP, Konig D, Oppenauer C, Lueger-Schuster B, et al. Altered reward processing in the nucleus accumbens and mesial prefrontal cortex of patients with posttraumatic stress disorder. *Neuropsychologia*. (2008) 46:2836–44. doi: 10.1016/j.neuropsychologia.2008.05.022

22. Starcke K, Brand M. Decision making under stress: a selective review. *Neurosci Biobehav Rev*. (2012) 36:1228–48. doi: 10.1016/j.neubiorev.2012.02.003

23. Petzold MB, Bendau A, Plag J, Pyrkosch L, Mascarell Maricic L, Betzler F, et al. Risk, resilience, psychological distress, and anxiety at the beginning of the COVID-19 pandemic in Germany. *Brain Behav*. (2020) 10:e01745. doi: 10.1002/brb3.1745

24. Wise T, Zbozinek TD, Michelini G, Hagan CC, Mobbs D. Changes in risk perception and self-reported protective behaviour during the first week of the COVID-19 pandemic in the United States. *R Soc Open Sci*. (2020) 7:200742. doi: 10.1098/rsos.200742

25. Breslau J, Finucane ML, Locker AR, Baird MD, Roth EA, Collins RL. A longitudinal study of psychological distress in the United States before and during the COVID-19 pandemic. *Prev Med*. (2021) 143:106362. doi: 10.1016/j.ypmed.2020.106362

26. Gómez-Salgado J, Andrés-Villas M, Domínguez-Salas S, Díaz-Milanés D, Ruiz-Frutos C. Related health factors of psychological distress during the COVID-19 pandemic in Spain. *Int J Environ Res Public Health*. (2020) 17:3947. doi: 10.3390/ijerph17113947

27. Kikuchi H, Machida M, Nakamura I, Saito R, Odagiri Y, Kojima T, et al. Changes in psychological distress during the COVID-19 pandemic in Japan: a longitudinal study. *J Epidemiol*. (2020) 30:522–8. doi: 10.2188/jea.JE20200271

28. Twenge JM, Joiner TE. Mental distress among US adults during the COVID-19 pandemic. *J Clin Psychol*. (2020) 76:2170–82. doi: 10.1002/jclp.23064

29. Pinto B, Carvalho AL, Serpa AL, Jardim J, de Paula D, Costa S, et al. Increased risk of health professionals to feel traumatized during the COVID-19 pandemic. *Sci Rep*. (2021) 11:18286. doi: 10.1038/s41598-021-97783-6

30. Cheung T, Cheng CPW, Fong TK, Sharew NT, Anders RL, Xiang YT, et al. Psychological impact on healthcare workers, general population and affected individuals of SARS and COVID-19: a systematic review and meta-analysis. *Front Public Health*. (2022) 10. doi: 10.3389/fpubh.2022.1004558

31. Gidron Y. Trait Anxiety. In: Gellman MD, Turner JR, editors. *Encyclopedia of Behavioral Medicine*. New York, NY: Springer Science+Business Media (2013).

32. Hartley CA, Phelps EA. Anxiety and decision-making. *Biol Psychiatry*. (2012) 72:113–8. doi: 10.1016/j.biopsych.2011.12.027

33. Xu P, Gu R, Broster LS, Wu R, Van Dam NT, Jiang Y, et al. Neural basis of emotional decision making in trait anxiety. *J Neurosci*. (2013) 33:18641–53. doi: 10.1523/JNEUROSCI.1253-13.2013

34. Maldonato M, Dell'Orco S. How to make decisions in an uncertain world: heuristics, biases, and risk perception. *World Futures*. (2011) 67:569–7. doi: 10.1080/02604027.2011.615591

35. De Martino B, Camerer CF, Adolphs R. Amygdala damage eliminates monetary loss aversion. *Proc Natl Acad Sci USA*. (2010) 107:3788–92. doi: 10.1073/pnas.0910230107

36. Sokol-Hessner P, Hsu M, Curley NG, Delgado MR, Camerer CF, Phelps EA. Thinking like a trader selectively reduces individuals' loss aversion. *Proc Natl Acad Sci USA*. (2009) 106:5035–40. doi: 10.1073/pnas.0806761106

37. Miu AC, Heilman RM, Houser D. Anxiety impairs decision-making: Psychophysiological evidence from an Iowa Gambling Task. *Task Biol Psychol*. (2008) 77:353–8. doi: 10.1016/j.biopsycho.2007.11.010

38. Weiss DS. The impact of event scale — revised In: JP Wilson and TM Keane, editors. *Assessing psychological trauma and PTSD. 2nd* ed. New York: The Guilford Press (2004).

39. Caiuby AVS, Lacerda SS, Quintana MI, Torii TS, Andreoli SB. Adaptação transcultural da versão Brasileira da Escala do Impacto do Evento - Revisada (IES-R) [cross-cultural adaptation of the Brazilian version of the event impact scale - revised (IES-R)]. *Cad Saude Publica*. (2012) 28:597–3. doi: 10.1590/S0102-311X2012000300019

40. Fioravanti-Bastos ACM, Cheniaux E, Landeira-Fernandez J. Development and validation of a short-form version of the Brazilian state-trait anxiety inventory. *Psicologia: Reflexão e Crítica*. (2011) 24:485–4.

41. Spielberger CD, Gorsuch RC, Lushene RE. *Manual for the state trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press (1970).

42. Mouta GS, Pinto AB, Malloy-Diniz LF, Pasian RS. Cross-cultural adaptation, and factor structure of the decision styles scale for Brazil. *Curr Res Behav Sci*. (2021) 2:100039. doi: 10.1016/j.crbeha.2021.100039

43. Hayes AF. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford publications (2017).

44. Milkman KL. Unsure what the future will bring? You may overindulge: uncertainty increases the appeal of wants over should. *Organ Behav Hum Decis Process*. (2012) 119:163–6. doi: 10.1016/j.obhdp.2012.07.003

45. Mani A, Mullainathan S, Shafir E, Zhao J. Poverty impedes cognitive function. *Science*. (2013) 341:976–0. doi: 10.1126/science.1238041

46. Ong Q, Theseira W, Ng IY. Reducing debt improves psychological functioning and changes decision-making in the poor. *Proc Natl Acad Sci USA*. (2019) 116:7244–9. doi: 10.1073/pnas.1810901116

47. Xavier DR, E Silva EL, Lara FA, E Silva GR, Oliveira MF, Gurgel H, et al. Involvement of political and socio-economic factors in the spatial and temporal dynamics of COVID-19 outcomes in Brazil: a population-based study. *Lancet Region HealthAmericas*. (2022) 10:100221. doi: 10.1016/j.lana.2022.100221

48. Ciuffini R, Marrelli R, Leuter C, Stratta P, Paladini A, Ciccozzi A, et al. The stress response of intensive care unit medical doctors facing repeated severe emergencies. *Front Psychol*. (2022) 13:895954. doi: 10.3389/fpsyg.2022.895954

49. Pollatos O, Traut-Mattausch E, Schroeder H, Schandry R. Interoceptive awareness mediates the relationship between anxiety and the intensity of unpleasant feelings. *J Anxiety Disord*. (2007) 21:931–3. doi: 10.1016/j.janxdis.2006.12.004

50. Baradell JG, Klein K. Relationship of life stress and body consciousness to hypervigilant decision making. *J Pers Soc Psychol*. (1993) 64:267–3. doi: 10.1037/0022-3514.64.2.267

51. Boyce WT, Ellis BJ. Biological sensitivity to context: I. an evolutionary–developmental theory of the origins and functions of stress reactivity. *Dev Psychopathol*. (2005) 17:271–1.

frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 11 April 2023
DOI 10.3389/fpsyt.2023.1102450

OPEN ACCESS

EDITED BY
Renato de Filippis,
Magna Græcia University,
Italy

REVIEWED BY
Georgia Nektaria Porfyri,
National and Kapodistrian University of Athens,
Greece
Thiago Henrique Roza,
Federal University of Rio Grande do Sul,
Brazil

*CORRESPONDENCE
Fatemeh Sadat Mirfazeli
✉ mirfazeli.f@iums.ac.ir

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

RECEIVED 18 November 2022
ACCEPTED 06 February 2023
PUBLISHED 11 April 2023

CITATION
Saeidi M, Rezvankhah T, Pereira-Sanchez V, Rafieian M, Shariati B, Esmaeeli ST, Emamikhah M, Alavi K, Shabani A, Soraya S, Kashaninasab F and Mirfazeli FS (2023) First-episode mania after COVID-19: A case series in Iran.
Front. Psychiatry 14:1102450.
doi: 10.3389/fpsyt.2023.1102450

First-episode mania after COVID-19: A case series in Iran

Mahdieh Saeidi[1], Tara Rezvankhah[1], Victor Pereira-Sanchez[2], Maryam Rafieian[1], Behnam Shariati[1], Soode Tajik Esmaeeli[1], Maziar Emamikhah[1], Kaveh Alavi[1], Amir Shabani[1], Shiva Soraya[1], Fatemeh Kashaninasab[1] and Fatemeh Sadat Mirfazeli[1]*

[1]Department of Psychiatry, Mental Health Research Center, School of Behavioral Sciences and Mental Health (Tehran Institute of Psychiatry), Iran University of Medical Sciences, Tehran, Iran, [2]Grossman School of Medicine, New York University, New York, NY, United States

Background: Increasing reports of manic episodes in patients during acute infection with COVID-19 have been documented since the pandemic began, including individuals without a previous personal or family history of bipolar disorder. As infections and autoimmunity have putative roles in bipolar disorder, we aimed to document the clinical presentations, associated stressors, family aggregation patterns, and brain imaging and electroencephalographic correlates with a series of patients with episodes of mania that emerged shortly after COVID-19 infections.

Methods: We obtained all relevant clinical information from 12 patients whose first manic episode started within a month of COVID-19 infection and were treated at Rasool-e-Akram hospital and Iran psychiatric hospital, two tertiary medical centers in Tehran, Iran, in 2021.

Results: Patients had a mean age of 44. The interval between the onset of symptoms of COVID and mania ranged between 0 and 28days (mean: 16.25, median: 14days); it was observed to be shorter in patients with a family history of mood disorders but not in those receiving corticosteroids. Alongside a descriptive overview of our sample, we provide detailed narrative descriptions of two of the cases for illustrative purposes and discuss our observations in the context of other cases reported elsewhere and the state-of-the-art regarding infectious diseases, COVID-19, and bipolar disorder as reported in previous literature.

Conclusion: Our case series documents observational and naturalistic evidence from a dozen of cases of mania in the context of acute COVID-19, which, while limited, calls for analytical research of the phenomenon, and points at a family history of bipolar disorder and the use of corticosteroids as factors for particular focus.

KEYWORDS

COVID-19, mania, bipolar disorder, pandemic, first-episode mania

Background

While the COVID-19 pandemic remains a major global health challenge, research has advanced in understanding the highly heterogeneous and multisystem manifestations of the infection. Neuropsychiatric symptoms in patients with COVID-19, either as new-onset manifestations or exacerbations or relapses of preexisting conditions, have been repeatedly

reported (1–4). Those are thought to be caused by the direct and indirect effects of the virus on the brain and by the psychosocial stressors brought up by the pandemic and containment measures (5, 6). Estimates of the prevalence of neurological and psychiatric symptoms in patients with COVID-19 are one-fifth and one-half, respectively (3). The neuropsychiatric manifestations of COVID-19 have been categorized into three distinct groups: olfactory symptoms; headache and limb force reduction; photophobia, hallucinations, mental state change, vision and speech problems, seizure, stroke, and ataxia (7). New-onset psychiatric illness has been identified in 5.8% of COVID-19 survivors within 14–90 days since the COVID-19 diagnosis (8).

Bipolar disorder (BD) is a spectrum of chronic, episodic, and highly disabling mood disorders with a lifetime prevalence of about 2.4% (9, 10) and is associated with poor health and reduced life expectancy due to psychiatric and general medical conditions, including suicide, respiratory and cardiovascular diseases, and cancer (11–13). A typical presentation of new-onset BD is first-episode mania, in which people without a previously known history of BD exhibit symptoms such as elevated or dysphoric mood, grandiosity, irritability, increased psychomotor activity, behavioral disinhibition, decreased need for sleep, distractibility, and, severe cases of, psychotic features such as delusions and hallucinations congruent with the mood (14). There have been increasing reports of first manic episodes in people within days after being infected by SARS-CoV-2 (15–22). While actual the causality, correlation, and pathophysiology of mania following COVID-19 are not yet understood, previous research associating BD with immune and inflammatory dysfunctions (23, 24) shows a way to study mania after COVID-19 as a possible result of direct and indirect brain effects of the virus.

Being first-episode mania, and consequently new-onset BD, a potential, rare yet very severe complication of COVID-19, it is paramount to identify affected individuals and characterize its manifestations and course. This study presents an original case series of 12 individuals presenting with first-episode mania within a month of being infected with COVID-19. It includes an overview of the series showing the most remarkable demographic and clinical details (symptoms, medical workup, treatment, etc.) of each case alongside two illustrative detailed cases. The series is accompanied by a compilation of other case reports previously published in international scientific literature to provide a more comprehensive and global understanding of the phenomenon and promote further discussion, data sharing, and research on the topic.

Methods

This original case series aimed to document the clinical presentation, associated stressors, family aggregation patterns, and brain imaging and electroencephalographic correlates in hospitalized patients with post-COVID first-episode mania. Patients' records were included in the series if they had their first manic episode within a month of COVID-19 infection and were excluded if patients were abusing substances or had any past medical history of a psychiatric or neurological disorder.

Twelve patients were included; they had attended Rasool-e-Akram hospital and Iran psychiatric hospital, two tertiary medical centers in Tehran, Iran, and were diagnosed with bipolar disorder type 1 (currently in the first episode of mania) by an experienced psychiatrist after a complete psychiatric assessment. COVID-19 had been diagnosed by an infectious disease specialist based on a positive RNA test and/or a spiral chest computerized tomography (CT) scan, these findings were reported by an experienced radiologist. Nine out of 12 patients had agreed to undergo brain magnetic resonance imaging (MRI) during hospitalization. Additional demographic and clinical data were collected by psychiatry residents through face-to-face interviews with the patients and their families during their hospitalization and through chart reviews of patients' records. Information of interest included demographic details, past medical, psychiatric, substance, drug, family history, COVID-19 symptoms and diagnostic methods, treatment records, and paraclinical data. Descriptive statistics were obtained using SPSS v.16.0 software (SPSS Inc., Chicago, IL, United States).

Informed consent for inclusion in the reported series was obtained from all patients and their families, and the study follows the Helsinki Declaration (current version, 2013).

Results

This case series included 12 patients with a mean age of 44 (median: 43, range: 32–69) including seven men and five women. Patients' characteristics are presented in Tables 1-1 and 1-2. The interval between the onset of symptoms of COVID-19 and mania ranged between 0 and 28 days (mean: 16.25 days, median: 14 days). Five out of 12 patients had a family history of mood disorders (cases 2, 4, 6, 7, and 8; see tables for correspondence), and eight out of 12 patients had received corticosteroids as a treatment for COVID-19 (cases 1, 2, 3, 6, 7, 8, 11, and 12; see tables for correspondence). None of the patients had a previous personal psychiatric history and only one had past substance use (methamphetamine). Findings from neurological examination and imaging were unremarkable for all patients. There was no observed relevant difference between men and women regarding the long interval between the onset of symptoms of COVID-19 and mania onset (mean: 15.43 days for men, and 17.4 for women).

Patients with a family history of mood disorders had an observed shorter average interval (mean: 13.2, median: 14 days) compared to those with a negative family history (mean: 18.43, median: 21 days). The median interval between COVID-19 symptoms and mania onset was similar in patients with and without corticosteroid treatment and in those with a mood disorder family history (the median for all three groups was 14 days), while individuals without a mood disorder family history had a longer median interval of 21 days.

The Mann–Whitney *U* test was chosen from the nonparametric tests. There was no significant relationship between the family history of mood disorder and the distance between the onset of mania and COVID-19 (p value = 0.722), as well as the use or non-use of

Abbreviations: COVID-19, Coronavirus disease 2019; BD, bipolar disorder; RNA, ribonucleic Acid; PCR, polymerase chain reaction; CT scan, computerized tomography scan; MRI, magnetic resonance imaging; EEG, electroencephalogram; ECT, electroconvulsive therapy; DSM-5, diagnostic and statistical manual of mental disorders, fifth edition; EBV, Epstein–Barr virus; CMV, cytomegalovirus; HSV, Herpes simplex virus; HBV, Hepatitis B virus; HCV, Hepatitis C virus.

TABLE 1-1 Characteristics of patients with post-COVID mania in the case series.

Case	Age (years), sex (M, F)	Educational level	Interval between the onset of COVID-19 and the onset of psychiatric symptoms	Psychiatric symptoms	COVID-19 symptoms	Diagnostic method	COVID-19 treatment	PMH
1	40 M	Elementary school	4 weeks	irritability, decreased need for sleep, aggression, hallucination auditory, grandiosity delusion, thought racing, distractibility	fever, myalgia	positive COVID-19 PCR, significant changes in Spiral Chest CT scan	favipiravir, IV corticosteroid therapy	None
2	32 M	BSc	2 weeks	irritability, decreased need for sleep, aggression, hallucination auditory, grandiosity delusion, thought racing, distractibility	fever, sleep deprivation, myalgia, fatigue	positive COVID-19 PCR, significant changes in Spiral Chest CT scan	IV corticosteroid therapy, remdesivir	None
3	69\u00B0F	Elementary school	10 days	irritability, decreased need for sleep, aggression, hallucination auditory, grandiosity delusion, reference delusions, agitation	fever, myalgia	positive COVID-19 PCR	IV corticosteroid therapy	None
4	45\u00B0F	Elementary school	2 weeks	elevated mood, increased energy, decreased need for sleep, talkativeness, flight of ideas and thought racing, grandiosity delusion, overspending, increased religious goal directed activity	cough, hemoptysis, fatigue	Significant changes in Spiral Chest CT scan	–	None
5	62 M	BSc	4 weeks	Irritability, decreased need for sleep, talkativeness, overspending, aggressive behaviors, auditory hallucinations, grandiosity delusions, persecutory delusions	myalgia, fatigue, productive cough, dyspnea	positive COVID-19 PCR, significant changes in Spiral Chest CT scan	favipiravir	None

(Continued)

10.3389/fpsyt.2023.1102450

TABLE 1-1 (Continued)

Case	Age (years), sex (M, F)	Educational level	Interval between the onset of COVID-19 and the onset of psychiatric symptoms	Psychiatric symptoms	COVID-19 symptoms	Diagnostic method	COVID-19 treatment	PMH
6	45 F	Diploma	2 weeks	irritability, talkativeness, aggression, elevated energy, suicidal ideation, visual and auditory hallucination, decreased need for sleep, persecutory delusions	fever, myalgia, shortness of breath	positive COVID-19 PCR, significant changes in Spiral Chest CT scan	IV corticosteroid therapy, remdesivir	None
7	36 M	PhD	2 weeks	irritability, talkativeness, aggression, elevated energy, increase in appetite, visual and auditory hallucination, decreased need for sleep	Myalgia, fatigue, productive cough, dyspnea	positive COVID-19 PCR, significant changes in Spiral Chest CT scan	IV corticosteroid therapy	None
8	44 M	BSc	10 days	irritability, decreased need for sleep, aggression (verbal and physical), talkativeness, increased energy, flight of ideas and thought racing, grandiosity delusions, visual and auditory hallucinations (religious content)	fever, cough, diarrhea, fatigue	positive COVID-19 PCR	IV corticosteroid therapy	None
9	45 M	Elementary school	2 weeks	Increased energy, irritability, decreased need for sleep, flight of ideas, grandiosity delusions	fever, myalgia, cough	Positive COVID-19 PCR	–	None

(Continued)

10.3389/fpsyt.2023.1102450

TABLE 1-1 (Continued)

Case	Age (years), sex (M, F)	Educational level	Interval between the onset of COVID-19 and the onset of psychiatric symptoms	Psychiatric symptoms	COVID-19 symptoms	Diagnostic method	COVID-19 treatment	PMH
10	42 M	Diploma	concurrent	persecutory and grandiosity delusions, auditory hallucinations, irritability, increased energy, decreased need for sleep, flight of ideas, aggression	fever, fatigue	positive COVID-19 PCR	conservative therapy	IHD
11	37 F	Diploma	3 weeks	grandiosity delusions, auditory hallucinations, irritability, increased energy, decreased need for sleep, flight of ideas, aggression	fever, fatigue	positive COVID-19 PCR, significant changes in Spiral Chest CT scan	IV corticosteroid therapy, colchicine	intellectual disability
12	35 F	Diploma	4 weeks	irritability, flight of ideas, grandiosity delusions, visual hallucinations, decreased need for sleep, agitation not available/ applicable aggression	fever, myalgia, fatigue	positive COVID-9 PCR	IV corticosteroid therapy, remdesivir	none

M, male; F, female; BSc, bachelor of science; PhD, doctor of philosophy; PMH, past medical history; PCR, polymerase chain reaction; CT scan, computed tomography; IHD, ischemic heart disease.

10.3389/fpsyt.2023.1102450

corticosteroids. There was no significant relationship between the time interval between the onset of mania and COVID-19 (p value = 0.308).

Illustrative case 1

A 40-year-old man (case #1; see tables for correspondence), with no significant medical, psychiatric, family, or substance use history, was brought to the psychiatric emergency department. His companion reported an abnormal body movement (pseudo seizure) while he was awake and that he became aggressive and sexually disinhibited. He had exposed himself in front of others and said inappropriate sexual content. Based on the family member's report, his sense of orientation was intact. Weeks earlier he had had fever and myalgia and had been assessed by an infectious disease specialist; the diagnosis of COVID-19 was supported by the polymerase chain reaction (PCR) and spiral chest CT scan. He was treated with favipiravir and intravenous corticosteroid therapy. While the symptoms of COVID-19 were improving, new-onset psychiatric symptoms emerged with an acute and progressive course: irritability, decreased need for sleep, thought racing, distractibility, aggression, auditory hallucinations (hearing God's voice telling him about his 'superpower' and intelligence), and grandiosity delusions (being the 'special servant of God, being able to read people's minds and actions with closed eyes, having a great power to change the whole world). After admission to the hospital, a thorough physical and neurological workup was obtained, including brain CT and MRI, electroencephalogram (EEG), lumbar puncture, and urine toxicology, and the findings were unremarkable. Due to the unreliable history of a possible seizure just before hospitalization, neurologists started phenytoin 100 mg intravenous, three times a day, and after no evidence of a seizure, neurologists changed it to capsule phenytoin 100 mg three times a day and then tapered it to discontinuation during hospitalization.

His symptoms were severe and he was aggressive; he would remove his intravenous line and fight with the staff despite receiving several haloperidol injections alongside oral medication (sodium valproate 1,500 mg/day, haloperidol 5 mg three times a day, biperiden 4 mg/day, and olanzapine 5 mg per night). He, therefore, received three sessions of bilateral electroconvulsive therapy (ECT) and his symptoms improved significantly; he was eventually discharged in a state of clinical remission after 22 days of hospitalization with the following medications: sodium valproate 500 mg every night, haloperidol 5 mg three times a day, biperiden 2 mg every night, and clonazepam 1 mg every night.

Illustrative case 2

A 32-year-old man (case #2; see tables for correspondence), with no previous history of psychiatric disorders, presented at the hospital emergency department with mood symptoms. The patient was irritable, restless, and aggressive. He had a decreased need for sleep, the pressure of speech, and paranoid ideations about his neighbors (reporting that they were watching him through the window and wanted to ruin his reputation). He also had been presenting an unusually inflated self-esteem and sense of importance in the previous days, and he reported feeling like his 'brain was racing'. The patient had also been overspending money, with financial and legal consequences. According to the patient's wife, these acute symptoms had emerged in the context of insomnia due to myalgia and other symptoms associated with COVID-19. The patient had a fever, lethargy, weakness, severe myalgia, and lung damage 2 weeks before going to the psychiatric emergency department. He had been treated with intravenous injections of corticosteroids and remdesivir, with symptomatic physical improvement and psychiatric worsening. He had no significant past use of tobacco or alcohol. His mother had a history of manic episodes with the diagnosis of bipolar disorder.

Upon assessment, findings from his physical and neurological examination were unremarkable, and his mental status exam recorded a pressure of speech, elevated mood, and grandiosity delusions perseverative in religious content. The grandiosity delusion consisted of a conviction of possessing great power and knowledge and having "the mission of saving human beings." The patient also had auditory hallucinations, reportedly hearing "the voice of God" and showing hallucinatory behaviors such as self-talking and externally unmotivated spontaneous laughing.

After the patient was admitted to the psychiatric ward, a lumbar puncture was performed for diagnostic measures, in which the analysis of cerebrospinal fluid was reported to be normal (colorless, white blood count of 0, red blood count of 450, bacteria not seen). Both patient's brain MRI and EEG have lacked significant abnormalities. The patient was diagnosed with BD type I, a current episode of severe mania with psychotic features according to the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) and received pharmacotherapy (haloperidol 15 mg per day, sodium valproate 2,000 mg per day, biperiden 5 mg per day, clonazepam 1 mg per day, and quetiapine 50 mg per day). The patient was discharged after 27 days of hospitalization with a euthymic mood and without any psychotic symptoms. In the first 3 months of follow-up, the patient remained asymptomatic and medicated (haloperidol 7.5 mg per day, sodium valproate 1,500 mg per day, and biperiden 3 mg per day).

Cases reported In previous literature

We searched and reviewed other case reports previously published in international scientific literature to provide a global context of the phenomenon. The most relevant information to compare with our samples is compiled in Table 2.

Discussion

Our case series includes 12 patients with similar presentations of manic episodes within a month of being infected with COVID-19, which bears similarities with other cases reported in the international scientific literature. While inferences and generalizations cannot be made through the clinical description of a local, small sample, and an actual association between COVID-19 and mania cannot be confirmed beyond temporal concurrence, our observations provide valuable insights for the formulation of hypotheses and the design of future systematic observations and inferential research.

The emergence of psychopathology during a major infectious disease outbreak such as COVID-19 manifested as new-onset, relapse, or exacerbation is understood as possibly associated with direct and indirect neurotropic effects of pathogens and the immune response they trigger, as well as with the psychological stress produced by the

TABLE 1-2 Characteristics and imaging of patients with post-COVID mania in the current study.

Case	PPH	Psychiatric treatment	DH	FH	SH	Neuroimaging	EEG	ECT	CSF analysis
1	None	Na valproate 500 mg, HS, haloperidol 5 mg, TDS, biperiden 2 mg, HS, clonazepam 1 mg, HS	Negative	None	None	Normal	Unremarkable	3 sessions	Unremarkable
2	None	–	Negative	Bipolar disorder in first degree relatives	None	Normal	Unremarkable	Not available/ applicable	Unremarkable
3	None	olanzapine 5 mg, TDS	Negative	None	None	Normal	Unremarkable	Not available/ applicable	Unremarkable
4	None	Na valproate 500 mg BD, haloperidol 5 mg BD, quetiapine 100 mg, HS	Negative	Mood disorder in second degree relatives	None	Normal	Not available/ applicable	Not available/ applicable	Not available/ applicable
5	None	Na valproate 500 mg, 1HS, risperidone 4 mg, 1HS, clonazepam 1 mg, HS	Negative	None	None	Mild senile atrophic changes, moderate small hypersignal lesions centrum semiovale, frontoparietal periventricular white matter basal ganglia, external capsules are seen (that could be due to small vessel ischemic changes), inflammatory changes in paranasal sinuses are seen, mild cistern magna widening is seen.	Not available/ applicable	Not available/ applicable	Not available/ applicable
6	None	tab olanzapine 5 mg, D, Na valproate 500 mg, BD	Negative	Unipolar depression in first degree relatives	None	Normal	Unremarkable	Not available/ applicable	Unremarkable
7	None	olanzapine 5 mg, 2 HS	Negative	Mood disorder in first degree relatives	None	Normal	Not available/ applicable	Not available/ applicable	Unremarkable
8	None	Na valproate500mg, TDS, risperidone 4 mg, 1.5HS	Negative	Mood disorder in first degree relatives	None	–	Not available/ applicable	Not available/ applicable	Not available/ applicable

(Continued)

10.3389/fpsyt.2023.1102450

TABLE 1-2 (Continued)

Case	PPH	Psychiatric treatment	DH	FH	SH	Neuroimaging	EEG	ECT	CSF analysis
9	None	–	Negative	None	None	–	Not available/ applicable	Not available/ applicable	Not available/ applicable
10	Substance (methamphetamine) induced psychotic disorder	olanzapine5mg, TDS, Na valproate 500 mg, TDS	Negative	None	methamphetamine	Normal	Not available/ applicable	Not available/ applicable	Not available/ applicable
11	None	olanzapine5mg, BD, Na valproate 500 mg, BD	Negative	None	None	Normal	Abnormal due to diffuse slowing (tetha, delta waves) and focal poly sharp waves	Not available/ applicable	Unremarkable
12	None	Na valproate500mg, TDS, quetiapine 100 mg, TDS, biperiden 2 mg, BD, perphenazine 8 mg, TDS	Negative	None	None	–	Not available/ applicable	Not available/ applicable	Not available/ applicable

PPH-past psychiatry history, DH-drug history, FH-family history, SH-substance history, EEG-electroencephalogram, ECT-electroconvulsive therapy, CSF-cerebrospinal fluid, HS-hora somni/at night, BD-bis in die/twice a day, TDS-ter die sumendus/three times a day, D-once a day.

10.3389/fpsyt.2023.1102450

TABLE 2 A review of previously studied post-COVID manic patients.

Author	Age (years), sex, country	COVID—Mania interval	PI	PPH	PMH	FH	COVID symptoms	Steroids	Mania medications	Brain imaging
Mawhinney et al. (19)	41, male, United Kingdom	11 days	Elevated mood, agitation, disinhibition, racing thoughts, grandiosity delusions, persecutory delusions	A history of paranoid features after cannabis use 16 years ago	Congenital nystagmus	Postpartum psychosis and B1D in sister	Dry cough, fever, headache	None	olanzapine 10 mg daily, clonazepam 1 mg BD	MRI: Hyperintense signal in the splenium of the corpus callosum + decreased diffusion coefficient
Sen et al. (21)	33, female, Turkey	Concurrent	Irritability, decreased need for sleep, dysphoric mood, derailment of thoughts, persecutory, mystic and infidelity delusions	None	None	None	Sore throat and fever	None	olanzapine 20 mg/day	No MRI
Shaojia Lu et al. (17)	51, male, China	17 days	Irritability, decreased need for sleep, increased energy, talkativeness, grandiosity delusions	None	None	None	Pharyngalgia, fever, shortness of breath	Methylprednisolone	olanzapine 10 mg/day	MRI: Small ischemic lesions at Basal ganglia and semiovale center
Noone et al. (20)	49, male, USA	3 weeks	Dysphoric mood, grandiosity delusion, auditory hallucination, disorientation	None	HTN, HLP, DM2	None	Unknown	None	olanzapine 2.5 mg/day and then quetiapine up to 150 mg/day	Unremarkable MRI
Noone et al. (20)	34, female, USA	Concurrent	Irritable mood, agitation, decreased need for sleep, pressure of speech, distractibility, disorganized behavior, persecutory delusion	None	None	None	Unknown	None	Risperidone 1 mg BD	MRI: Nonspecific foci of T2 hyperintense signal abnormality in the right parietal subcortical white matter

(Continued)

10.3389/fpsyt.2023.1102450

TABLE 2 (Continued)

Author	Age (years), sex, country	COVID—Mania interval	PI	PPH	PMH	FH	COVID symptoms	Steroids	Mania medications	Brain imaging
Devasia et al. (25)	53, male, India	8–10 days	Irritability, decreased need for sleep, pressure of speech, grandiosity delusion, persecutory delusion, flight of ideas	None	None	B1D in brother	Sore throat, fever, myalgia, headache, anosmia	None	Risperidone 2 mg/day + Carbamazepine 400 mg/day	MRI: Small vessel ischemic changes
Shanmugam et al. (22)	52, male, United Kingdom	2 weeks	Elevated mood, overspending, aggression, excessive toilet cleaning, pressure of speech, disinhibition, grandiose ideas	None	HTN	None	High fever, diarrhea, mild headache, dry cough, anosmia	None	High dose Olanzapine + Sodium valproate	Unremarkable MRI
Reinfeld et al. (26)	Early 50s, male, India	Concurrent	Irritability, decreased need for sleep, pressure of speech, paranoid delusion, Sometimes staring with features of excited catatonic, fluctuating orientation	None	None	None	Low-grade fever, tachycardia, lung involvement	None	Electroconvulsive therapy	No MRI
Varsak et al. (27)	64, female, Turkey	12 days	Irritable mood, euphoria, agitation, increased energy, talkativeness, grandiosity delusion	None	None	None	Fever, myalgia, headache, diarrhea, taste and smell disorder	Methylprednisolone	olanzapine 20 mg/day uclopenthixol decanoate every 2 weeks (2 doses)	Unremarkable brain CT Scan
Uzun et al. (28)	16, male, Turkey	10 days after the end of infection	Irritability, euphoria, increased energy, and decreased sleep, talkativeness	None	Cerebral palsy	None	Mild symptoms	None	risperidone 3 mg/day, lithium 1,200 mg/day	No MRI

PI, present illness; PPH, past psychiatric history; PMH, past medical history; FH, family history; B1D, bipolar disorder type 1; MRI, magnetic resonance imaging; BD, bis in die/twice a day; HTN, hypertension; HLP, hyperlipidemia; DM2, diabetes mellitus type2.

10.3389/fpsyt.2023.1102450

trauma and social and economic impacts of the outbreak and containment measures (29–32). COVID-19 is a particular case of a global pandemic with a massive social impact caused by a virus with neurotropic potential (31, 33), which makes it plausible to trigger manic relapses in patients with BD and new-onset episodes in predisposed individuals, especially those with a family history of BD. In these regards, insights from scientific literature related to the neuropsychiatric effects of viral diseases and the mental health impact of disasters are relevant to contextualize the discussion of our case series.

Regarding potential neurotropic pathways for COVID-19 to trigger manic episodes, previous research has associated several viral infections with BD, including Epstein–Barr virus (EBV), cytomegalovirus (CMV), herpes simplex virus (HSV), hepatitis B virus (HBV), and hepatitis C virus (HCV) (34–38). It has been hypothesized that an immune/inflammatory mechanism could induce changes in neurotransmitters at the limbic network (39), and several studies have found associations between BD and inflammation (34, 35, 40, 41). One study found increased C reactive protein during acute episodes of BD (42); another study reported a significant difference in peripheral blood lymphocytes which correlated with each phase of BD type 2, suggesting that cytotoxic T lymphocytes would migrate from blood to the brain in acute episodes of BD (43). As T cells are known for their defensive role against intercellular pathogens, especially viruses (44), these data support an underlying immune mechanism for BD and could help clarify the emergence of mania during acute infection by SARS-CoV-2. There has been a brain organoid study in which both indirect neuroinflammation and direct neuronal invasion of the virus have played a role in the neuropsychiatric manifestations of COVID-19 (33).

In terms of psychosocial stressors, Matsumoto et al. documented manic episodes in patients with BD in remission during the Great East Japan Earthquake and subsequent Fukushima nuclear disaster; notably, those BD relapses consisted more in manic rather than depressive episodes and were more observed in women than men (45). The COVID-19 pandemic unleashed a wide array of acute and chronic stressors including fear of being infected or infecting others, restrictive nationwide lockdown policies facilitating social isolation, domestic violence, boredom, inappropriate sleep hygiene, financial strain, trauma, and grief associated with the loss of loved ones, misinformation, insufficient social support of vulnerable populations, including the elderly with cognitive decline, social stigma, and limited access to care (46–48).

Patients with a family history of BD in our series had an earlier mania onset while they had normal or unremarkable paraclinical data. While speculative, it might be possible that psychosocial stress and treatment with corticosteroids would be the main triggers of acute mania in those with a family history, while neurotropic damage by the virus would have a more prominent role in cases without such evident genetic vulnerability. However, in previous case reports some patients with a family history presented abnormal neuroimaging findings (19, 25).

Corticosteroid therapy is one of the major components of the treatment of many cases of severe COVID-19, and it poses a well-known potential to induce acute neuropsychiatric conditions, including typically, mania, which gives them a possible relevant role in some of our cases. Corticosteroid-induced psychiatric symptoms are dose-dependent and tend to occur during the first weeks after initiation (49, 50). The main underlying mechanisms are unclear but there is evidence of disturbances in glucocorticoid stimulation and mineralocorticoid receptor stimulation which cause glutamate-induced neuronal toxicity (51). To note, there seemed to be no relevant difference in the interval between COVID-19 and mania onset in patients receiving those treatments in our series as compared to those not receiving them.

It is essential to note the main limitations of the evidence presented in this study. First of all, we had a small sample size and missing data, including clinical and imaging for some of our patients. Second, other than COVID-19, corticosteroids, and a family history of mood disorders, there could be many other factors playing a role in the emergence of mania in our patients that we have not contemplated or our data are not able to capture. Third, there was no follow-up for all patients after discharge. Finally, the nature of our study cannot present inferential evidence about the putative role of COVID-19 as a cause or a risk factor in the emergence of the first episode of mania. There is a great need for further research regarding the risk and protective factors for patients to present a first manic episode after COVID-19 infection, potentially identifying the high-risk groups that need closer follow-up.

While the pathophysiology of BD, involving complex interactions of genetic, epigenetic, and environmental predisposing and triggering factors, remains unclear (34, 39), future systematic research of the phenomenon of mania in the context of COVID-19 infection could provide valuable insights to inform the understanding and management of this disorder in contexts beyond COVID-19.

Conclusion

Our series provides observational, naturalistic evidence regarding the phenomenon of first-episode mania after an acute COVID-19 infection, and questions whether a family history of bipolar disorder and the use of corticosteroids could be triggering factors. Clinicians treating patients with COVID-19 should be aware of the possibility of the emergence of mania and other psychiatric disorders in the course of infection and its treatment, considering the putative roles of inflammation and pharmacological iatrogenic and trying to identify patients with potentially higher risk for those conditions.

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 Ethics Research Committee of the Iran University of Medical Sciences with unique number IR.IUMS.REC.1399.080 and protocol number 17630. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the

publication of any potentially identifiable images or data included in this article.

Author contributions

MS and TR: contribution in the design, acquisition of data, drafting, approval and agreement to be accountable for all aspects of the work. VP-S: contribution in the conception of data, interpretation of data, revising, approval and agreement to be accountable for all aspects of the work. MR, BS, SE, AS, and KA: contribution in the acquisition of data, drafting, approval and agreement to be accountable for all aspects of the work. BS and ME: contribution in the acquisition of data, revising, approval and agreement to be accountable for all aspects of the work. FM: contribution in the design and conception, acquisition of data, interpretation, revising. 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.

The handling editor RF declared past collaborations with one of the authors VP-S.

Publisher's note

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

References

1. Ahmad, I, and Rathore, FA. Neurological manifestations and complications of COVID-19: a literature review. *J Clin Neurosci*. (2020) 77:8–12. doi: 10.1016/j.jocn.2020.05.017

2. de Sousa Moreira, JL, Barbosa, SMB, Vieira, JG, Chaves, NCB, Felix, EBG, Feitosa, PWG, et al. The psychiatric and neuropsychiatric repercussions associated with severe infections of COVID-19 and other coronaviruses. *Prog Neuro-Psychopharmacol Biol Psychiatry*. (2021) 106:110159. doi: 10.1016/j.pnpbp.2020.110159

3. He, X, Zhang, D, Zhang, L, Zheng, X, Zhang, G, Pan, K, et al. Neurological and psychiatric presentations associated with COVID-19. *Eur Arch Psychiatry Clin Neurosci*. (2022) 272:41–52. doi: 10.1007/s00406-021-01244-0

4. Nakamura, ZM, Nash, RP, Laughon, SL, and Rosenstein, DL. Neuropsychiatric complications of COVID-19. *Curr Psychiatry Rep*. (2021) 23:1–9. doi: 10.1007/s11920-021-01237-9

5. Cascella, M, and De Blasio, E. Pathophysiology of COVID-19-associated neurotoxicity In: *Features and Management of Acute and Chronic Neuro-Covid*. Berlin: Springer (2022). 1–41.

6. Manolis, TA, Apostolopoulos, EJ, Manolis, AA, Melita, H, and Manolis, AS. COVID-19 infection: a neuropsychiatric perspective. *J Neuropsychiatry Clin Neurosci*. (2021) 33:266–79. doi: 10.1176/appi.neuropsych.20110277

7. Mirfazeli, FS, Sarabi-Jamab, A, Jahanbakhshi, A, Kordi, A, Javadnia, P, Shariat, SV, et al. Neuropsychiatric manifestations of COVID-19 can be clustered in three distinct symptom categories. *Sci Rep*. (2020) 10:1–9. doi: 10.1038/s41598-020-78050-6

8. Taquet, M, Luciano, S, Geddes, JR, and Harrison, PJ. Bidirectional associations between COVID-19 and psychiatric disorder: retrospective cohort studies of 62 354 COVID-19 cases in the USA. *Lancet Psychiatry*. (2021) 8:130–40. doi: 10.1016/S2215-0366(20)30462-4

9. Carvalho, AF, Firth, J, and Vieta, E. Bipolar disorder. *N Engl J Med*. (2020) 383:58–66. doi: 10.1056/NEJMra1906193

10. Merikangas, KR, Jin, R, He, J-P, Kessler, RC, Lee, S, Sampson, NA, et al. Prevalence and correlates of bipolar spectrum disorder in the world mental health survey initiative. *Arch Gen Psychiatry*. (2011) 68:241–51. doi: 10.1001/archgenpsychiatry.2011.12

11. Walker, ER, McGee, RE, and Druss, BG. Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. *JAMA Psychiat*. (2015) 72:334–41. doi: 10.1001/jamapsychiatry.2014.2502

12. Chan, J, Wong, C, Yung, N, Chen, E, and Chang, W. Excess mortality and life-years lost in people with bipolar disorder: an 11-year population-based cohort study. *Epidemiol Psychiatr Sci*. (2021) 30:e39. doi: 10.1017/S2045796021000305

13. Weiner, M, Warren, L, and Fiedorowicz, JG. Cardiovascular morbidity and mortality in bipolar disorder. *Ann Clin Psychiatry*. (2011) 23:40–7. PMID: 21318195

14. Grande, I, Berk, M, Birmaher, B, and Vieta, E. Bipolar disorder. *Lancet*. (2016) 387:1561–72. doi: 10.1016/S0140-6736(15)00241-X

15. Correa-Palacio, AF, Hernandez-Huerta, D, Gómez-Arnau, J, Loeck, C, and Caballero, I. Affective psychosis after COVID-19 infection in a previously healthy patient: a case report. *Psychiatry Res*. (2020) 290:113115. doi: 10.1016/j.psychres.2020.113115

16. Lazzari, C, Nusair, A, Shoka, A, Hein, SM, and Rabottini, M. Case reports of first psychiatric presentations during CoViD-19 pandemic. *Riv Psichiatr*. (2020) 55:319–21. doi: 10.1708/3457.34465

17. Lu, S, Wei, N, Jiang, J, Wu, L, Sheng, J, Zhou, J, et al. First report of manic-like symptoms in a COVID-19 patient with no previous history of a psychiatric disorder. *J Affect Disord*. (2020) 277:337–40. doi: 10.1016/j.jad.2020.08.031

18. Marchini, S, Van Ormelingen, O, and Delhaye, M. First manic episode in 14-year-old adolescent during COVID-19 pandemic lockdown measures: a case report. *Ann Psychiatry Treatment*. (2020) 4:034–6. doi: 10.17352/apt.000018

19. Mawhinney, JA, Wilcock, C, Haboubi, H, and Roshanzamir, S. Neurotropism of SARS-CoV-2: COVID-19 presenting with an acute manic episode. *BMJ Case Reports CP*. (2020) 13:e236123. doi: 10.1136/bcr-2020-236123

20. Noone, R, Cabassa, JA, Gardner, L, Schwartz, B, Alpert, JE, and Gabbay, V. Letter to the editor: new onset psychosis and mania following COVID-19 infection. *J Psychiatr Res*. (2020) 130:177–9. doi: 10.1016/j.jpsychires.2020.07.042

21. Sen, M, Yesilkaya, UH, and Balcioglu, YH. SARS-CoV-2-associated first episode of acute mania with psychotic features. *J Clin Neurosci*. (2021) 87:29–31. doi: 10.1016/j.jocn.2021.02.012

22. Shanmugam, S, Kumar, P, and Carr, B. Acute mania with psychotic symptom in post COVID-19 patient. *BJPsych Open*. (2021) 7:S50–1. doi: 10.1192/bjo.2021.182

23. Muneer, A. Bipolar disorder: role of inflammation and the development of disease biomarkers. *Psychiatry Investig*. (2016) 13:18–33. doi: 10.4306/pi.2016.13.1.18

24. Rapaport, MH, Guylai, L, and Whybrow, P. Immune parameters in rapid cycling bipolar patients before and after lithium treatment. *J Psychiatr Res*. (1999) 33:335–40. doi: 10.1016/S0022-3956(99)00007-2

25. Devasia, M, Prabhakaran, A, and Rithwik, S. A case report of manic episode following SARS-CoV-2 infection. *Kerala J Psychiatry*. (2021) 34:72–4. doi: 10.30834/KJP.34.1.2021.264

26. Reinfeld, S, and Yacoub, A. A case of delirious mania induced by COVID-19 treated with electroconvulsive therapy. *J. ECT*. (2021) 37:e38–e39.

27. Varsak, N, Topaloğlu, M, and Özdemir, E. First Manic Attack During COVID-19 Treatment: A Case Report. *Clin. Psychopharmacol Neurosci*. (2021) 19:786.

28. Uzun, N, Kılıç, AO, Akıncı, MA, Özgül-Katırcıoğlu, D, and Erden, S. Could COVID-19 be a trigger for manic attack in an adolescent? *Neurol. Sci*. (2021) 42:3521–2.

29. Chaudhury, SS, Sinha, K, Majumder, R, Biswas, A, and Das Mukhopadhyay, C. COVID-19 and central nervous system interplay: a big picture beyond clinical manifestation. *J Biosci*. (2021) 46:1–12. doi: 10.1007/s12038-021-00165-3

30. Pacheco-Herrero, M, Soto-Rojas, LO, Harrington, CR, Flores-Martinez, YM, Villegas-Rojas, MM, León-Aguilar, AM, et al. Elucidating the neuropathologic mechanisms of SARS-CoV-2 infection. *Front Neurol*. (2021) 12:660087. doi: 10.3389/fneur.2021.660087

31. Veleri, S. Neurotropism of SARS-CoV-2 and neurological diseases of the central nervous system in COVID-19 patients. *Exp Brain Res*. (2021):1–17. doi: 10.1007/s00221-021-06244-z

32. Zhan, W-R, Huang, J, Zeng, P-M, Tian, W-Y, and Luo, Z-G. Emerging neurotropic features of SARS-CoV-2. *J Mol Cell Biol*. (2021) 13:705–11. doi: 10.1093/jmcb/mjab044

33. Ng, J-H, Sun, A, Je, HS, and Tan, E-K. Unravelling pathophysiology of neurological and psychiatric complications of COVID-19 using brain organoids. *Neuroscientist*. (2021). doi: 10.1177/10738584211015136

34. Avramopoulos, D, Pearce, BD, McGrath, J, Wolyniec, P, Wang, R, Eckart, N, et al. Infection and inflammation in schizophrenia and bipolar disorder: a genome wide study

for interactions with genetic variation. *PLoS One*. (2015) 10:e0116696. doi: 10.1371/journal.pone.0116696

35. Chong, L-W, Hsu, C-C, Lee, C-Y, Chou, R-H, Lin, C-L, Chang, K-H, et al. Association of viral hepatitis and bipolar disorder: a nationwide population-based study. *J Transl Med*. (2018) 16:1–10. doi: 10.1186/s12967-018-1542-3

36. Frye, MA, Coombes, BJ, McElroy, SL, Jones-Brando, L, Bond, DJ, Veldic, M, et al. Association of cytomegalovirus and toxoplasma gondii antibody titers with bipolar disorder. *JAMA Psychiat*. (2019) 76:1285–93. doi: 10.1001/jamapsychiatry.2019.2499

37. Hamdani, N, Bengoufa, D, Godin, O, Doukhan, R, Le Guen, E, Daban-Huard, C, et al. Immunoglobulin sub-class distribution in bipolar disorder and schizophrenia: potential relationship with latent toxoplasma Gondii infection. *BMC Psychiatry*. (2018) 18:1–6. doi: 10.1186/s12888-018-1821-9

38. Pender, MP. Hypothesis: bipolar disorder is an Epstein–Barr virus-driven chronic autoimmune disease–implications for immunotherapy. *Clin Translational Immunol*. (2020) 9:e1116. doi: 10.1002/cti2.1116

39. Magioncalda, P, and Martino, M. A unified model of the pathophysiology of bipolar disorder. *Mol Psychiatry*. (2021) 27:202–11. doi: 10.1038/s41380-021-01091-4

40. Fries, GR, Walss-Bass, C, Bauer, ME, and Teixeira, AL. Revisiting inflammation in bipolar disorder. *Pharmacol Biochem Behav*. (2019) 177:12–9. doi: 10.1016/j.pbb.2018.12.006

41. Stich, O, Andres, TA, Gross, CM, Gerber, SI, Rauer, S, and Langosch, JM. An observational study of inflammation in the central nervous system in patients with bipolar disorder. *Bipolar Disord*. (2015) 17:291–302. doi: 10.1111/bdi.12244

42. Dargél, AA, Godin, O, Kapczinski, F, Kupfer, DJ, and Leboyer, M. C-reactive protein alterations in bipolar disorder: a meta-analysis. *J Clin Psychiatry*. (2015) 76:142–50. doi: 10.4088/JCP.14r09007

43. Pietruczuk, K, Lisowska, KA, Grabowski, K, Landowski, J, Cubała, WJ, and Witkowski, JM. Peripheral blood lymphocyte subpopulations in patients with bipolar disorder type II. *Sci Rep*. (2019) 9:1–9. doi: 10.1038/s41598-019-42482-6

44. Andersen, MH, Schrama, D, Thor Straten, P, and Becker, JC. Cytotoxic T cells. *J Investig Dermatol*. (2006) 126:32–41. doi: 10.1038/sj.jid.5700001

45. Matsumoto, J, Kunii, Y, Wada, A, Mashiko, H, Yabe, H, Niwa, S, et al. Mental disorders that exacerbated due to the F ukushima disaster, a complex radioactive contamination disaster. *Psychiatry Clin Neurosci*. (2014) 68:182–7. doi: 10.1111/pcn.12112

46. Dubey, S, Biswas, P, Ghosh, R, Chatterjee, S, Dubey, M, Lahiri, D, et al. Psychosocial impact of COVID-19. *Diabetes Metab Syndr Clin Res Rev*. (2020) 14:779–88. doi: 10.1016/j.dsx.2020.05.035

47. Hossain, MM, Tasnim, S, Sultana, A, Faizah, F, Mazumder, H, Zou, L, et al. Epidemiology of mental health problems in COVID-19: A review. *F1000Res*. (2020) 9:9. doi: 10.12688/f1000research.24457.1

48. World Health Organization. *Mental Health and Psychosocial Considerations During the COVID-19 Outbreak*. Geneva: WHO (2020).

49. Brown, ES, and Chandler, PA. Mood and cognitive changes during systemic corticosteroid therapy. *Prim Care Companion J Clin Psychiatry*. (2001) 3:17–21. doi: 10.4088/PCC.v03n0104

50. Hosseinnia, Z, and Yahyavi, ST. "Covid-19 management" induced mania! A call for alert and further research. *J Iranian Med Council*. (2021). doi: 10.18502/JIMC.V4I4.8486

51. Janes, M, Kuster, S, Goldson, TM, and Forjuoh, SN. Steroid-induced psychosis. *Baylor Univ Med Center Proc*. (2019) 32:614–5. doi: 10.1080/08998280.2019.1629223

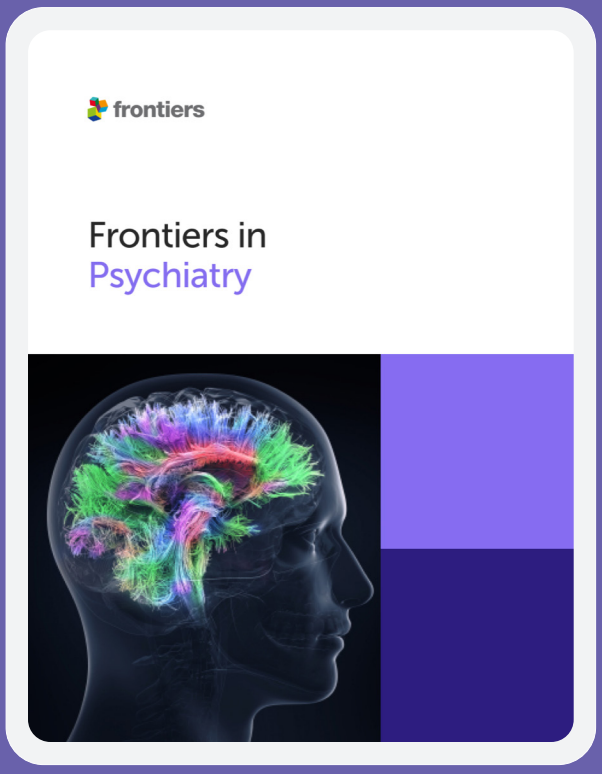
Frontiers in Psychiatry

Explores and communicates innovation in the field of psychiatry to improve patient outcomes

The third most-cited journal in its field, using translational approaches to improve therapeutic options for mental illness, communicate progress to clinicians and researchers, and consequently to improve patient treatment outcomes.

Discover the latest Research Topics

See more →



Frontiers

Avenue du Tribunal-Fédéral 34
1005 Lausanne, Switzerland
frontiersin.org

Contact us

+41 (0)21 510 17 00
frontiersin.org/about/contact