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

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

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Table of contents

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

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coronavirus, lockdown, mental health, mental disorders, psychiatry, psychological impact, social distancing, social isolation

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

Three years after the global coronavirus pandemic outbreak, its severe and manifold consequences have been largely demonstrated not only in terms of global economy, culture, society, and general health, but also mental health (1–3). Many aspects of daily life have been affected by the lockdown and social distancing measures, further filtered by individual factors, as well as specific sociocultural dynamics, including norms, values, and religions (4–8).

Continuing the path taken in the previous two volumes of the Community Series of our Research Topic entitled "*Mental Illness, Culture, and Society: Dealing with the COVID-19 Pandemic*" (9, 10), this third Volume collects nine new papers exploring, in different ways, the complex relationship between the COVID-19 pandemic and mental health, mediated in distinctive ways by peculiar cultures, societies, and backgrounds all over the world.

Five studies dealt with the differential impact of COVID-19 on mental health-related symptoms in special populations. The team lead by Macaron et al. conducted a systematic review and meta-analysis to explore geographical differences of physicians' burnout during the early and late phases of the pandemic. The synthesis of 45 cross-sectional studies demonstrated a 54.60% overall prevalence of burnout (from 60.7% in the early phase to 49.3% in the late pandemic period), particularly marked among frontliners and those residing in the Middle East and North Africa region, and mainly characterized by emotional exhaustion, depersonalization, and personal accomplishment.

The paper published by Nishat et al. assessed the mental health burden of 304 early married girls in Bangladesh during the pandemic. They found a depression and anxiety rates of 60.9 and 23.7%, respectively, with higher peaks in younger girls and those belonging to the Sanatan (Hindu) religion compared to older and Muslim participants.

Heesen et al. presented results from their longitudinal observational study over three time points, evaluating the role of COVID-19 vaccination on social participation and mental health status in immunocompromised individuals. Overall, 60% of the 126 participants increased their social participation over time after the vaccination. The authors did not find any

association between social participation and mental health, sociodemographic, or medical factors except hypertension.

The paper by Wegner and Liu focused on the differences in positive and negative experiences of lonely and non-lonely people during the COVID-19 pandemic in Germany. According to this cross-sectional online survey involving 1,758 participants, lonely individuals reported fewer positive experiences and more negatives ones of living in the COVID-19 pandemic, as compared to non-lonely individuals. Interestingly, compared to non-lonely participant, lonely people were less likely to view the pandemic as a conspiracy.

The last paper addressing a special population came from Ransing et al. who developed a stepped-care model for perinatal women, that aims to tackle COVID-19 vaccine hesitancy (CVH) in low- and middle-income countries (LMICs). After a systematic review of the literature, the team, consisting of vaccinators, experts, and stakeholders, reached a consensus about a COVID-19 Vaccine Confidence Project for Perinatal Women (CCPP). The CCPP model included health care personnel training, integration into ongoing COVID-19 vaccination programs, CVH screening, CVH intervention, and referral services suitable for implementation in LMICs.

On the other hand, three included papers used peculiar study design to add some elements of novelty to the field. Hajebi et al. proposed a study protocol of a randomized controlled trial aiming to explore the efficacy of three vs. five sessions of grief counseling on the psychological aspects following COVID-19 bereavement. This multi-center study will enroll 120 people in bereavement due to COVID-19 in either three-session or five-session grief counseling intervention groups; the trial will span over 3 months.

Wang et al. proposed a mixed methods research study to examine short message service (SMS) as a way of meeting the public's need for emotional support during the COVID-19 pandemic in China. According to the authors' findings, SMS messages had some efficacy only in the elderly population while, with the stabilization of COVID-19, SMS has once again been discarded by users, especially digital natives.

Fu et al. presented a visual analysis using co-occurrence and VOSviewer bibliometric methods to analyze the evolution of research on depression during COVID-19. The authors demonstrated a global breakthrough unprecedented in the history of research, with universities in the United States, China, and the United Kingdom having the largest number of publications, and in a close cooperation with each other.

Through a cross-sectional population-based study conducted in South Korea, Lee et al. assessed the socio-economic factors associated with mental health outcomes during the COVID-19 pandemic. According to the authors' conclusions, the most affecting risk factors for depressive and anxiety symptoms were being single, reporting a lower household income, lower support from friends or family, and increased stress from the workplace or home.

Summarizing, the articles collected in this third Volume of our Research Topic continue to emphasize the role of different cultural and social features in the responses and psychiatric consequences to the COVID-19 pandemic throughout the world. While, on the one hand, the immediate impact of the pandemic has proved to be above all economic and medical in general, the medium- to long-term effects are substantial on mental health and remain still far from being resolved.

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.

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References

1. 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

2. Adiukwu F, Orsolini L, Gashi Bytyçi D, El Hayek S, Gonzalez-Diaz JM, Larnaout A, et al. COVID-19 mental health care toolkit: an international collaborative effort by Early Career Psychiatrists section. *Gen Psychiatry.* (2020) 33:e100270. doi: 10.1136/gpsych-2020-100270

3. Rosa PA, Cowden RG, de Filippis R, Jerotic S, Nahidi M, Ori D, et al. Associations of lockdown stringency and duration with Google searches for mental health terms during the COVID-19 pandemic: a nine-country study. *J Psychiatr Res.* (2022) 150:237–45. doi: 10.1016/j.jpsychires.2022.03.026

4. 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

5. 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

6. Adiukwu F, Bytyçi DG, El Hayek S, Gonzalez-Diaz JM, Larnaout A, Grandinetti P, et al. Global perspective and ways to combat stigma associated with COVID-19 indian. *J Psychol Med.* (2020) 42:569–74. doi: 10.1177/0253717620964932

7. 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

8. 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

9. 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

10. 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

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Texting in a crisis—using SMS for information and emotional support during COVID-19: A mixed methods research study

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In the era of new media, short message service (SMS) is no longer seen as advantageous and it is no longer used very much by the Chinese public. However, as a traditional media, local governments managing public health crises used SMS as a way of meeting the public's need for emotional support during the COVID-19 pandemic. Our study examined 108 SMS texts pushed to phones in Chongqing between January and December 2020, and carried out in-depth interviews with ten interviewees. This mixed research method of descriptive and grounded theory analysis was designed to investigate how SMS was used to communicate prevention guidelines and give emotional support during COVID-19. The results show that Chongqing Municipal Health and Health Commission gained the public's attention with SMS messages consisting of neutral, objective advice, and guidance to reduce people's anxiety and panic. However, with the stabilization of COVID-19, SMS has once again been discarded by users, including the public health sector. The study found that the emotional support offered by SMS was limited to the elderly, a subset of the population considered to be weak users of the internet. SMS has been replaced by other technologies, but along with other media, such as official media and social media, it has shaped the media communication environment and served as an emotional support channel for the public. Undoubtedly,the use of SMS during COVID-19 presents a research opportunity for exploring its capacity for prevention, control and emotional support.

KEYWORDS

short message service (SMS), COVID-19, emotional support, grounded theory, traditional media

Introduction

Short message service (SMS) is the traditional communication medium of information push technology in the mobile network. It is a product of information transmission during the period of mobile communication development and the developing Internet information network. With the advent of Internet information and the new media era, SMS seem to have disappeared from public life in China. According to the statistics from The Ministry of Industry and Information Technology of China (Zhongming et al., 2017), the phone SMS volume in China was 58,110.7867 million in

October 2008, with an increase of 20.1% over the same period of 2007. In the following years, the growth of SMS traffic declined, falling to 6.4% at the end of 2011 and showing negative (−0.6%) growth at the end of 2013. The decline in SMS use in just a few years was due to upgrades in Internet and media technology and the upward trend of China's Internet users. The main reason is that from 2008 to 2013, China realized the transition of the network era from 2G and 3G to 4G. On December 4, 2013, the 4G license was distributed to the three major mobile operators (Mobile, Unicom, and Telecom) and the 4G network business began operations. Meanwhile, in 2011, a Chinese version of WhatsApp, known as WeChat, went online. WeChat is a social media service that allows users to communicate *via* audio, video, and text while relying on web traffic to cut costs. Driven by Internet information technology and new media, SMS disappeared in people's daily life in a short time. According to the *Statistics of China Internet Development Report (2019)* (CNNIC, 2020), the number of Internet users in China reached 800 million by the end of 2018, and the percentage of Internet users accessing the Internet through mobile phones was as high as 98.6%. This phenomenon of increasing network users is happening all over the world where the number of people using the Internet far exceeds the number using SMS (CTIA Wireless Association, 2009).

Whether used as a medium for public emotional support or information exchange, the public's perception of the advantages of SMS has declined. As an intermediary communication medium, SMS can promote "interconnected existence" or "communication preparation" (Licoppe and Smoreda, 2005; Nardi, 2005). People can meet multiple times simultaneously and across time, which facilitates a continuous understanding of other people and relationships, indicates users' availability, and maintains the social climate (e.g., continuous common ground or connection area). These uses in turn influence the way other media are chosen and interpreted (Wei and Lo, 2006). Because of the limited text capacity of SMS, the sender and the receiver need to know how to use text and understand the limited text content, which is not conducive to social contact. Studies have found that people use Internet instant messaging to conduct daily conversations with many friends, a practice that is more social than Face to Face or telephone conversations and can also extend users' social network (Oksman and Turtiainen, 2004; Hyo et al., 2007).

However, SMS have been used to address users' health issues and provide emotional support. Examples of this include weight loss, smoking cessation, community sexual health programs, and rural environment projects (Ryan and Hayden, 2012; Sneha et al., 2014; Cassandra et al., 2016; Chalela et al., 2020). SMS are regarded as a low-cost communication medium for patients and consumers and patients and providers. Meanwhile, SMS ensures anonymity and emotional interaction between participants and provides additional assistance when necessary (Fjeldsoe et al., 2010). However, the effectiveness of SMS is also controversial. Some studies have found that SMS can be effective in managing weight loss (Bauer et al., 2010; Fukuoka et al., 2010), but other studies found no increase in motivation or willingness to exercise or significant effect on weight loss among people who receive exercise text messages (Newton et al., 2009). Similarly, in smoking cessation programs, SMS may have been effective because the participants were mostly light or moderate smokers who did not need a great deal of support to quit (Chalela et al., 2020). The Sexual Health and Youth (SHY) project using SMS had little effect (Cassandra et al., 2016). These studies give us avenues to explore how SMS can be a more useful communication tool.

In China, SMS use is declining. Their simplicity, low cost, and ability to act as a prompt for action (Rice and Katz, 2003) had advantages in the early days of the Internet but the maximum text capacity of 160 characters has downgraded this advantage. SMS has been replaced by faster and more diverse and more capacious forms of the Internet. In addition, the functionality of SMS has shifted so that SMS is no longer popular with the public. The emergence of new media has replaced the function of SMS, with the result that SMS now have new functions and users. Users are no longer the public but enterprises and advertisers who conduct product promotions and user registration, send out push messages and provide verification code services. Even more serious are illegal groups that engage in illegal activities such as sending harassing text messages or viral text messages in group batches. These spam messages have led to a loathing of SMS by citizens and altered their attitude toward SMS. According to a report by the China 360 Company, a company engaged in mobile phone and computer network security (360ISC, 2020), the company intercepted 71.2 billion spam messages for 220 million users, 195 million a day in 2012, through its security software. The spam messages contained information on goods discounts and promotions (43%), while the rest of the messages consisted of fraud and illegal information. By 2017, 360ISC had intercepted about 9.85 billion spam messages, or 26.986000 a day on average. Although the overall trend shows a rapid decline, it was enough to indicate that SMS's original function had been replaced and its media role no longer met users' needs. There are similar situations in other countries where SMS messages on goods, services, and promotional ideas are sent to individuals, groups, or customers. A large number of SMS (one-way communication) on promotions and coupons are sent to customers. However, it is unclear if the sender received permission to send the SMS and whether the illegal content provokes users (Noprisson et al., 2016).

Although the SMS situation in China is unfortunate, short message pushing has been officially recognized by the government and continues to be used for official information propaganda, notice release, and policy delivery. SMS is a form of media-oriented government governance for the government's management of public events, policy requirements, and

interaction with the media, especially during public health crises such as COVID-19. This has led to an interesting phenomenon—SMS lost their advantage and became unpopular with the public but are still used by the government for pandemic management. Therefore, it is necessary to revisit the role of SMS in governance and their relationship to the psychological and emotional support needs of the public. Therefore, in this study, we focused on the following research premise: Compared with other media, SMS have the advantage of extensive coverage even though the information they deliver is extremely limited and relatively simple. They have become unpopular and abandoned by the public in the new media era. Why then are SMS still recognized and used for governance? Thus, it is necessary to re-examine and discuss SMS and the public emotional support they offer for the prevention and control of COVID-19.

For this paper, we researched the role of SMS during the height of the Covid period (January–December 2020) in Chongqing, China. During this period, the government pushed pandemic-related SMS data analysis and interview surveys to users' mobile phones. We used descriptive analysis and grounded theory research methods to study the entire process of pandemic prevention and control by the government to discover how SMS, now a traditional rather than innovative media form, provided emotional support to the public during the crisis and helped the public to recover from the traumatic event.

Materials and methods

Research methods

This study used a mixed research approach. A mixed research approach enables the collection, analysis, and mixing of quantitative and qualitative data in a study or a series of studies to better understand the research problem. This mixed research approach is the third methodological paradigm after quantitative and qualitative research (Johnson et al., 2007). We adopted a two-stage study: descriptive analysis, semi-structured interviews, and a hybrid study based on grounded theory.

Descriptive analysis is mainly used to describe relevant characteristics or trends by grouping them by different regions, different times or different types, using data (including laboratory test results) obtained from routine testing records or through specialized surveys (Heymann et al., 2014). By collecting the data of Chongqing's SMS use during the COVID-19 period, we conducted a descriptive analysis for both historical review and structural profile (Lawless and Heymann, 2010). The characteristics and process of Chongqing's SMS use were reviewed and described using Excel in the time dimension, and then the process was combined with the specific content of the pushed messages and the relevant pandemic policies of Chongqing city. This process or stage was further analyzed in depth. The problem of *what* is mainly solved.

Immediately following the *why* question, we collected data through semi-structured interviews and adopted a grounded theory approach to interpretation. The grounded theory approach is interpretivist (Cassiani et al., 1996), focusing on the foundations of theory generation in a systematic process of data collection and analysis (Noble and Mitchell, 2016). Zigzag theory, on the other hand, is inductive in nature and allows for subjective interpretation during data analysis, so that researchers can go beyond the collected data and form an interpretation of the context of the data source (Tripathi et al., 2022). To obtain data for the grounded theory analysis, we conducted semi-structured interviews for different ages, occupations and types of interviewees in Chongqing, noting their thoughts, and coding and analyzing them through NVivo 12 software.

Sample selection and data collection

SMS data collection

Chongqing was chosen as the study area for the following reason. Firstly, its geographical location and population density. Chongqing is adjacent to Hubei province, where the outbreak started, and 53 towns and counties in nine districts and counties in Chongqing border with Hubei province (Figure 1). Chongqing has close economic and demographic ties with Hubei province. In addition, Chongqing has the highest population density in China, with an area of 23 km^2 and a resident population of 32.12 million as of 2021. The resident population growth rate in 2021 was 0.1%, faster than the national average of 0.07%, and had been growing for 17 consecutive years. At the beginning of the COVID-19 pandemic, Chongqing was affected by geographical location and population factors, and cases spread rapidly. It became one of the top ten hardest hit areas in China.

Secondly, Chongqing is one of the four municipalities directly under the central government of China, and has the fourth largest GDP in China and an important economic status. With a total import and export trade of 651.4 billion RMB in 2020, Chongqing is in the top ten in China and has close ties with foreign regions, so it was significant for China's economic and social stability that Chongqing could effectively prevent and control the pandemic.

Thirdly, the researchers and their institutions are based in Chongqing city, making field surveys easier during the pandemic. For these reasons, the study of the relationship between SMS and pandemic prevention and control in Chongqing is representative and operable. Number of monthly new COVID-19 cases, deaths, trace close contacts and suspected cases in China and Chongqing city is shown in Figure 2.

We studied SMS messages sent by the government about pandemic prevention and control in Chongqing between

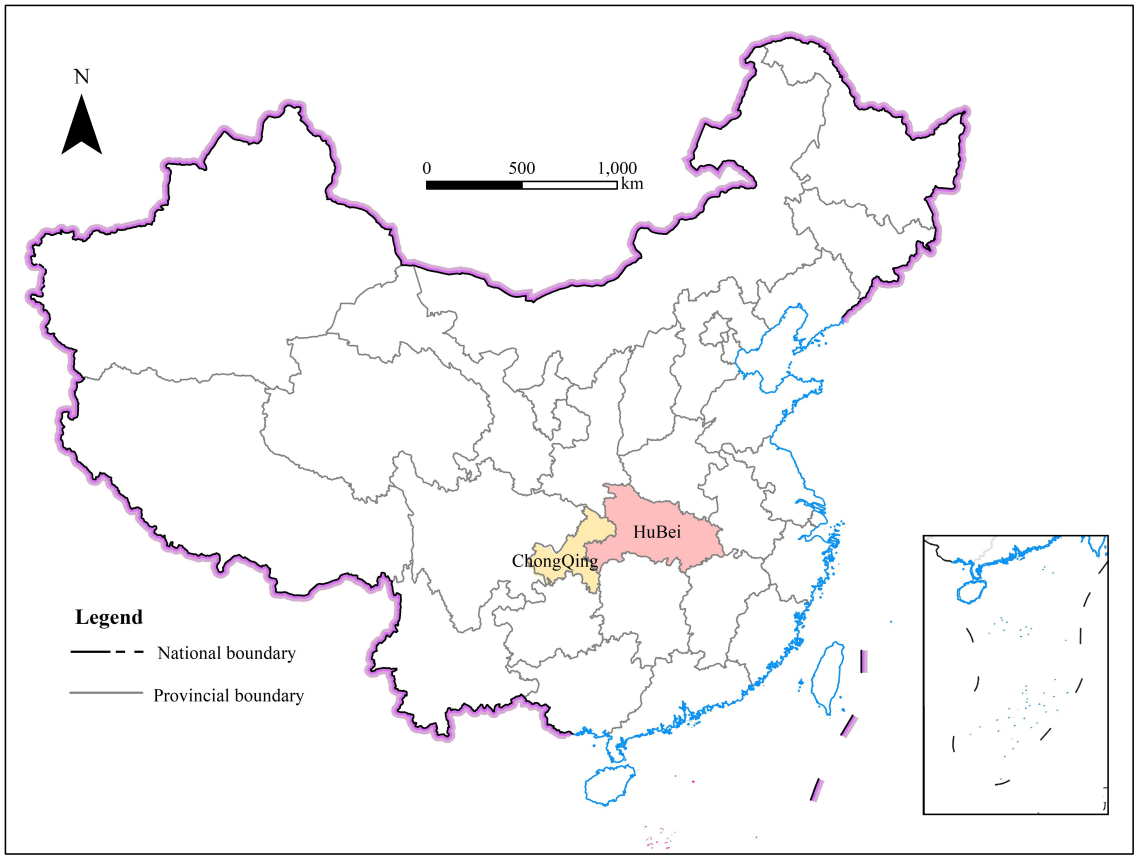


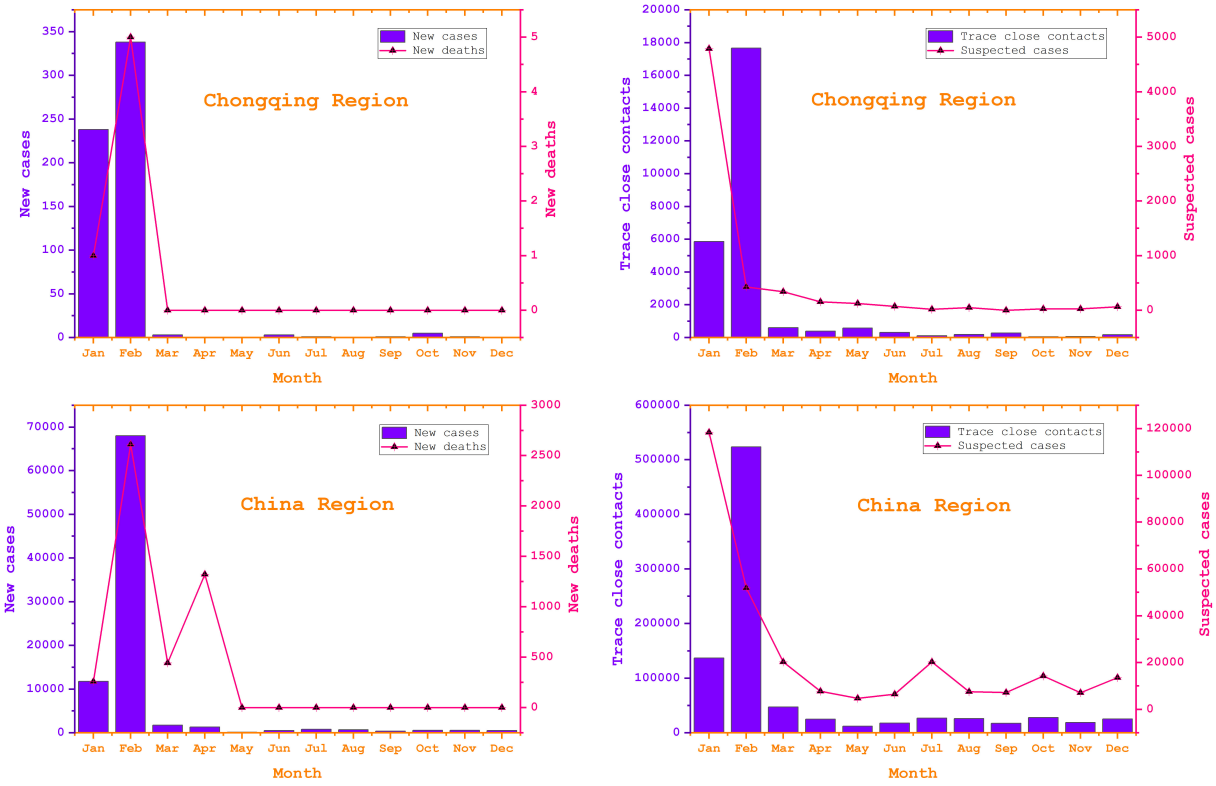
FIGURE 1
Locations of Chongqing and Hubei.

January and December 2020. This was a critical period for the prevention and control of the pandemic in China. It spread rapidly at the beginning of the outbreak, and the strictest and most thorough measures were taken to prevent and control the outbreak. The National Health and Wellness Commission and governments at all levels organized the issuing of guidelines for the prevention and control, actively easing public panic, and sharing prevention and control information. After the effective prevention and control of the pandemic in China, many places lowered the level of public health emergencies from Level 1 to Level 2, comprehensively promoted the resumption of work and school, restored normal economic and social order, and adopted the Yu Kang Code for public pandemic follow-up and news announcements.

In view of the specific changes in prevention and control and the content of SMS messages, we divided our study into two phases: the first phase being containment (January–April 2020), and the second phase normalization of pandemic prevention and control (May–December 2020). During this period, there were SMS messages from both national and local governments, and we focused on the date, content, frequency, and origin to examine the role of SMS messages.

Interview data collection

This study addressed the core question of how public sentiment needs could be met during a pandemic and whether SMS messages can support public sentiment needs. We conducted semi-structured interviews based on grounded theory (Corbin and Strauss, 1990; Hsieh and Shannon, 2005; Chung and Seomun, 2021) around the theme of SMS governance of public health crises. These were online in-depth interviews. A small group of representative citizens and expert scholars were selected from the researcher's own social network as interviewees. At the same time, considering the trust base of community workers and government personnel among the public, online one-on-one interviews were conducted *via* WeChat or telephone for urban and rural communities in Chongqing, as well as for the Chongqing Health Commission, selected



Note: The original data are from the official websites of the National Health Commission of the People's Republic of China (http://www.nhc.gov.cn) and Chongqing Municipal Health Commission (http://wsjkw.cq.gov.cn).

FIGURE 2
Number of monthly new COVID-19 cases, deaths, trace close contacts and suspected cases in China and Chongqing city.

TABLE 1 Descriptive statistical analysis of interviewees.

Interviewee code	Sex	Age	Type	Occupation
1	Female	61	Urban elderly	/
2	Female	62	Rural elderly	/
3	Male	28	Young	Construction worker
4	Female	29	Young	Enterprise executive
5	Male	45	Middle-aged	Construction worker
6	Female	43	Middle-aged	Housewife
7	Male	32	Urban community	Leader
8	Female	41	Rural community	Leader
9	Male	43	Chongqing Health Commission	Government personnel
10	Male	48	University	Professor

to participate in the prevention and treatment of the COVID-19 pandemic.

We had a total of ten interviewees. Through the analysis of grounded theory after-interview data collection and according to the principle of information saturation (Martin-Crespo and Salamanca, 2007; Noble and Mitchell, 2016), no more interviewees were added when information saturation was reached. The specific characteristics of the interviewees are shown in Table 1.

Although the interview process began with an interview outline (Table 2), the questions asked were open-ended, and the interviewees' responses were not limited to the interview outline, allowing for more relevant and useful information. We maintained a neutral attitude during the process, recording the

TABLE 2 Interview outline.

Item	Interview question	Type
A	What were your sources of information during the pre- and post- COVID-19 outbreak?	Description
B	Did you receive any government messages in the run-up to the COVID-19 outbreak? Were you aware of its content and what did you think of it?	Description and evaluation
C	How did you respond to the government's call to take control of the COVID-19 pandemic in the run-up to the outbreak?	Description
D	Did you get any misinformation? Through what channels did you get it? How do you feel when you heard misinformation? How did you handle and identify the misinformation?	Description and evaluation
E	Did your perception of the COVID-19 pandemic change during the pre- and post- COVID-19 pandemic period? How did it change?	Description
F	What is your assessment of the short messages throughout the prevention and control of the outbreak?	Evaluation
G	In your opinion, how do you rate the way the government pushed out SMS messages during the prevention and control of the COVID-19 outbreak compared to other media?	Evaluation

interviews in a timely manner without value guidance, and trying to capture new clues. We also informed the interviewees of the purpose of the information collection and of their anonymity. We obtained permission from the interviewees.

Research data analysis

SMS descriptive analysis

Between January 21, 2020, and December 31, 2020, the Chongqing government sent a total of 108 identical short messages to Chongqing residents (including the interviewees) in response to COVID-19. After collating the data on the time, departments, and content of the short messages sent, we found that within a 12-month cycle, January, February, March, and April were the months with the highest number of sent short messages −11,33,27,12—respectively, followed by a general decreasing trend. Concerning the short messages push departments of the Chongqing Municipal Health Commission, a total of 78 short messages were sent by 72% of the departments. The remaining push departments included the Office of State Security, the Office of Popular Law, the Tourism Bureau, the Civil Affairs Bureau, the Transport Bureau, and 14 other departments. The content of the SMS focused on personal protection (e.g., daily mask protection), policy requirements (e.g., standards for enterprises to resume work), holiday tips, rumor clarification, etc.

As can be seen in Figure 3, there were two phases in SMS outreach for pandemic prevention and control. One is from January to May 2020 and the other is from June to December 2020. We analyzed the interview results by stages.

From January to May 2020, the Chongqing municipal government sent a total of 86 short messages. We collated the time, department, content, and other data of these messages. Within 5 months, the number of push messages per month was 11, 33, 27, 12, and 3, respectively. The Chongqing Municipal

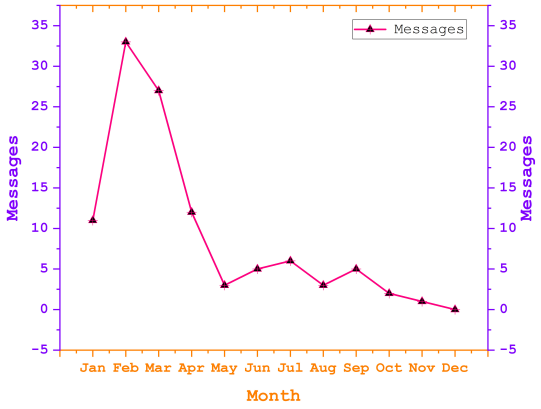


FIGURE 3
The trend chart for the quantity of SMS about the pandemic situation in Chongqing.

Health Commission (CMHC) was the main push department, accounting for 72% of the total 62 SMS sent. The remaining 14 departments included, among others, the National Security Office (NSO), The Popularization Law Office (PLO), the Tourism Bureau, and the Transportation Bureau. The content of the short messages focuses on personal protection (daily mask protection, etc.) and policy requirements (such as standards for enterprises to resume work and production) during COVID-19.

Furthermore, by placing the above SMS in the context of COVID-19 in Chongqing, we found the following characteristics of SMS: (1) SMS focuses on the core content or key tasks of government policies and plays a preventive role in prompting. Among the 86 short messages sent, about 90% of their content is about reminding citizens of prevention and control behavior, which is consistent with the requirements for home quarantine and personal prevention and control advocated by national policy. Moreover, the content was pushed in the form of warm

prompts. (2) The SMS was part of government policy and the rest of the government departments assisted. The department with the responsibility for the SMS is the CMHC. The CMHC led the other departments in the prevention and control of COVID-19. More than 50% of government departments were involved in message delivery in Chongqing. (3) The frequency of SMS is consistent with the different degrees of urgency required by government departments for events or policies. In other words, government departments will adjust the frequency of an SMS push according to the emergencies so that the SMS push is consistent with policy promotion and event governance progress. From May 2020, Chongqing City passed through the outbreak period and entered a relatively calm period.

As shown in Table 3, 11 messages were pushed for 10 days in January 2020, during which the first-level response to major public health events was launched in Chongqing. In February 2020, a total of 33 posts were pushed, with an average of 1.14 posts per day. During this period, Chongqing issued the policy of resuming production and work in batches and an orderly manner at the beginning of the month. At the same time, the prevention and control measures were implemented in the latter part of February in regions and counties that were categorized as low-risk, medium-risk, and high-risk regions. In March, Chongqing's status was adjusted as requiring a second-level response to a major public health event. The policy included guidance on the prevention and control of the pandemic when returning to work and the city. By May 2020, COVID-19 in Chongqing city and China was well under control. Therefore, the number and frequency of SMS were sharply reduced during that period. Public SMS were sent out during the two major festivals, Qingming Festival and Labor Day, as reminders of the requirements for pandemic prevention and control. From June to December 2020, Chongqing Municipal Government sent 22 short messages, a significant decrease in the number. The content was all around tips for warm weather, such as pay attention to daily protection, keep social distance, and so on. The main sender of SMS messages was the Chongqing Municipal Health Commission.

Grounded theory analysis of SMS messages

After interview data collection was completed, the data analysis phase began. We adopted a procedural version of grounded theory, including open, axial, and selective coding for our data analysis.

Open coding

Open coding is a word-by-word analysis of interview sentences to refine meaningful concepts (Pieterse, 2011). First, we collected and organized the interview data, and compared and analyzed word-by-word and sentence-by-sentence to find key words and formulate labels. Then, by stripping the original materials layer-by-layer, we further abstracted them to form concepts with core contents. Finally, the concepts were classified around the core issues, and merged with each other to refine generalized categories. During this process, the researcher kept an open mind.

The coding was done without omitting any important information until saturation, at the same time looking for words in the interviewee's discourse to condense for analysis. Seventeen concept codes, and 13 core categories were obtained. After completing the interviews with ten people, no more new concepts emerged, and the theory was largely saturated. The open coding process was completed with the help of NVivo12 software and open coding local examples, as shown in Table 4.

Axial coding

Axial coding is used to discover and establish associations between conceptual classes to describe the connections between parts of the material (Liu et al., 2020). By revisiting the research questions and repeatedly reading the source material, the main categories with convergent meaning are further integrated. After meticulously combing the 13 categories formed from the open coding for clustering and summarizing, the four main categories of emotional need, SMS function, individual difference, and media channel were formed. The main axis coding process and the meanings of the corresponding categories are shown in Table 5.

Selective coding

Selective coding is used to systematically analyze the established conceptual categories and select a core category that is overarching and can link other categories into a whole to form a systematic theoretical framework. After analyzing all the discovered conceptual categories, we took "SMS function satisfies emotional needs" as the core category, studied the connections among the formed main categories from the perspective of logical relationships, clarified the storyline of information, described the main categories, sub-categories and their attributes and dimensions, and determined the selective coding path of the main categories in this study The relationships are shown in Table 6 and Figure 4.

Results

SMS messaging supported the emotional needs of the public during COVID-19

From the above analysis of the data, it can be seen that the SMS in Chongqing during the outbreak of COVID-19 included content on government policy requirements for COVID-19

TABLE 3 Descriptive statistical analysis of SMS.

Month	Quantity	Policy	Type	Main content
Jan	11	Initiate level 1 response for major public health events	Suggestion	Chongqing Municipal Health Commission reminds you: For your health and the health of others, please consciously implement the requirements of the Level 1 response, protect yourself well and reduce your outings. One less party meal, and family and friendships will not be broken. (January 28, 2020) Chongqing Municipal Transportation Bureau Tips: For your health and the health of others, please minimize unnecessary traffic trips and wear a mask on public transport. (January 30, 2020)
Feb	33	Orderly resumption of production and work	Suggestion warning education	Chongqing Municipal Health Commission reminds you: According to the relevant provisions of the pandemic prevention and control, if you have come to Chongqing from other provinces, for your health, please be sure to stay at home or in centralized quarantine observation for 14 days. Do not go out at will, and if you have symptoms of discomfort, please seek medical attention or report to your community in a timely manner. Thank you for your support and cooperation! (February 10, 2020) Chongqing Municipal Emergency Management Bureau reminds you: that it is strictly forbidden for enterprises to resume production and work ahead of schedule in violation of regulations... Production and operation are not allowed without pandemic prevention and safety conditions. (February 11, 2020) Chongqing Municipal Health Commission suggests: Please obtain information on the pandemic and protection from authoritative sources. Do not believe misinformation that creates panic, and do not spread misinformation that creates panic. Take basic precautionary measures, maintain a normal lifestyle, eat a reasonable diet, exercise appropriately, and avoid negative emotions. (February 26, 2020)
Mar	27	Reduced to major public health event level 2 response	Suggestion warning education	Chongqing Municipal Health Commission tips: the recent increase in the number of people returning to Chongqing, the risk of bringing in and spreading the pandemic has increased. Continue to implement preventive and control measures, strengthen self-protection, strictly prevent the risk of importing the virus and local sporadic risk, and resolutely prevent a resurgence of the pandemic. (March 19, 2020) Warm tip: prevent and control the pandemic, keep in mind the rule of law, and act in accordance with the law when fighting the pandemic. The National Law Popularization Office. (March 10, 2020) Chongqing Municipal Health Commission reminds you: everyone is responsible for their own health and should consciously take personal responsibility for the prevention and control of the pandemic. (March 10, 2020)
Apr	12	The pandemic has been effectively prevented and controlled	Suggestion education	Chongqing Municipal Health Commission suggests: at the juncture when pandemic prevention and control continue to improve, it is important not to be careless, not to relax. Don't be, blindly optimistic or complacent. Maintain good hygiene habits, continue to strengthen self-protection, wear masks, wash hands frequently, ventilate more, disinfect often, don't share meals, don't crowd together. Work together to consolidate the hard-won prevention and control achievements. (April 12, 2020) The National Anti-Fraud Center reminds you: Recently, there are some unscrupulous persons pretending to be the Department of Disease Control and Prevention, Medical Insurance Bureau and other departments to sell masks and other pandemic prevention materials and implement telecommunication fraud. 96110 is the national anti-fraud warning number, please answer it promptly. (April 20, 2020)

(Continued)

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TABLE 3 (Continued)

Month	Quantity	Policy	Type	Main content
May	3	Requirements for pandemic prevention and control during holidays	Suggestion education	Chongqing Municipal Culture and Tourism Bureau and Chongqing Municipal Health Commission remind you: In accordance with the requirements of pandemic prevention and control, and for the health of tourists, the city's tourist attractions are open strictly by reservation in limited time slots during the May Day holiday. There is no admission without reservation. Please make reservations in advance for time slots, receive health codes, stagger your travel, go cautiously to popular scenic spots such as Hongya Cave, Yangtze River Ropeway and Magzikou, wear masks when visiting, do not crow together, keep social distance and visit in an orderly and civilized manner. (May 20, 2020)
Jun–Dec	22	Tips for warm weather	Suggestion	Chongqing Municipal Health Commission suggests: as the weather starts to get hot, the use of air conditioning needs to be evaluated comprehensively. If office premises and public places are known to have cases of COVID-19, generally do not use central air conditioning. (June 27, 2020) Chongqing Municipal Health Commission suggests: if you have fever and respiratory symptoms, please go to a designated hospital promptly. The general public should continue to maintain good health habits such as wearing masks, washing hands regularly, having more ventilation, gathering less, not crowding together, and working together for prevention and control to prevent the spread of the pandemic. (August 4, 2020)

prevention and control, but they also provided support for the emotional needs of the public. As a traditional form of government communication media, SMS supported the public's emotions in three ways, which are described in the paragraphs below.

SMS suggestions attract the emotional attention of the public

The goal of government-led SMS is to promote government policies and governance of public events in educational and constructive ways that are closely connected to the daily life of the recipients, namely the public. The differences among the users of Internet-related platforms are a result of an information network infrastructure gap. Even though it is a subset of the Internet, SMS are no longer universally popular and their outlook is bleak. However, the new media forms are not accessible to everyone. Therefore, SMS delivery should be integrated into overall mobile communication technology to ensure that official policy information can be transmitted to all members of the public. While the integration of SMS with new media technology is in process, SMS can serve the preferences of different audiences by disseminating information through a short message format and suggested content. Traditional SMS does have the advantage of being able to deliver timely and effective information to the public. For example, in January 2020, most government text messages prompted users to "Pay attention to diet, go out and party less, and take personal protection." The following excerpt is about one interviewee's assessment of the effectiveness of government governance by SMS during the COVID-19 pandemic.

In the early days of the outbreak, information about the outbreak had not yet reached a scientific conclusion. The government's work had two requirements. First, to make every member of the public as aware as possible and to participate in the prevention and control of the outbreak. Second, to tell them clearly and succinctly what to do. At this time, television and text messages could play this role very well (Interviewee 9).

SMS calm public nervousness with value-neutral text messages

SMS have the unique characteristics of neutrality and value. They do not evaluate public events or the administrative official notice but focus instead on how the information conveyed affects or interferes with social public life. Concerning official government propaganda media, SMS are ineffective administratively but incorporate the intrinsic value of official media. In particular, SMS are a traditional way of disseminating government information and are part of the government's administrative function. The content of SMS conveyed to the public is consistent with the government's views. However, this unity lacks administrative effectiveness and does not have the

TABLE 4 Examples of open coding analysis.

Partial original statements	Concept codes	Categories
Older people like us still mainly use SMS, and it is difficult for us to access information through multiple channels like younger people who are familiar with the internet. (Interviewee 1)	Sex, age, region, and occupation	Individual characteristics
The main concern of construction workers like us is when we can resume work. Short messages are still able to deliver news about the resumption of work in a relatively timely manner. (Interviewee 5)		
There are many news apps on mobile phones, Access to news on the COVID-19 pandemic is still relatively easy and comprehensive. (Interviewee 4)	Behavior on the internet	Information learning capability
I use an old-fashioned mobile phone (non-smart phone without internet access), I don't have internet access, and I don't know about the COVID-19 pandemic, so I can only listen to other people in the village or my children's news. (Interviewee 2)	Channels for information acquisition	
I think the COVID-19 pandemic is still dangerous and easily contagious, causing me to be emotionally tense as well. Most residents are still more concerned about their own safety. (Interviewee 7)	Emergency, serious, crisis, and dangerous	Stressful emotions
Later on, fewer SMS messages were sent and the news conveyed the message that the pandemic was effectively under control, so everyone was relaxed. (Interviewee 8)	Safe, relaxed	Sense of security
The main reason for this is that I don't know enough and I can't do anything about it. (Interviewee 6)	Disaster, panic, anxiety, and helplessness	Feelings of panic
Misinformation increases public panic about the COVID-19 pandemic, and such misinformation should be clarified and controlled in a timely manner. (Interviewee 10)		
SMS is essentially in line with the government's efforts to prevent and control the COVID-19 pandemic, and I can understand this type of service. (Interviewee 4)	Support, approval, and understanding	Sense of identity
Residents are able to support our work well in the prevention and control of the COVID-19 pandemic, regardless of the type of information service. (Interviewee 7)		
I have received short messages from the government, all of which are warm weather reminders. These messages can teach me how to do a good job of daily protection, and can be called up at any time to see, quite convenient. (Interviewee 6)	Warm weather tips	Suggestions by short messages
	Protection recommendations	
When we work in rural areas, we remind residents to pay attention to short messages on their mobile phones because they can receive short messages no matter what kind of mobile phone they have, even if it is an older model. (Interviewee 8)	Communication of information	Neutral short messages
For some time, misinformation about "salt can prevent COVID-19" spread, and our government sent short messages about "don't believe misinformation, don't spread misinformation, and pay attention to authoritative information". Instead of making direct comments, the misinformation is clarified by the national authoritative media. (Interviewee 9)	Clarification of misinformation	Opinion-led short messages
Chongqing Municipal Bureau of Justice has sent a short message informing about an incident that jeopardized the prevention and control of the COVID-19 pandemic, conveying the need for legal responsibility for disrupting pandemic prevention and control. This short message had a great effect on creating a good environment for pandemic prevention and control. (Interviewee 10)	Notification of the incident	

(Continued)

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TABLE 4 (Continued)

Partial original statements	Concept codes	Categories
I am more concerned about when I can resume work, short messages telling me what materials I need to prepare, how to pay attention to protection during the resumption of work, etc. (Interviewee 5)	Handling services	Educational short messages
Not long after the policy on resumption of work came out, a short message was sent about "whether to turn on the air conditioner in the office", and we were equipped with knowledge and skills on how to ventilate the office if the air conditioner was turned on to prevent and control the pandemic. (Interviewee 10)	Protective skills	
At the beginning of the COVID-19 outbreak, the first channels to get information were TV news and short messages. Short messages were displayed directly on mobile phones without manipulation or internet access. (Interviewee 1)	Effective service, easy operation, and wide-ranging reception	SMS
I learned about the government's requirement for us to segregate at home mainly through official news and official Mini-Apps. (Interviewee 6)	Official, authoritative, relatively rich in content	Official media
I usually follow online news and social media more because it allows me to engage in interactive communication and it has many forms. Recently I have received short messages but have not read them in a timely and regular manner. (Interviewee 4)	Network news, social media, interactive communication	Social media

force of law. The value of the official message media channel is its neutrality. Specifically, the SMS form of media emphasizes the official requirements and value of the message but does not require a mandatory Yes or No response. Communication of information imparts value and is not a command. Short messages beginning with the words "warm tips" is an example of such communication. Excerpts from interview interviewees also provide feedback on government SMS—"In the early days of the outbreak, our community staff was highly stressed, not to mention other community residents," (Interviewee 7) and. . . .

When working in the countryside, we reminded residents to pay attention to short messages on mobile phones because no matter what type of mobile phone, they can receive text messages that persuade them to consciously isolate themselves at home. This dispels residents' resistance and calms down citizens' nervousness (Interviewee 8).

The use of public opinion to dispel public panic

Official SMS consists of official information from the government and is the government's response to social media. Official SMS has no decision-making significance and is another way to convey the government's policies or events. SMS also plays a key role in the government's information dissemination goal—to guide public opinion. Important decisions concerning major emergencies or the public's opinions on the government's social media are multifarious. The public's opinion of SMS guidance is apparent. The government's goals for SMS sent from its social media department are to instigate a public opinion response and to lead the mainstream with its social media propaganda. This is accomplished *via* the interpretation of major decisions or push to represent the government in decision-making. Therefore, based on the promotion of wide coverage and timely SMS dissemination, SMS have become the guiding standard of the government in social media propaganda and can deliver the government's authoritative information and attitudes to the grass-roots audience. For example, on February 14, 2020, a short message from the government warned that "if someone in the vicinity is diagnosed, take good precautions and do not panic." On February 25, 2020, the government warned that a "rational response to the pandemic should not be excessive panic and anxiety." On February 26, the government sent out an SMS that people in the "low-risk area could go out," and pointed out rumors such as "blood pressure drugs increase the risk of disease," and "onions can aid the adsorption of viruses to reduce risk" as false. The Chongqing municipal government's social platform released the messages "please get the pandemic information protection knowledge from authoritative sources and "don't believe misinformation, don't spread misinformation, either" on the same day. Interview

TABLE 5 Results of axial coding.

Main category	Subcategory	Connotation of categories
Individual differences	Individual characteristics	The individual's gender, age, region, occupation, etc.
	Information learning capability	Differences in individual knowledge and use of various media.
Emotional needs	Stressful emotions	Nervousness and helplessness.
	Sense of security	The public correctly understands the COVID-19 pandemic and maintains a stable and peaceful mindset.
	Feelings of panic	Crisis/emergency evaluation of the COVID-19 pandemic event as well as their own fear and panic psychology.
	Sense of identity	Recognition, support, affirmation and understanding of SMS.
Functions of SMS	Suggestive short messages	Warm tips and advice on individual behavior from short messages.
	Neutral short messages	No emotionally charged words in the content of SMS messages.
	Opinion-led short messages	For misinformation and violations during the COVID-19 pandemic, they are guided by warning and guidance SMS messages tweeted.
	Educational short messages	SMS teaches the public how to protect themselves effectively in their daily life and work
Media formats	SMS	SMS has a wide range of acceptance and is easy to operate and reliable.
	Official media	A portion of the public prefers official media, which is considered more authoritative and relatively rich in content.
	Social media	A segment of the public tends to choose social media for its efficiency and ease of communication.

TABLE 6 Results of selective coding.

Typical relationship structure	Relationship type	Connotation of relational structure
Functions of SMS → emotional needs	Causality	The different service functions of SMS meet and respond to the different emotional needs of the public.
Media formats → emotional needs	Causality	Differences in awareness and use of different media can satisfy different levels of emotional needs.
Media formats ↓ (Functions of SMS → emotional needs)	Moderating relationship	Differences in the public's awareness and choice of media affect the different demands for the functions of SMS, leading to different requirements for meeting emotional needs.
Individual differences ↓ (Media formats → emotional needs)	Moderating relationship	Individual differences lead to differences in the extent to which emotional needs are met when using the same media.

excerpts from interviewees 1 and 5 also provide feedback on government SMS, as follows:

I think the most effective thing about a text message is that it's reliable. Especially when someone in the surrounding area is infected, you'll panic and not know what to do. You'll know what to do once you read the message. Although the community will help us to solve the problem, that is really after the fact. So, a first-time text message let me feel at ease (Interviewee 1).

Like us builders, we are relatively uneducated, and we are worried about our safety, but we can't tell when there are rumors, so we feel even worse. I thought it was really nice to clear up the rumor in a text message (Interviewee 5).

Discarded SMS: a focus on "individuals with limited internet access" and the emotional needs for security during COVID-19

In June 2020, Chongqing's Covid-19 pandemic prevention and control outreach for COVID-19 entered a relatively calm period. From June 2020 to December 2020, the Chongqing municipal government sent out a total of 22 text messages, a significant decline in numbers from the preceding months. The SMS content included "warm tip" type messages on ways to pay attention to daily protection and maintain social distance. The

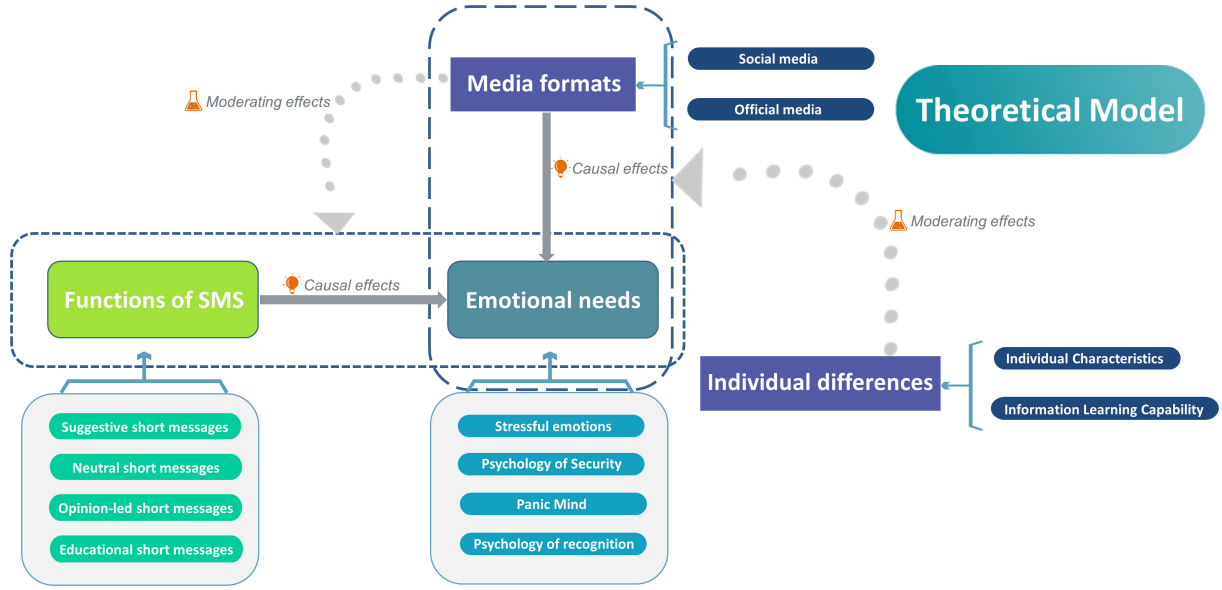

FIGURE 4
Theoretical model of SMS function to meet emotional needs.

main sender of the SMS push was the Chongqing Municipal Commission of Health.

Between June 2020 and December 2020, the role of SMS changed as the public's nervousness and panic over the outbreak eased after it was brought under control. At this juncture, authoritative information became abundantly available in the new media, and the SMS push was relegated to the discarded stage of its evolution as its effects on public emotion were replaced by new technology.

SMS devolves into an emotional support tool for "individuals with limited internet access"

The informational credibility of SMS affected users' behavior and attitudes (Ryan and Hayden, 2012). Credible and authentic informational messages to users can gain users' trust. This perception is the essence of SMS and can affect user's actions (McMahan et al., 1998; Taylor, 2009). In the interviews, we found that due to familiarity with the Internet, young people (regardless of gender and occupation), were to be able to derive the latest news about COVID-19. Concerning SMS, they said that they "did not carefully read;" "information is not much, feel useless," or "it is more suitable for the traditional older people's use"(Interviewees 3 and 4), which are similar to findings of previous studies (Yousra et al., 2019). For older people, however, the opposite was true. Most older people said, "read (or heard) message." There is a special mobile phone design for the elderly in China commonly known as the "Senior machine," with large format fonts and voice broadcast SMS. Interviewee 1 said, "the feeling is very useful, to know how to prevent COVID-19." Interviewee 2 said, "know how to arrange the pandemic prevention and control of the state." Different benefits accrue from the wide coverage of SMS. In the research, we met an older person who returned from the remote mountain areas in Chongqing following his children. Interviewee 2 said "over there the signal is weak. Our village people have to go door to door disseminating prevention and control information. Many mobile phone short messages were sent and many were received, more than before. The state should pay attention to the pandemic because if people know the situation, they will also know how to cooperate."

According to the 45th Statistical Report on Internet Development in China, in 2020, the number of Internet users in China will be 28.2% in rural areas; 16.9% of users will be people over 50 years old. This shows that rural areas and the older population are vulnerable targets for Internet development. In the face of public health crises, these groups can obtain authoritative and effective information through SMS. Compared with the information on the Internet, simple SMS content can meet COVID-19 prevention and control needs and provide access to information to a wide range of residents in a pandemic situation.

There are many kinds of SMS in China for the elderly and other unsure Internet users such as weather services, health services, and so on. But these services are based on the design and benefits of service providers. Services for public health emergencies such as COVID-19 are relatively weak with

poor design for SMS. However, it is undeniable that during the COVID-19 prevention and control period, SMS played an important media role for elderly people, people with weak Internet access, and people living in remote rural areas and other areas with low Internet access.

The safe passage code of short messages replaced by the Yu Kang code (application small program) to meet emotional security needs

During COVID-19, the Ministry of Industry and Information Technology of the People's Republic of China held a press briefing with China's three telecom enterprises. They requested the telecom enterprises to provide customers with 14/15 days of visiting query services based on pandemic prevention and control requirements and telecom data analysis, with the user's authorization. Queries included the following: "Can you prove that you haven't been to a place with a severe outbreak in the last 14/15 days? Just send a text message to your carrier." In China, as per the communication protocol, when each user handles the mobile phone SIM card and uses the communication services, the mobile phone terminal connects with the base station and verifies the user's identity (code and number information), and recognizes the communication routing and connection. In short, mobile phones have signals under normal conditions, the signal source is the base station, and each base station has a corresponding position. As the mobile phone moves, the base station of the signal source changes constantly and the base station records the mobile phone's access during the moving process, tracking the user's life trajectory. However, as per the needs of COVID-19, it is set at a 14/15-day time range for the query. The base station reflects the administrative area behind it but it can only reflect the general range. The precision range has not been captured so there will be no leakage of user privacy information.

Visiting query services can help relevant departments to improve the efficiency of itinerant inspection, conduct screenings on key groups, and carry out precise prevention and control to facilitate the resumption of work and production under the current situation. For example, China's mobile users first write CXMYD and send it to 10,086; they then list the provinces they have visited in the past 14/15 days by entering the four digits of their ID card based on the reply message to the appropriate municipal city.

This personal track serves as a passcode for users to return to factories and businesses during outbreaks. Interviewee 3, a migrant returning to work in Chongqing during the survey said "this method is easy to operate and can be operated without the Internet." China has divided three risk areas into "high, medium, and low." Users in high-risk areas are generally not encouraged to go out, while users in low-risk areas are discouraged from going to high-risk areas. Personal track services by SMS can visually display the areas that users have visited within 14/15 days and determine whether they can go back to work according to the level of risk. The information became an important safe passage code during COVID-19. But for the majority of the public, this security access code information has security problems. "It's a threat to your privacy to identify where you are by text message" (Interviewee 4).

After May 2020, Chongqing City released and popularized the Yu Kang Code small program. The program docks with data from the Chongqing Municipal Health Commission to protect privacy, authority, and security. The program contains the user's pandemic status (red QR code for infected, green QR code for security personnel, and yellow for close contacts). The function of the safe access code, the results of nucleic acid detection, and the vaccination were combined into a small program.

When asked to compare the safe access code with the Yu Kang code, interviewee 3 said that the "Yu Kang Code is additional authority and security," interviewee 4 said "it can make people feel more at ease, and interviewee 6 said "I don't read text messages so much, it's convenient to travel with this code." The Yu Kang Code is an effective application of big data technology. According to interviewee 9, "from the public's perspective, it is incomparable with other media such as short messages. It is easier to meet the public's needs for timely and authoritative information and information security."

Discussion and conclusions

The use of certain media in communication activities is influenced by inter-related media characteristics (Trevino et al., 1987). Specific communication conditions, perceptions of the purpose of the media, and the diversity of participants affect how the media is used. It defines the nature of the communication technology and media (Licoppe and Smoreda, 2005), and how well the different media cooperate rather than compete (Quan-Haase and Wellman, 2006). Hyo et al. (2007) studied the role of different media in Korea—a media group made up of SMS, E-mail, and Face to Face—and analyzed the distribution mode of different media. Hyo's study supports the need to research the role of SMS in the media structure and the government's pandemic management and intervention efforts concerning the public's informational and emotional needs.

Comparison and links between SMS, official media and social media

From the perspective of the government's media structure, SMS, a traditional communication medium, together with official media and social media, has shaped the media communication environment and channels for public emotional support. The official media publicly and formally disseminates the government's decisions and/or opinions with administrative

effectiveness. Social media is represented by various media platforms and by social or mobile clients in the current media integration space. The official media distribution channels and participants in the main body are relatively separate but their dissemination of information remains authoritative. The current channels are extensive distribution channels of various forms providing complex information for social public participation within the main body. Somewhere in between lies SMS.

Therefore, the interaction between SMS and the government needs to return to its media environment and the structure should be discussed. SMS forms a triangle of stable media structures with official media and social media. This structure is determined by the characteristics of the government's official information communications. Firstly, official government communications should guarantee the authority and authenticity of the information communicated, provide guidelines, and advocate mainstream values. Important decisions of significance to the government should provide an authoritative emotional support base for the public.

Secondly, official government information should be targeted at the public and should include broad coverage, receptivity of information, communication tools, content, and form.

Thirdly, as the media channel for disseminating information to the public, official government information needs to be differentiated from diversified and complicated social media content. Although the government should have limited intervention in social media, it should take into account the requirement, challenges, and benefits of social media so it can respond to the varying emotional needs of the public. Official media communicates authoritative information and values, whereas social media responds to information demand and provides social value feedback to the public. SMS is a conversation between the government and the public that provides neutral and objective suggestions and guidance. As an intermediary medium and source of emotional support, SMS disseminates official government information to the public far beyond social media. SMS is not only the authority for guiding public behavior in society, it can also specify the appropriate response to social media. The three—SMS, official media and social media—form a complementary triangle and an interactive communication structure.

In addition, during the pandemic prevention and control period, an interesting phenomenon was that government departments in some countries (including China, Japan and Italy) used loudspeakers to broadcast easy-to-understand prevention and control content in the streets and communities at grassroots level. The public felt the support of government and a collective cohesion through the use of vivacious voices. This inspired a positive mood in dealing with the pandemic and cooperating in prevention and control management. In particular, during the emergency phase of the containment and home quarantine policy in China, a multi-channel online/offline propaganda and communication model was established through radio, SMS announcements, telephone communication and WeChat to disseminate information and keep abreast of the physical and emotional needs of the public.

Government departments organized distribution of food and medicine, helped citizens with inconveniences and difficulties in an orderly manner, and opened a *green channel* (Medical, transportation and other departments set up easy procedures, safe and fast access) for patients with acute illnesses and pregnant women to seek medical treatment. This was also a reflection of the reality of the triangular media structure.

Application of SMS messaging in public health crises in developing countries

From the perspective of the governance of public health emergencies and intervention to public sentiment, the interaction of SMS in the government's governance in developing countries focuses on the dynamic adjustment of information dissemination and the public's emotional needs.

This interaction also motivates the government to develop policy communication to address public health crises. The interactive role of SMS in the government's communication media structure focuses on the dynamic adjustment of media and information transmission. SMS is a combination of official, authoritative media, and social media, which requires it to adjust the media relationship between the two and maintain a benign media interaction. When the government faces a major decision or emergency, social media is superior to SMS in timeliness, but SMS is a complementary form of social media, which extends the information transmission range and coverage. It can especially serve older people who may have limited internet access.

SMS delivery of health information is beneficial for public health (Ybarra et al., 2014), and extends the scope and effectiveness of national governance. In community efforts to prevent dengue fever and rabies, the combination of SMS and regular information meetings can produce better results (Dammert et al., 2014; Wu, 2016; Ashmin et al., 2019). SMS is also effective as a control tool to reduce the malaria burden in children under 5 years (Aliyu et al., 2019). When social media is flooded with a variety of active voices and misleading content, SMS, as an extension of the authority of the official media, can respond with rules and guidance to ensure effective coordination between official media and social media.

SMS can help public health event governance and public emotional needs in developing countries, thanks to its ability to push our information and support (Lubis et al., 2019). Studies have found that SMS reduced negative emotions in the public (Bengtsson et al., 2015; Mao et al., 2016; Panigutti et al., 2017). SMS has gained new life in public health crisis management. It has brought action and a framework to governance based

on its data superiority and capacity for providing emotional support. In the internet information age, this advantage is both irreplaceable and an innovation in governance. Mobile phone tracking technology is considered one of the most effective ways of identifying precise locations and information due to the widespread use of mobile phones by a large number of people (Lai et al., 2019). In the context of public health issues, mobile phone data can be used to predict a patient's movement trajectory and to identify the transmission source or area of the disease before implementing targeted control. Scholars have called SMS intervention "spatio-temporal personalization" (Yin et al., 2020).

Research limitations and contributions

There are limitations in the data and analytical methods. Firstly, the government releases messages during important events or festivals in China. Due to inherent unpredictability, we were not able to obtain a whole year's data. We were also not able to obtain information on SMS sent by the governments of other provinces. Fortunately, the SMS messages we were able to obtain were consistent, that is they were supervised national government actions. Secondly, due to restrictions on access to SMS to protect personal privacy, we did not have access to information on the number of messages sent to every citizen. We can only conduct interviews on relevant short message topics in emergency governance research. In these interviews, we found that the effect of SMS was often ignored by interviewees. When we asked interviewees, they realized they had received short news messages and dozens of unread messages. We believe that these limitations don't affect the value of our research findings as we did not focus on the individual characteristics of users and usage habits, but only on the SMS. We found that the public's positive sentiments around the government's response to COVID-19 can be attributed to the positive impact of SMS.

Concerning the governance of COVID-19, the main conclusion of this study is that SMS had a positive impact on recipients. As a traditional media, SMS forms a triangle with the official media and social media, creating the government's communications structure. At the same time, SMS reshaped government emergency management, particularly in the initial stage of COVID-19. The emotional support offered by SMS to the public extended the scope of the government's emergency management. It also provided an effective channel for weaker uses of the internet to receive and perceive the efficiency and authenticity of government information. However, SMS now lags behind in form, content, and technology. We still need to understand the positive role this traditional media plays in meeting the public's emotional needs and the government's decision-making and governance of major public health crises. Changes in information technology and the current media environment can also enhance the significance of traditional media. An important topic for research into media development should be how to effectively identify the positive role of traditional media.

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

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

MW and CW: conceptualization, data curation, supervision, and visualization. MW and XP: field research, validation, and writing-original draft. MW, CW, and XP: formal analysis. MW: writing-review and editing. All authors have read, agreed to the published version of the manuscript, and approved the final manuscript.

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Conflict of interest

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

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References

360ISC. (2020). 360 Internet Security Center (360ISC). Beijing: 360ISC. Available online at: https://www.aqniu.com/industry/24904.html (accessed September 11, 2020).

Aliyu, M., Princess, R. A., Easmon, O., Francis, A. O., Roderick, L. R., and Ellis, O. D. (2019). Mobile phone short message service (SMS) as a malaria control tool: a quasi-experimental study. *BMC Health Serv. Res.* 19, 1193. doi: 10.1186/s12889-019-7336-6

Ashmin, H. B., Guardian, Y. S., Anil, K., Randeep, K., and Riris, A. A. (2019). The addition of mobile SMS effectively improves dengue prevention practices in community: an implementation study in Nepal. *BMC Health Serv. Res.* 19, 699. doi: 10.1186/s12913-019-4541-z

Bauer, S., de Niet, J., Tinman, R., and Kordy, H. (2010). Enhancement of care through self-monitoring and tailored feedback *via* text messaging and their use in the treatment of childhood overweight. *Patient Educ. Couns.* 79, 315–319. doi: 10.1016/j.pec.2010.03.014

Bengtsson, L., Gaudart, J., Lu, X., Moore, S., Wetter, E., and Sallah, K. (2015). Using mobile phone data to predict the spatial spread of cholera. *Sci. Rep.* 5, 8923. doi: 10.1038/srep08923

Cassandra, J. C., Wright, A. B. D., Kaytlyn, L. C., Megan, S. C., and Lim, A. B. (2016). Challenges to translating new media interventions in community practice: a sexual health SMS program case study. *Health Promot. J. Aust.* 27, 70–73. doi: 10.1071/HE15057

Cassiani, S., Caliri, M., and Pelá, N. (1996). Grounded theory as an approach to interpretive research. *Rev. Lat. Am. Enfermagem.* 4, 75–88.

Chalela, P., McAlister, A. L., Munoz, E., Despres, C., Akopian, D., Kaghyan, S., et al. (2020). "Reaching Latinos through social media and SMS for smoking cessation," in *Advancing the Science of Cancer in Latinos*, eds A. Ramirez, and E. Trapido (Location: Springer), 187–196. doi: 10.1007/978-3-030-29286-7_18

Chung, M.-S., and Seomun, G. (2021). Health issues with learning to use smart devices in the digital age: using a grounded theory approach. *Int. J. Environ. Res. Public Health* 18, 7062. doi: 10.3390/ijerph18137062

CNNIC (2020). *China Internet Network Information Center (CNNIC)*. Beijing: CNNIC. Available online at: http://www.cnnic.cn/gywm/xwzx/rdxw/20172017_7057/202004/t20200427_70973.htm (accessed September 11, 2020).

Corbin, J. M., and Strauss, A. (1990). Grounded theory research: procedures, canons, evaluative criteria. *Qual. Sociol.* 13, 3–21.

CTIA Wireless Association (2009). *CTIA Semi-Annual Wireless Industry Survey*. Washington, DC: CTIA Wireless Association.

Dammert, A. C., Galdo, J. C., and Galdo, V. (2014). Preventing dengue through mobile phones: evidence from a field experiment in Peru. *J. Health Econ.* 35, 147–161. doi: 10.1016/j.jhealeco.2014.02.002

Fjeldsoe, B. S., Miller, Y. D., and Marshall, A. L. (2010). Mobile Mums: a randomized controlled trial of an SMS-based physical activity intervention. *Ann. Behav. Med.* 39, 101–111. doi: 10.1007/s12160-010-9170-z

Fukuoka, Y., Vittinghoff, E., Jong, S. S., and Haskell, W. (2010). Innovation to motivation—pilot study of a mobile phone intervention to increase physical activity among sedentary women. *Prev. Med.* 51, 287–289. doi: 10.1016/j.ypmed.2010.06.006

Heymann, H., King, E. S., and Hopfer, H. (2014). "Classical descriptive analysis," in *Novel Techniques in Sensory Characterization and Consumer Profiling* (Boca Raton: CRC Press), 9–40. doi: 10.1201/b16853-3

Hsieh, H.-F., and Shannon, S. (2005). Three approaches to qualitative content analysis. *Qual. Health Res.* 15, 1277–1288. doi: 10.1177/1049732305276687

Hyo, K., Gwang, J. K., Han, W. P., and Ronald, E. R. (2007). Configurations of relationships in different media: ftf, email, instant messenger, mobile phone, and SMS. *J. Comput. Mediat. Commun.* 12, 1183–1207. doi: 10.1111/j.1083-6101.2007.00369.x

Johnson, B., Onwuegbuzie, A. J., and Turner, L. A. (2007). Towards a definition of mixed methods research. *J. Mixed Methods Res.* 1, 112–133. doi: 10.1177/1558689806298224

Lai, S., Farnham, A., Ruktanonchai, N. W., and Tatem, A. J. (2019). Measuring mobility, disease connectivity and individual risk: a review of using mobile phone data and mHealth for travel medicine. *J. Travel Med.* 26, taz019. doi: 10.1093/jtm/taz019

Lawless, H. T., and Heymann, H. (2010). "Descriptive analysis," in *Sensory Evaluation of Food* (New York: Springer), 227–257. doi: 10.1007/978-1-4419-6488-5_10

Licoppe, C., and Smoreda, Z. (2005). Are social networks technologically embedded? How networks are changing today with changes in communication technology. *Soc. Netw.* 27, 317–335. doi: 10.1016/j.socnet.2004.11.001

Liu, F., Lu, Y., and Wang, P. (2020). Why knowledge sharing in scientific research teams is difficult to sustain: an interpretation from the interactive perspective of knowledge hiding behavior. *Front. Psychol.* 11, 537833. doi: 10.3389/fpsyg.2020.537833

Lubis, A. R., Lubis, M., and Azhar, C. D. (2019). The effect of social media on the sustainability of short message service (SMS) and phone call. *Proced. Comput. Sci.* 161, 687–695. doi: 10.1016/j.procs.2019.11.172

Mao, L., Yin, L., Song, X., and Mei, S. (2016). Mapping intra-urban transmission risk of dengue fever with big hourly cellphone data. *Acta Trop.* 162, 188–195. doi: 10.1016/j.actatropica.2016.06.029

Martin-Crespo, M. C., and Salamanca, A. (2007). *El muestreo en la investigación cualitativa*. Nure Investigación: Revista Científica de enfermería. 27, 1–4. Available online at: https://bit.ly/3yQxJ5D

McMahan, S., Witte, K., and Meyer, J. A. (1998). The perception of risk messages regarding electromagnetic fields: extending the extended parallel process model to an unknown risk. *Health Commun.* 10, 247–259.

Nardi, B. (2005). Beyond bandwidth: dimensions of connection in interpersonal communication. *Comput. Support. Coop. Work* 14, 91–130. doi: 10.1007/s10606-004-8127-9

Newton, K. H., Wiltshire, E. J., and Elley, C. R. (2009). Pedometers and text messaging to increase physical activity: randomized controlled trial of adolescents with type 1 diabetes. *Diabetes Care*. 32, 813–815. doi: 10.2337/dc08-1974

Noble, H., and Mitchell, G. (2016). What is grounded theory? *Evid. Based Nurs.* 19, 34–35. doi: 10.1136/eb-2016-102306

Noprisson, N., Husin, N., Zulkarnaim, P., Rahayu, A. R., and Sensuse, D. I. (2016). "Antecedent factors of consumer attitudes toward SMS, E-mail and social media for advertising," in *International Conference on Advanced Computer Science and Information Systems (ICACSIS)* (Malang), 165–170. doi: 10.1109/ICACSIS.2016.7872742

Oksman, V., and Turtiainen, J. (2004). Mobile communication as a social stage: meanings of mobile communication in everyday life among teenagers in Finland. *New Media Soc.* 6, 319–339. doi: 10.1177/1461444804042518

Panigutti, C., Tizzoni, M., Bajardi, P., Smoreda, Z., and Colizza, V. (2017). Assessing the use of mobile phone data to describe recurrent mobility patterns in spatial epidemic models. *R. Soc. Open Sci.* 4, 160950. doi: 10.1098/rsos.160950

Pieterse, H. J. C. (2011). An open coding analytical model of sermons on poverty with Matthew 25:31–46 as sermon text. *Acta Theol.* 31, 95–112. doi: 10.4314/actat.v31i1.6

Quan-Haase, A., and Wellman, B. (2006). "Hyperconnected network," in *The Firm as a Collaborative Community: Reconstructing Trust in the Knowledge Economy*, eds C. Heckscher, and P. Adler (New York: Oxford University Press).

Rice, R., and Katz, J. (2003). Comparing internet and mobile phone usage: digital divides of usage, adoption and dropouts. *Telecomm. Policy.* 27, 297–623. doi: 10.1016/S0308-5961(03)00068-5

Ryan, S., and Hayden, B. (2012). Short message service (SMS) text messaging as an intervention medium for weight loss: a literature review. *J. Health Inform*. 18, 235–250. doi: 10.1177/1460458212442422

Sneha, P., Shruti, M., Swati, S., Krishna, M., and Ashish, J. (2014). A pilot study to assess perceptions of using SMS as a medium for health information in a rural setting. *J. Health Care Technol*. 22, 1–11. doi: 10.3233/THC-130766

Taylor, C. (2009). Editorial: the six principles of digital advertising. *Int. J. Advert*. 28, 411–418. doi: 10.2501/S0265048709200679

Trevino, L. K., Lengel, R. H., and Daft, R. L. (1987). Media symbolism, media richness, and media choice in organizations: a symbolic interactionist perspective. *Commun. Res*. 14, 553–574.

Tripathi, J., De Vries, R. A., and Lemke, M. (2022). The three-step persuasion model on YouTube: a grounded theory study on persuasion in the protein supplements industry. *Front. Artif. Intell*. 5, 1–16. doi: 10.3389/frai.2022.838377

Wei, R., and Lo, V. H. (2006). Staying connected while on the move: cell phone use and social connectedness. *New Media Soc*. 8, 53–72. doi: 10.1177/1461444806059870

Wu, H. (2016). Community-based interventions to enhance knowledge, protective attitudes and behaviors towards canine rabies: results from a health communication intervention study in Guangxi, China. *BMC Infect. Dis*. 16, 701. doi: 10.1186/s12879-016-2037-6

Ybarra, M. L., Prescott, T. L., and Holtrop, J. S. (2014). Steps in tailoring a text messaging-based smoking cessation program for young adults. *J. Health Commun*. 19, 1393–1407. doi: 10.1080/10810730.2014.901441

Yin, L., Lin, N., Song, X. Q., Mei, S. J., Shih-Lung, S., Fang, Z. X., et al. (2020). Space-time personalized short message service (SMS) for infectious disease control Policies for precise public health. *Appl. Geogr*. 114, 102103. doi: 10.1016/j.apgeog.2019.102103

Yousra, B., Ahmed, T., and Hakim, M. (2019). Drivers of SMS advertising acceptance: a mixed-methods approach. *J. Res. Interact. Mark*. 13, 96–118. doi: 10.1108/JRIM-02-2018-0033

Zhongming, Z., Linong, L., Xiaona, Y., Wangqiang, Z., and Wei, L. (2017). Ministry of Industry and Information Technology (MIIT) of the People's Republic of China. Beijing: MIIT. Available online at: https://www.miit.gov.cn/gxsj/tjfx/txy/index.html (accessed September 11, 2020).

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Randomized controlled trial for the efficacy of three versus five sessions of grief counseling on the psychological aspects following COVID-19 bereavement: A study protocol

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Background: During the COVID-19 pandemic, many people have experienced traumatic losses and therefore are at risk of developing complicated grief regarding the restrictions on the performance of routine mourning rituals. This study is a randomized controlled trial for assessing the efficacy of three versus five sessions of grief counseling on grief intensity, psychological distress, and quality of life of grief among bereaved people due to COVID-19.

Methods: A total of 120 bereaved people, due to COVID-19, will be enrolled in this multi-center randomized controlled trial after assessment for inclusion and exclusion criteria. Following the informed consent procedure, participants will be allocated into two groups equally by the Stratified Balanced Block Randomization, one of them delivering a three-session grief counseling intervention and the other delivering a five-session grief counseling intervention. The intervention will be delivered by trained psychologists *via* in-person individual sessions. The primary outcome is grief intensity, and the secondary outcomes are psychological distress, quality of life, and satisfaction of the participants. These outcomes will be measured by the Grief Intensity Scale (GIS), the General Health Questionnaire-28 (GHQ-28), the Short Form Health Survey-12 (SF-12), and the Client Satisfaction Questionnaire (CSQ-8), respectively. The assessments will be done at three time points, one before the intervention and the others 1 month and 3 months

after the intervention. The data will be analyzed using the SPSS V.18 and Stata V.11 software. The analysis approach will be "intention to treat."

Discussion: Results of this study can be applied for selecting the most suitable intervention leading to the prevention of complicated grief and the maintenance and promotion of the mental health of bereaved people due to COVID-19.

Clinical trial registration: [irct.ir], identifier [IRCT20200505047305N1].

KEYWORDS

grief, counseling, COVID-19, bereavement, mental health

Introduction

Grief is an emotional reaction manifesting as deep sadness and regret and a range of other feelings which an individual experiences following the loss of a loved one (1). The concept of grief is mainly related to the various reactions and mental feelings that individuals experience after a loss and especially death of an intimate person (2, 3). Grieving individuals may not ever return to their previous emotional status but are usually able to go on with their lives and let go of their pain and eventually start to build new relationships (4, 5). This process happens in a process named bereavement. Bereavement is a universal reaction to loss, and individuals come to an acceptance of it over a period of about 6 months to 1 year; their attachment to the lost one loosens as they come back to normal life (6, 7). Although grief is a normal reaction, it is accompanied by various feelings. Some are able to handle the loss and cope with it through the mourning process, and others experience severe sorrow throughout a long period. These severe emotional reactions are poor prognostic factors and predictors of a prolonged grief disorder or complicated grief (8). Based on International Classification of Diseases 11th Revision (ICD-11), prolonged grief disorder is a disturbance in which, following the death of a person close to the bereaved, there is persistent and pervasive grief response (more than 6 months at a minimum) and causes significant impairment in personal, family, social, educational, occupational, or other important areas of functioning (9). The DSM-5 (diagnostic and statistical manual of mental disorders, fifth edition) proposed "persistent complex bereavement disorder" as a psychiatric disorder categorized under the entity of stress-related disorders (1). Individuals diagnosed with persistent complex bereavement disorder are also at an increased risk of mental health and other health problems. This may also affect their behavior and at times lead to suicidal ideation or attempts, necessitating therapeutic interventions (10). We know that COVID-19 has many physical and mental consequences, including lung, kidney and liver complications, drug-related complications, depression, anxiety, and psychological distress (11–14). The high prevalence of psychological distress, stress reaction, insomnia symptoms, and the increased burden of mental disorders during the pandemic provide evidence for the serious impact of COVID-19 on mental health (15, 16).

Ever since the COVID-19 outbreak began, many people have been experiencing loss and are going through tragic processes of shock and denial (17, 18). Evidence shows that following sudden and unpredictable deaths such as deaths due to COVID-19, grief levels are higher, and grief reactions are more intense and, therefore, may convert to complex or prolonged grief disorder (8, 19–22). In this case, Tang and Xiang reported a high prevalence of prolonged grief disorder among people bereaved due to COVID-19 (23). These bereaved people have to face fears of virus transmission during corpse handling, which leads to limitations in the burial process alongside their deep anguish, and they have no opportunities to say goodbye (21, 24). Social distancing measures simultaneously hinder the performance of routine mourning rituals and ceremonies, which otherwise would have a facilitating role in the grieving process for the individual. Mourning is a societal process, and bereaving individuals are in need of social support to be able to go through it; nevertheless, in COVID-19 cases, social support is mainly absent (24–26).

Grief counseling is a psychological intervention that assists bereaving individuals manage their emotions throughout the grief process (8). Evidence-based interventions for reducing the burden of suffering on bereaved individuals have been proven to decrease long-term health risks and are beneficial in improving clinically relevant outcomes (27). Psychological interventions in grieving individuals have both immediate and long-term effects on grief, especially when delivered individually (28). Greater symptom change has been observed in people at risk for developing persistent complex bereavement disorder in the long term and after the intervention has been completed, and this shows that counseling helps more than the passage of time alone (29). For individuals diagnosed with persistent

complex bereavement disorder, psychological interventions are quite different and are consisted of specific techniques (8).

The study aims at comparing the efficacy of providing three versus five sessions of a grief counseling intervention to family members of those deceased due to COVID-19 in the setting of a multi-center randomized clinical trial. The primary outcome measure is the intensity of grief of individuals after a 3-month follow-up period. Quality of life, psychological distress, and satisfaction with the intervention are the secondary outcomes that will be compared among both groups. In this study, in addition to a general investigation of the efficacy of grief counseling, we aimed to compare the efficacy of three- and five-session grief counseling. If similar efficacy is seen between the two groups due to a lack of resources, three-session counseling can be introduced to the authorities as a population-based intervention for bereaved people in the country. In this case, by spending less time and money, more bereaved people will benefit from this service.

We hypothesize that the effect of the three-session grief counseling intervention on the grief intensity, psychological distress, quality of life, and satisfaction with the intervention among participants will be comparable with the five-session intervention and supposedly have equal efficacy.

Methods

Study design

This study is a parallel multi-center randomized controlled trial for comparing the efficacy of a three- versus five-session counseling intervention on bereaved people who had lost a loved one due to COVID-19 by dividing them into two equal intervention groups.

Inclusion and exclusion criteria

The participants are first-degree relatives of those deceased due to COVID-19, ranging from 15 to 64 years old. According to the study protocol, following 1 week after the occurrence of the death of a COVID-19 patient, a phone call will be made to connect with a family member of the deceased to initially assess them regarding the inclusion criteria. If the individual is eligible and willing to participate, the grief counseling sessions will be started 2 weeks after the death of the loved one. Participants should be literate and be able to understand and speak the Persian language. They should all give written informed consent to enter the study. If an individual has received any type of mental health service, including biological or non-biological therapies or interventions throughout this 2-week period, or if the individual has a severe comorbid medical or neurological condition along with disability, or fulfills the criteria of any psychiatric disorder, they will be excluded from the study. Serious suicidal ideation, suicidal attempts and a history of self-harm, and being diagnosed with any substance use disorder are also among the exclusion criteria. If a participant enters the counseling process and any of these exclusion criteria come up in the middle of the study; in that case, that individual will be excluded from the study but the necessary and standard therapy will not be withheld.

Setting

This study will be conducted in the setting of 20 health centers affiliated with 10 of the universities of medical sciences of Iran, which are responsible for health services and medical education in their catchment area (including Ahvaz, Arak, Golestan, Guilan, Iran, Kerman, Mashhad, Shiraz, Tabriz, and Tehran universities). In each university, two health centers will be selected. These centers routinely offer basic mental health services by master clinical psychologists. A specific number of clinical psychologists of these centers will be further trained in a 2-day online workshop. In this workshop, psychologists learned how to perform three- and five-session mourning counseling according to a protocol by an expert panel to provide the intervention in a uniform and coordinated manner.

Intervention

The content of grief counseling was provided by an expert panel, including psychiatrists and psychologists with experience in this field. Its stages include a literature review about the method of mourning during the COVID-19 pandemic, psychosocial consequences of COVID-19, types of grief, interventions related to grief counseling and treatment of traumatic bereavement, preparation of an initial intervention package with an emphasis on the COVID-19 pandemic, editing the package after the implementation of the pilot intervention and based on the opinions of the interveners and the target group. A service package has been developed to help the bereaved people of those deceased due to COVID-19 to go through the normal grieving process. This intervention package mainly focuses on the items below:

- To facilitate the acknowledgment and acceptance of the recent loss.
- To help the participant cope with the pain and anguish of the recent loss.
- To assess the participants' defense mechanisms and approaches toward the recent loss.
- To mutually explore finding some sort of meaning in the painful event.
- To empower the participants to manage difficult situations and adjust to normal life.

- To enable participants to be able to live in the absence of the lost one and to learn coping and problem-solving skills.
- To find a way to be comfortable in life while keeping bonds with the lost one.

In both intervention methods, each session takes 45 min. Each session starts and ends with reviewing and presenting assignments. In both intervention groups, if the participant misses a session, the psychologist will call them two times at two different times on two different days to ask about the reason for their absence in the session. In case the participant is not willing to cooperate further, they will be excluded from the study.

The five-session intervention group

In the five-session intervention, sessions will be held once a week, and the topics of the sessions will be as follows:

1. Session 1: Psychological assessment and preliminary consultation; creating a therapeutic alliance, and collecting demographic information.
2. Session 2: Open evaluation of the event and acceptance of the loss; narrative of death (talking about the events related to death by the bereaved), mourning narrative (talking about the mourning ceremony), and evaluating the dominant emotions such as anger, disappointment, anxiety, sadness, and missing.
3. Session 3: Learning to cope with the loss and searching for meaning in loss; explanation about the usual methods of dealing with grief: effective and inefficient methods, discussing the bereaved confrontation with the grief, and explanations about the meaning.
4. Session 4: Recovery and adjustment to normal life in the absence of the deceased; the role of the deceased person in the life of the bereaved, the problems ahead after the loss, reviewing the usual method of solving problems, and teaching problem-solving techniques.
5. Session 5: Assessment of the bereaving process and returning to life in the absence of the lost one; examining the feelings and emotions experienced, feelings about self, examining behavioral changes in self-care and relationships, and examining the change in attitude toward goal setting for the future.

The three-session intervention group

In the three-session intervention, sessions will be held every 2 weeks, and the topics of the sessions will also be as follows:

1. Session 1: Psychological assessment and preliminary consultation; creating a therapeutic alliance and collecting demographic information.
2. Session 2: Open evaluation of the event and acceptance of the loss, expanding understanding of the recent loss, learning to cope with the loss and searching for meaning in loss; flexible assessment of the event and increased understanding of the reality of loss/coping with grief, increasing understanding of the reality of loss and coping with the pain caused by loss, examining defenses and countermeasures, and helping survivors find meaning in painful experiences.
3. Session 3: Recovery and adjustment to normal life in the absence of the lost one; recovery, adaptation, and return to life without the deceased, helping survivors adjust to loss through problem-solving, returning to life, and examining the changes according to their narrative.

Recruitment process

Five of the researchers will be in direct connection with the 10 medical universities. In every university, two health centers will be selected for service delivery, and one trained clinical psychologist will be the service provider in each center. The clinical psychologist obtains names and phone numbers of bereaved people on a routine basis from the social service department of the hospitals in the catchment area of the center and will invite them by phone to encourage them to attend the grief counseling sessions. The clinical psychologist will also try to create effective communication and express compassion and empathy toward the grieving individuals. When participants attend health centers, their demographic data are obtained and registered, and the inclusion or exclusion criteria will then be re-assessed. If inclusion criteria exist and in the absence of the exclusion criteria, the participant will be thoroughly informed on the designed counseling intervention process, and informed consent will be obtained. If several family members of one COVID-19 victim attend the health center to receive service, only one of them will be enrolled in the study, and the rest will be directed to receive the usual grief counseling services provided at health centers. Assessments will be done at three time points, one before the intervention and the others 1 month and 3 months after the intervention.

Consent procedure

Participants entering the study will receive oral explanations of the trial intervention and will sign an informed consent form. This is performed by the clinical psychologist of the health center, and they are responsible for responding to any queries. Informed consent will be mainly provided in a general non-technical language, so that it would be comprehensible at any scholastic level. If a participant does not have the necessary inclusion criteria or does not give informed consent to be enrolled in the study, they will be excluded from the

study and will receive services as usual. The informed consent method of this study has been approved by the Medical Ethics Committee of the Iran University of Medical Sciences (IUMS) and has been registered with the trial registration number of IRCT20200505047305N1. Participants can exit the trial whenever they wish.

Randomization

After informed consent, participants are randomized into three- or five-session intervention groups. Allocation of participants to each group will be done with the use of Stratified Balanced Block Randomization. Twelve participants will be selected from each university, and randomization will be done separately for each. Among 20 possibilities for six blocks including forms of three individuals in the five-session group and three individuals in the three-session group, two blocks will be randomly chosen for each university in the Microsoft Office Excel software with the use of the RANDBETWEEN formula and a random sequence will be formed. Subsequently, participants will be divided into the three- and five-session groups equally according to the random sequence. Randomization will be done in the main research headquarters in the Mental Health Research Center of the IUMS, and information will be only given to the health centers at the time of initiation of the intervention.

Data collection/management process

The primary outcome measure is the grief intensity based on the grief intensity scale (GIS) score of individuals receiving grief counseling sessions after a 3-month follow-up period, and the secondary outcomes are the quality of life, psychological distress, and satisfaction with the services. In this study, one qualified clinical psychologist will be entitled to each medical university attending two of the health centers to collect data at three points of participant entry (baseline assessment) and two follow-up points at 1-month and 3-month follow-up periods. Satisfaction with the services will be assessed at the end of the counseling sessions (either three or five) and 3-month after it. Clinical psychologists who are working as raters will be trained to use the questionnaires, and inter-rater reliability will also be checked after the training sessions. To reduce the risk of research bias, the raters will not be among those clinical psychologists providing the grief counseling sessions and will be blind toward the number of sessions each individual has received.

Demographic variables will be obtained using a questionnaire created by the researcher, and data collection for obtaining the dependent variables of the study will be performed by using the GIS, the General Health Questionnaire (GHQ-28), the Short Form Health Survey (SF-12), and the Client Satisfaction Questionnaire (CSQ-8).

The grief intensity scale

The GIS is a scale proposed by Prigerson et al. (30) and consists of 12 questions measuring the thoughts, emotions, and behaviors of individuals who have recently lost an important person. This scale represents the severity of the reactions of the bereaving individual. It facilitates clinicians to be able to assess the risk of an individual being later diagnosed with prolonged grief disorder after the loss of a loved one. The first two questions of this scale question the time elapsed since the death of a loved one and the decline in performance. The sum of the scores of the next 10 Likert-scale questions, each of which is answered with never, at least once a month, once a week, once a day, and several times a day, is analyzed as a grief intensity score. Each item receives a score of 1–5. A higher score represents a higher intensity of grief symptoms (31). We conducted a pilot study to investigate the validity and reliability of the Persian version of GIS and estimate the mean and standard deviation of the grief intensity score of the bereaved persons due to COVID-19. The face and content validity of the questionnaire was confirmed by the expert panel. Cronbach's α of 0.92 and the intraclass correlation coefficient of 0.87 indicated good internal consistency and test–retest reliability of the Persian version of GIS.

The general health questionnaire

The GHQ-28 is designed for screening non-psychotic mental disorders and is commonly used among researchers all over the world. It consists of four subscales, such as somatic symptoms, anxiety symptoms, social functioning, and depressive symptoms. The Farsi version of the GHQ-28 has been validated by Noorbala et al. (32) for use in Iranians above 15 years old, and it has demonstrated good reliability and validity for research. The 28-item questionnaire includes multiple-choice questions accompanied by the following four possible responses: Not at all, No more than usual, Rather more than usual, and Much more than usual. A score ranging from 0 to 3 can be given for each response, with a total possible score ranging from 0 to 84. A higher total score is an indicator of poor general health, and 23 is the most reliable cut-off point for the presence of distress (32).

The short form health survey

The SF-12 is a short form of the SF-36 Health Survey with 12 questions and two main domains that provide glimpses into mental and physical functioning, including physical functioning (two items), bodily pain (two items), limitations in usual role activities because of physical problems (one item), general health (one item), vitality and energy (one item), social functioning (one item), limitations in usual role activities because of emotional problems (two items), and perceived mental health (two items). The individual's score is calculated separately for the mental and physical component summary. The SF-12 has been validated for use in the Iranian population

by Montazeri et al. (33), demonstrating Cronbach's α of 0.72 and good reliability and validity.

The client satisfaction questionnaire

The CSQ-8 is a questionnaire proposed by Larsen et al., which is used to measure clients' satisfaction rate with health services (34). This questionnaire consists of eight items, each question is accompanied by four responses from very positive to very negative, and each item gets a score of 1–4. The minimum total score is 8, and the maximum total score is 32. A higher score shows higher satisfaction with the services. The internal consistency of the questionnaire has been validated with Cronbach's α of 0.91 (35). In the study of Imanzadeh et al. (36), the validity and reliability of the Persian version of CSQ-8 were approved.

Reducing loss to follow-up

For decreasing loss to follow-up of the participants, their phone numbers will be obtained at the beginning of the counseling sessions, and before each assessment, they will be reminded by phone 1 week before. If the participant does not attend, two follow-up telephone calls will be made. Calls will be at different times on different days, so the possibility of reaching the participant will increase. If, after two telephone calls, the participant is not willing to cooperate, the rater will try to fill out the GIS by phone and end the assessment.

Blinding

It is obvious that we will not be able to blind the participants of the two groups toward the number of sessions, but the raters will not be among those clinical psychologists providing the grief counseling sessions and will be blind toward the number of sessions each individual has received. Those who are involved in the analysis of the data will also be blinded toward the participants' affiliation to each group, as these data will be coded.

Quality assurance

Before the study, the service providers will be trained in a 2-day workshop to be able to offer the trial service package. Raters will also be trained to fill out the questionnaires. One team will train the whole team of raters and service providers, and one single training module will be used. Quality assurance at the national level will be the responsibility of the "National Executive Committee." One supervisor will be chosen from each university which will ensure keeping up with the study protocols and standards, including calls, counseling sessions, and ratings. One national coordinator will also be allocated for every two universities for further supervision.

Sample size calculation

The sample size has been calculated to be 60 individuals in each group, which is a total of 120 individuals. Twelve individuals will be selected from two health centers of each of the 10 universities. This calculation has been done using the G*Power software (37) for comparing the grief intensity score as the primary outcome among the two groups and based on the results of the pilot study. In this calculation, the type one error (α) is 0.05, the type two error (β) is 0.2, the effect size (d) is 0.5, and the drop-out expectation is 20% of the participants.

Planned analysis

The data, after entering and cleaning, will be analyzed using the SPSS V.18 and Stata V.11 software. Mean and standard deviation will be calculated to continuous data and frequency, and percent will be used for showing categorical variables. The analysis approach will be "intention to treat." An independent and paired *t*-test, a chi-square, and a repeated-measures ANOVA (non-parametric tests if necessary) will be used to compare the studied outcomes in the follow-ups between and within the groups. The generalized estimating equations (GEEs) will be fitted in separate models for each outcome, and $\alpha < 0.05$ will be considered as statistical significance.

Ethical considerations

Before the study, the participants will be fully informed about the study and research process, and informed consent will be obtained from every individual. Confidentiality will be reassured, and the results will not contain personal identification data. Participants will be ensured that they can drop out of the study at any point of the study and receive the routine services. Participants will not have to pay for the services. The questionnaires will be labeled with a code, and data will be entered into the database without names. The informed consent process has been approved by the Ethics Committee of IUMS with the code of IR.IUMS.REC.1399.272 and has been registered with the trial registration number of IRCT20200505047305N1.

Discussion

This study is a multi-center randomized controlled trial for comparing the efficacy of a three-session versus a five-session counseling intervention on the bereaved people of those deceased due to COVID-19 regarding the intensity of grief, psychological distress, quality of life, and satisfaction with the services. In the recent COVID-19 outbreak, many people lost their loved ones without being able to perform mourning

ceremonies due to safety protocols and were deprived of the necessary social support they could have received otherwise from their family members and friends, putting them at risk of later developing complicated and prolonged grief disorder as health crisis due to COVID-19 (21, 23, 38). This study is a multi-center randomized controlled trial with the objective of preventing psychological problems in bereaved people due to COVID-19, being conducted for the first time in Iran. In addition to a general investigation of the efficacy of grief counseling, we aimed to compare the efficacy of three- and five-session grief counseling. If similar efficacy is seen between the two interventions, the three-session counseling can be introduced to the authorities as a population-based intervention for bereaved people in the country. In this case, by spending less time and money, more bereaved people will benefit from this service.

The results of this study will facilitate policymakers, planners, clinicians, and other service providers to design proper interventions for the prevention of complicated and unexpressed grief among the bereaved people due to COVID-19, and this can have a vast effect on the mental health of the society in the COVID-19 and post-COVID-19 era.

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of Iran University of Medical Sciences (Reference number IR.IUMS.REC.1399.272). The patients/participants provided their written informed consent to participate in this study.

Author contributions

AH and NK designed the study and procured the funding. MR, MF, MN, MA, and AA monitored the study at the various study sites. AT and MN analyzed and interpreted the data and wrote up the reports. NK had the ultimate authority over all of these activities. AH, MR, NK, and AT wrote the draft of the manuscript. All authors collaborated in developing the plan for the trial, contributed to the article, and approved the final version of this manuscript.

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Conflict of interest

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

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References

1. Sadock B, Sadock V, Ruiz P. *Kaplan & Sadock's Synopsis of Psychiatry: Behavioral Sciences/Clinical Psychiatry*. Alphen aan den Rijn, NL: Wolters Kluwer (2015).

2. Bailley S, Dunham K, Kral M. Factor structure of the grief experience questionnaire (GEQ). *Death Stud.* (2000) 24:721–38. doi: 10.1080/074811800750036596

3. Waller A, Turon H, Mansfield E, Clark K, Hobden B, Sanson-Fisher R. Assisting the bereaved: a systematic review of the evidence for grief counselling. *Palliat Med.* (2016) 30:132–48. doi: 10.1177/0269216315588728

4. Hogan N, Greenfield D, Schmidt L. Development and validation of the hogan grief reaction checklist. *Death Stud.* (2001) 25:1–32. doi: 10.1080/07481180125831

5. Kowalski S, Bondmass M. Physiological and psychological symptoms of grief in widows. *Res Nurs Health.* (2008) 31:23–30. doi: 10.1002/nur.20228

6. Rubin S, Malkinson R, Witztum E. Clinical Aspects of a Dsm Complicated Grief Diagnosis: Challenges, Dilemmas, and Opportunities. In: Stroebe MS, Hansson RO, Schut H, Stroebe W editors. *Handbook of Bereavement Research and Practice: Advances in Theory and Intervention*. Washington, DC: American Psychological Association (2008). p. 187–206.

7. Shuchter S, Zisook S. *The Course of Normal Grief. Handbook of Bereavement: Theory, Research, and Intervention*. New York, NY: Cambridge University Press (1993). p. 23–43.

8. Worden J. *Grief Counseling and Grief Therapy: A Handbook for the Mental Health Practitioner*. 5th ed. New York, NY: Springer Publishing Company (2018).

9. World Health Organization [WHO]. *International Classification of Diseases for Mortality and Morbidity Statistics (11th Revision)*. (2022). Available online at: https://icd.who.int/browse11/l-m/en#/http://id.who.int/icd/entity/1183832314 (accessed November 25, 2022).

10. Nakajima S. Complicated grief: recent developments in diagnostic criteria and treatment. *Philos Trans R Soc Lond B Biol Sci.* (2018) 373:20170273. doi: 10.1098/rstb.2017.0273

11. Daneshfar M, Dadashzadeh N, Ahmadpour M, Ragati Haghi H, Rahmani V, Frouzesh M, et al. Lessons of mortality following COVID-19 epidemic in the united states especially in the geriatrics. *J Nephropharmacol.* (2021) 10:e06. doi: 10.34172/npj.2021.06

12. Lotfi B, Farshid S, Dadashzadeh N, Valizadeh R, Rahimi M. Is coronavirus disease 2019 (COVID-19) associated with renal involvement? a review of century infection. *Jundishapur J Microbiol.* (2020) 13:e102899. doi: 10.5812/jjm.102899

13. Rahimi M, Jahantabi E, Lotfi B, Forouzesh M, Valizadeh R, Farshid S. Renal and liver injury following the treatment of COVID-19 by remdesivir. *J Nephropathol.* (2021) 10:e10. doi: 10.34172/jnp.2021.10

14. Rogers J, Chesney E, Oliver D, Pollak T, McGuire P, Fusar-Poli P, et al. Psychiatric and neuropsychiatric presentations associated with severe coronavirus infections: a systematic review and meta-analysis with comparison to the COVID-19 pandemic. *Lancet Psychiatry.* (2020) 7:611–27. doi: 10.1016/s2215-0366(20)30203-0

15. Ellis L, Dammery G, Wells L, Ansell J, Smith C, Tran Y, et al. Psychological distress and digital health service use during COVID-19: a national australian cross-sectional survey. *Front Psychiatry.* (2022) 13:1028384. doi: 10.3389/fpsyt.2022.1028384

16. Liao X, Zhang S, Wang Y, Jiang J, Li Y, Zhang W. Mental burden among chinese undergraduate medical students: a prospective longitudinal study before, during, and after the COVID-19 outbreak. *Front Psychiatry.* (2022) 13:982469. doi: 10.3389/fpsyt.2022.982469

17. del Rio C, Malani P. COVID-19—new insights on a rapidly changing epidemic. *JAMA.* (2020) 323:1339–40. doi: 10.1001/jama.2020.3072

18. Simon N, Saxe G, Marmar C. Mental health disorders related to COVID-19-related deaths. *JAMA.* (2020) 324:1493–4. doi: 10.1001/jama.2020.19632

19. Breen L, Mancini V, Lee S, Pappalardo E, Neimeyer R. Risk factors for dysfunctional grief and functional impairment for all causes of death during the COVID-19 Pandemic: the mediating role of meaning. *Death Stud.* (2022) 46:43–52. doi: 10.1080/07481187.2021.1974666

20. Eisma M, Tamminga A, Smid G, Boelen P. Acute grief after deaths due to COVID-19, natural causes and unnatural causes: an empirical comparison. *J Affect Disord.* (2021) 278:54–6. doi: 10.1016/j.jad.2020.09.049

21. Eisma M, Boelen P. Commentary on: a call to action: facing the shadow pandemic of complicated forms of grief. *OMEGA J Death Dying.* (2021). [Epub ahead of print]. doi: 10.1177/00302228211016227

22. Menichetti Delor J, Borghi L, Cao di San Marco E, Fossati I, Vegni E. Phone follow up to families of COVID-19 patients who died at the hospital: families' grief reactions and clinical psychologists' roles. *Int J Psychol.* (2021) 56:498–511. doi: 10.1002/ijop.12742

23. Tang S, Xiang Z. Who suffered most after deaths due to COVID-19? prevalence and correlates of prolonged grief disorder in COVID-19 related bereaved adults. *Globalizat Health.* (2021) 17:19. doi: 10.1186/s12992-021-00669-5

24. Wallace C, Wladkowski S, Gibson A, White P. Grief during the COVID-19 pandemic: considerations for palliative care providers. *J Pain Symptom Manag.* (2020) 60:e70–6. doi: 10.1016/j.jpainsymman.2020.04.012

25. Fang C, Comery A. Understanding grief during the first-wave of COVID-19 in the united kingdom—a hypothetical approach to challenges and support. *Front Sociol.* (2021) 6:607645. doi: 10.3389/fsoc.2021.607645

26. Borghi L, Menichetti J. Strategies to cope with the COVID-related deaths among family members. *Front Psychiatry.* (2021) 12:622850. doi: 10.3389/fpsyt.2021.622850

27. Currier J, Holland J, Neimeyer R. The effectiveness of bereavement interventions with children: a meta-analytic review of controlled outcome research. *J Clin Child Adolesc Psychol.* (2007) 36:253–9. doi: 10.1080/15374410701279669

28. Johannsen M, Damholdt M, Zachariae R, Lundorff M, Farver-Vestergaard I, O'Connor M. Psychological interventions for grief in adults: a systematic review and meta-analysis of randomized controlled trials. *J Affect Disord.* (2019) 253:69–86. doi: 10.1016/j.jad.2019.04.065

29. Newsom C, Schut H, Stroebe M, Wilson S, Birrell J, Moerbeek M, et al. Effectiveness of bereavement counselling through a community-based organization: a naturalistic, controlled trial. *Clin Psychol Psychother.* (2017) 24:O1512–23. doi: 10.1002/cpp.2113

30. Prigerson H, Boelen P, Xu J, Smith K, Maciejewski P. Validation of the new DSM-5-Tr criteria for prolonged grief disorder and the pg-13-revised (pg-13-r) scale. *World Psychiatry.* (2021) 20:96–106. doi: 10.1002/wps.20823

31. Gang J, Falzarano F, She W, Winoker H, Prigerson H. Are deaths from COVID-19 associated with higher rates of prolonged grief disorder (PGD) than deaths from other causes? *Death Stud.* (2022) 46:1287–96. doi: 10.1080/07481187.2022.2039326

32. Noorbala A, Bagheri yazdi S, Mohammad K. The validation of general health questionnaire- 28 as a psychiatric screening tool. *Hakim Health Syst Res J.* (2009) 11:47–53.

33. Montazeri A, Vahdaninia M, Mousavi S, Omidvari S. The iranian version of 12-item short form health survey (sf-12): factor structure, internal consistency and construct validity. *BMC Public Health.* (2009) 9:341. doi: 10.1186/1471-2458-9-341

34. Larsen D, Attkisson C, Hargreaves W, Nguyen T. Assessment of client/patient satisfaction: development of a general scale. *Eval Prog Plann.* (1979) 2:197–207. doi: 10.1016/0149-7189(79)90094-6

35. Attkisson C, Zwick R. The client satisfaction questionnaire. psychometric properties and correlations with service utilization and psychotherapy outcome. *Eval Prog Plann.* (1982) 5:233–7. doi: 10.1016/0149-7189(82)90074-x

36. Imanzadeh S, Alivandi Vafa M, Hashemi T, Azemoudeh M. Examining the role of the therapeutic alliance in treatment efficacy by mediating client engagement. *J Appl Psychol Res.* (2021) 12:171–90. doi: 10.22059/japr.2021.313926.643694

37. Faul F, Erdfelder E, Lang A, Buchner A. G*power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* (2007) 39:175–91. doi: 10.3758/bf03193146

38. Breen L. Harnessing social support for bereavement now and beyond the COVID-19 pandemic. *Palliat Care Soc Pract.* (2021) 15:2632352420988009. doi: 10.1177/2632352420988009

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The evolution of research on depression during COVID-19: A visual analysis using Co-Occurrence and VOSviewer

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Background: The COVID-19 pandemic has led to public health problems, including depression. There has been a significant increase in research on depression during the COVID-19 pandemic. However, little attention has been paid to the overall trend in this field based on bibliometric analyses.

Methods: Co-Occurrence (COOC) and VOSviewer bibliometric methods were utilized to analyze depression in COVID-19 literature in the core collection of the Web of Science (WOS). The overall characteristics of depression during COVID-19 were summarized by analyzing the number of published studies, keywords, institutions, and countries.

Results: A total of 9,694 English original research articles and reviews on depression during COVID-19 were included in this study. The United States, China, and the United Kingdom were the countries with the largest number of publications and had close cooperation with each other. Research institutions in each country were dominated by universities, with the University of Toronto being the most productive institution in the world. The most frequently published author was Ligang Zhang. Visualization analysis showed that influencing factors, adverse effects, and coping strategies were hotspots for research.

Conclusion: The results shed light on the burgeoning research on depression during COVID-19, particularly the relationship between depression and public health. In addition, future research on depression during COVID-19 should focus more on special groups and those at potential risk of depression in the general population, use more quantitative and qualitative studies combined with more attention to scale updates, and conduct longitudinal follow-ups of the outcomes of interventions. In conclusion, this study contributes to a more comprehensive view of the development of depression during COVID-19 and suggests a theoretical basis for future research on public health.

KEYWORDS

COOC analysis, VOSviewer, depression during COVID-19, bibliometric analysis, visualization analysis

Introduction

The COVID-19 pandemic had a tremendous impact on humans, crippling daily life activities and posing a serious threat to human health, particularly regarding public mental health. The outbreak of the COVID-19 pandemic caused widespread mass panic. Meanwhile, the lockdown brought about by the COVID-19 outbreak has further triggered psychological stress among the public, including symptoms of depression, anxiety, and posttraumatic stress. For example, Wu et al. found that depression and anxiety rates were significantly higher among college students during the pandemic than before, due to factors such as being isolated at home, online learning stress, and conflict between parents and children (1). Socioeconomic instability, increased burden of living, social isolation, and unemployment were suicidal behavior triggers during the pandemic (2–4). Furthermore, fear of infection, unpredictability, and uncertainty of the COVID-19 pandemic were major stressors that triggered various mental health problems (5, 6). Thus, studying the public's mental state under the impact of a pandemic has become necessary.

The study of depression was an important area of research, even before the pandemic, focusing on depression measurement tools, influencing factors, and treatments. First, in its assessment, many researchers have developed appropriate scales, such as the Beck Depression Inventory and Montgomery Depression Test Scale. Second, regarding factors influencing the development of depression, psychosocial stress (7), patient status (8, 9), physical health status (10, 11), obesity (12), cross-cultural factors (13), and others play a role. Third, many scholars are still exploring treatments for depression, which can be divided into psychotherapy, pharmacotherapy, and other treatments (14, 15).

The relationship between depression and COVID-19 has received considerable attention in the face of sudden outbreaks. There are many theoretical and practical studies on depression during COVID-19, focusing on four aspects: the causes of depression during COVID-19, influencing factors, effects on people, and methods of alleviation. First, regarding its causes, several studies have concluded that the public's social activities were restricted due to pandemic prevention and control measures and that the masses were faced with a lack of exercise and unstable economic resources, in addition to the fear of infection (16, 17). For example, an online survey of 1,258 Italian residents revealed that social isolation during the pandemic had a significant psychosocial impact on people, especially those in vulnerable groups within the population (18). Second, various factors influenced depression during the COVID-19 pandemic. These factors can be divided into several categories: sex, age, occupation, and environmental factors, such as daily exercise. In a study involving 2,992 adults in China, depression rates were higher among men than women and higher among young adults than older adults (19). In addition to sex and age, several other factors contribute to depression. Some researchers have linked the emergence of psychological problems, such as depression, to professions (20–22). Third, depression during COVID-19 also affects public behaviors, such as insomnia (23, 24), alcohol abuse (25, 26) and irregular eating behaviors (27). Fourth, many scholars are currently seeking better ways to cope with the current trend of a high prevalence of psychological disorders, allowing for alleviation. Healthcare workers, for example, face heavy work pressure during the pandemic and usually have higher psychological stress and a higher prevalence of depression than the general population. In response, the mental burden on healthcare workers can be reduced by providing high-quality and transparent communication and accurate information updates to all staff, complete and high-quality personal protective equipment, and supplies to prevent infection (28).

This study applies an innovative approach to conducting literature reviews through systematic reviews with the support of COOC (29) and VOSviewer software, commonly used for bibliometric analysis. COOC is the most powerful bibliometrics and knowledge mapping software available, which eliminates duplication, clears multiple databases, and constructs multidimensional relationship matrices simply and efficiently (29–31). Similarly, VOSviewer is a scientific tool for creating web-based maps, visualizing and navigating them, and presenting large amounts of data in the form of knowledge maps (32). As a powerful tool for quantitatively assessing various parameters related to scientific literature published in a specific field, bibliometric analysis provides insights into popular research topics, trends, key researchers, and scientific institutions (33, 34). Several studies using bibliometric methods have been conducted in areas related to the COVID-19 pandemic. For example, Fan et al. (35) compared English and Chinese COVID-19 literature using bibliometric methods to summarize their differences and characteristics. Another study used a bibliometric approach to analyze literature related to the pediatric field during COVID-19 (36). During the last 3 years of the COVID-19 pandemic, while research in the depression-related field has evolved, the use of bibliometric methods to study this field remains incomplete (37–39).

This study provides a broad understanding of depression during COVID-19 and highlights key research topics to provide ideas for future research. It focuses on a systematic review of depression during COVID-19 using the bibliometric software COOC and VOSviewer, while considering and addressing the following questions: What are the research trends and evolutionary paths of depression during COVID-19? Which countries, authors, and institutions contributed the most to this research area? What are the research hotspots? What are the implications and limitations of this research? Considering the above, this study not only provides a deeper analysis of the literature in the field of depression during

TABLE 1 Summary of data source and selection.

Search settings	Contents
Databases	Science citation index expanded, social sciences citation index
Search term	TS = "depression" and "COVID-19"
	TS = "depression" and "SARS-CoV-2"
	TS = "depression" and "Novel Coronavirus 2019"
	TS = "depression" and "coronavirus-2"
	TS= "depression" and "Coronavirus disease 2019"
	TS = "depression" and "2019-nCOV"
Language	English
Literature type	Articles, early access, review articles
Date of search	August 31, 2022
Number of records	9,464

COVID-19 but also broadens the ideas for future research and provides a basis and reference for innovation in this field of research.

Data sources and research methods

Data sources

In this study, WOS was used as the literature information acquisition platform, and SSCI and SCIE in the core collection of WOS were used as data sources. A general search was selected, and the search conditions are shown in Table 1, with Articles, Early Access, and Review Articles selected as the literature types, and the search time range started in 2020 and ended on August 31, 2022, yielding 12,331 records. In addition, to ensure the integrity of literature retrieval, we extracted the corresponding terms from Medical Subject Headings (http://www.ncbi.nlm.nih.gov/mesh/). After merging the retrieved data with synonyms and removing duplicate and missing keyword documents, 9,464 valid records were obtained.

Research methods

Through the quantitative data analysis, bibliometrics summarizes and presents the developmental history and research hotspots of a given field. Correspondingly, based on bibliometrics, the analysis of scientific knowledge maps transforms complex knowledge from data mining and information processing into a visual knowledge map that assists scholars in scientifically obtaining the laws of dynamic development in relevant fields. Available software includes COOC, VOSviewer, CiteSpace, Bibexcel, and Bicomb. In this study, COOC and VOSviewer were mainly used, which were jointly developed by Academic Drip and the bibliometric team and are the most complete and relatively simple to operate in the bibliometric field. In addition, COOC can quickly construct relationship matrices and instantly derive matrix results such as word-part and dissimilarity matrices. More importantly, it can also pre-process data, such as batch merging synonyms and removing unnecessary words.

COOC does not currently allow for citation analysis; therefore, this study combined it with VOSviewer, developed in collaboration with Nees Jan van Eck and Ludo Waltman at Leiden University in the Netherlands, as a bibliometric analysis, and visualization tool based on a Java environment to further analyze the field of research on depression during COVID-19 (40). This is a powerful tool for "co-occurrence" network clustering and density analysis. In addition, while VOSviewer lacks data pre-processing and fast matrix generation functions compared to the COOC software, its powerful graphical presentation capabilities allow for better visualization of bibliographic relationships and provide an excellent operating environment for this study (40, 41).

This study was based on the retrieved literature and utilized tools including COOC and VOSviewer for statistical analysis, information processing, and visual knowledge mapping to comprehensively grasp the research hotspots and dynamic change patterns of "depression during COVID-19." COOC was used to create a cumulative time-zone map, while VOSviewer was used to create a co-occurrence map, as shown in Figure 1.

Results

Background information

The statistics of the temporal distribution of the literature partially reflect the level of research and development in the field, as shown in Figure 2. Overall, the relevant research literature in this field started late; however, the number of publications is increasing. The COVID-19 pandemic started to spread at the end of 2019, and the number of related publications was 1,214 at the end of 2020. The cumulative number of publications reached 5,525 by 2021, with a rapid upward trend in annual publications. As of August 31, 2022, 9,464 articles had been published.

Importing the processed literature data in the COOC software yielded the top 10 countries with the highest number of publications from 2020 to 2022, as shown in Figure 3. Since 2020, there has been a gradual increase in research on depression during the COVID-19 pandemic. Articles published in 2020 were mainly from countries such as the United States, China, and Italy. As the COVID-19 epidemic continued to spread and worsen, the year 2021 witnessed a steady spurt of relevant literature, with 4,311 publications. Articles published in 2021 were mainly from the United States, China, the United Kingdom, Italy, Canada, and Spain. As of August 31,

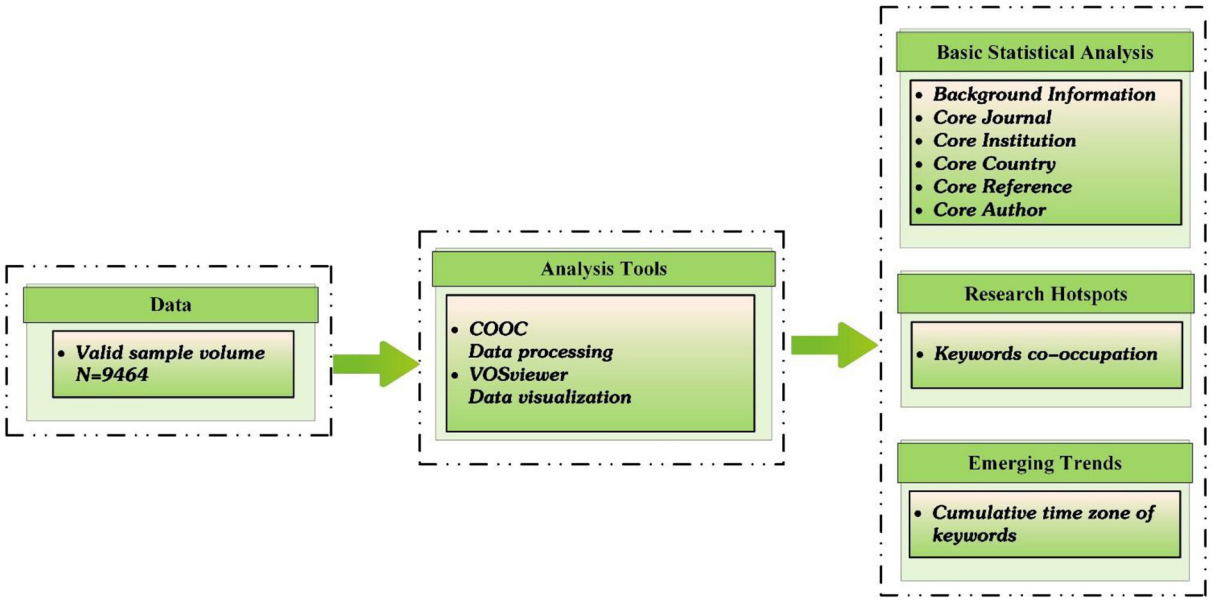

FIGURE 1
Flow chart of the research process.

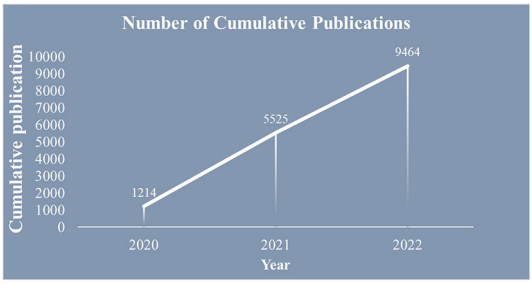

FIGURE 2
Number of cumulative publications on depression during COVID-19.

there were 3,939 articles published for 2022, mainly from the United States, China, and the United Kingdom.

Core journal analysis

According to statistics, 1,727 journals are involved in depression during COVID-19 research publications at WOS, and the top 10 journals in terms of the number of articles published are shown in Table 2, accounting for 29.17% of the total literature volume. Journals with citations ≥2,924 are considered among the top 10 journals in terms of citations, while in Table 2, the International Journal of Environmental Research and Public Health, Frontiers in Psychiatry, Frontiers in Psychology, PLOS One, Journal of Affective Disorders, and Psychiatry Research are among the top 10 cited journals. These six journals can shed light specifically on research hotspots and evolutionary trends in the field of research on depression during COVID-19, which can provide direction and ideas for future research.

Statistics show that journals in the field of depression research during the COVID-19 pandemic focus on psychology, clinical practice, psychiatry, and others.

Core institution analysis

To further understand the cooperation relationship between institutions, the data were imported into VOSviewer by setting the frequency to be ≥40, and the remaining parameters to default, resulting in 83 institutional cooperation networks, as shown in Figure 4. As can be seen from the inter-institutional cooperation network diagram, cooperation between institutions is relatively close. Kings College London, University of Toronto, and Harvard Med School are at the center of the network.

Table 3 shows the top 10 institutions by number of publications, and the top 10 institutions had ≥3,880 citations. Statistics show that Kings College London, University of Toronto, Wuhan University, and University College London (UCL) are among the top 10 institutions regarding the number of published articles and citations. This shows that these four institutions are in a highly significant position in the field of depression during COVID-19 research and can lead

FIGURE 3
Top 10 countries with the highest number of publications from 2020 to 2022.

TABLE 2 Top 10 journals ranked by number of publications.

Rank	Journal	Publication	Citation	Subjects covered
1	International Journal of Environmental Research and Public Health	769	15,170	Environmental Sciences; Public, Environmental & Occupational Health
2	Frontiers in Psychiatry	492	5,943	Psychiatry
3	Frontiers in Psychology	420	6,137	Psychology, Multidisciplinary
4	PLOS One	222	6,749	Multidisciplinary Science
5	Journal of Affective Disorders	206	7,515	Clinical Neurology; Psychiatry
6	Frontiers in Public Health	179	1,200	Public, Environmental & Occupational Health
7	BMJ Open	140	1,198	Medicine, General & Internal
8	Psychiatry Research	116	7,790	Psychiatry
9	Current Psychology	110	552	Psychology, Multidisciplinary
10	Healthcare	106	580	Health Care Sciences & Services; Health Policy & Services

future trends and hotspots in the field. From the institutional cooperation chart and the top 10 institutions ranking table, clearly the main force in research on depression during COVID-19 is major universities. Most of these universities are from the United States, China, and the United Kingdom, where universities are more active in the research field and the connections between universities from different countries are stronger.

Core country analysis

The number of publications in a country reflects the level of research and impact of the country in the relevant field. Table 4 lists the top 10 countries in terms of the number of publications on depression during COVID-19. As can be seen from Table 4, the United States had the highest number of publications (2,557 times), followed by China (1,535

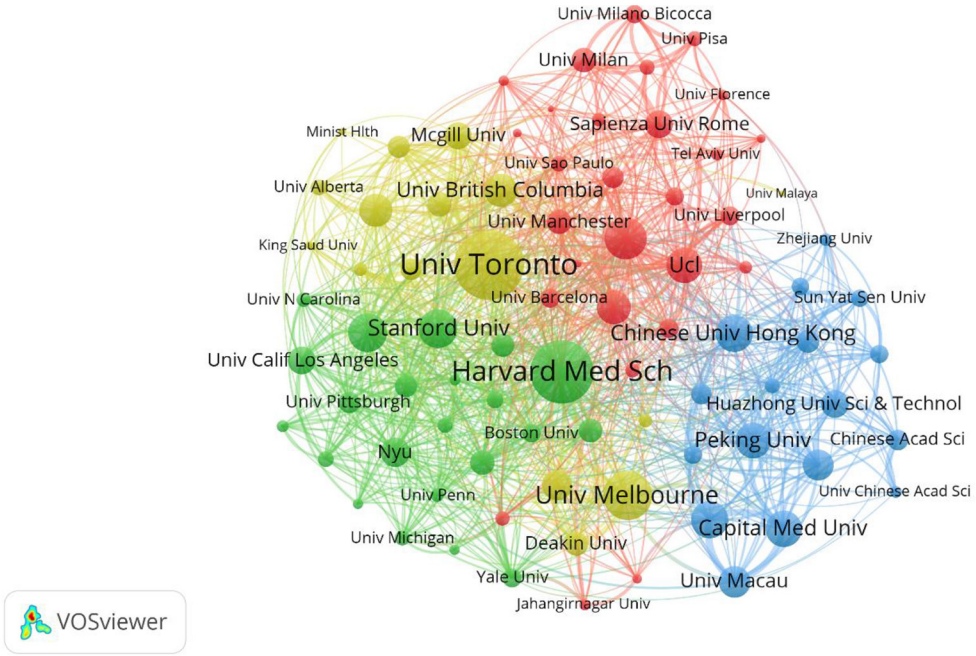

FIGURE 4
Map of institution network. The nodes represent institutions. The lines represent cooperation relationships.

TABLE 3 Top 10 institutions ranked by number of publications.

Rank	Institution	Publication	Citation
1	Univ Toronto	177	7,504
2	Harvard Med Sch	162	2,771
3	Kings Coll London	149	8,727
4	UCL	139	5,050
5	Columbia Univ	121	2,494
6	Huazhong Univ Sci & Technol	118	2,973
7	Univ Melbourne	118	1,337
8	Sapienza Univ Rome	100	3,153
9	Wuhan Univ	95	6,502
10	Univ Oxford	93	2,624

TABLE 4 Top 10 countries ranked by number of publications.

Rank	Country	Publication	Citation
1	United States	2,557	43,143
2	China	1,535	36,123
3	United Kingdom	1,289	17,990
4	Italy	806	13,006
5	Canada	636	10,383
6	Spain	588	10,602
7	Australia	523	8,849
8	Germany	480	8,103
9	Turkey	412	5,892
10	Brazil	325	6,384

times), the United Kingdom (1,289 times), Italy (806 times), Canada (636 times), Spain (588 times), Australia (523 times), Germany (480 times), Turkey (412 times), and Brazil (325 times). The United States, China, and the United Kingdom have accounted for more than 50% of the publications in this field and have made major contributions to research in this area.

The retrieved literature from 144 countries was imported into VOSviewer with the frequency set to 40, and the remaining parameters defaulted to obtain the cooperation network graph from 52 countries, as shown in Figure 5. The major research forces in this field are concentrated in the United States, China, the United Kingdom, Canada, Australia, Italy, and Spain. There are cooperative relationships among various countries, particularly the United States, with China and the United Kingdom having strong ties. Analyzing cooperative exchange relations between countries is conducive to further in-depth research on depression during the COVID-19 pandemic, which is an inevitable trend in research and development in this field.

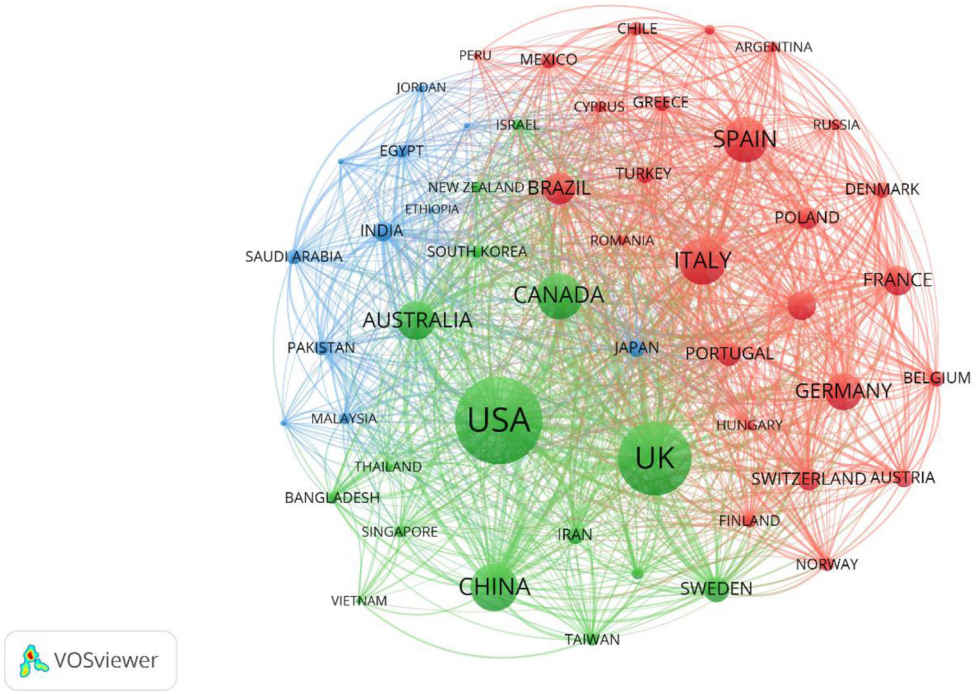

FIGURE 5
Map of countries network. The nodes represent countries. The lines represent cooperation relationships.

Core reference analysis

Citation analysis can reflect the structure of research and important literature in the field. To further understand the citation structure of the depression research field during COVID-19, this study analyzed the cited literature with critical reading and obtained three clusters. The required data were imported into VOSviewer, and the frequency was set to 300 to obtain the top 30 cited studies, as shown in Table 5. The most frequently cited references were Spitzer R. L. (published in 2006; cited 1391 times), Brooks S. K. (published in 2020; cited 1351 times), Kroenke K. (published in 2001; cited 1156 times), Wang C. Y. (published in 2020; cited 1053 times), Lai J.B. (published in 2020; cited 1040 times), and Holmes E.A. (published in 2020; cited 834 times).

In Figure 6, the 30 references were grouped into three categories, with each color representing a category. The references with high strength values in Table 5 represent important milestones in the field of depression research during COVID-19. The first milestone was to summarize the broad psychological impact of isolation measures and to consider how to reduce this impact (42). The second milestone was to study the mental health status of healthcare workers and its associated factors during COVID-19 (43). The third milestone was to develop a validated tool to screen for generalized anxiety disorder and assess its severity (44).

Core author analysis

The number of publications by an author reflects the author's degree of influence in the relevant field. Table 6 lists the top 10 authors who published articles on depression during the COVID-19 pandemic. The statistical analysis of the authors who published articles in the field of research on depression during COVID-19 was performed using VOSviewer, with the frequency set to 10 and other parameters defaulted, to generate an author collaboration network graph, as shown in Figure 7. The nodes in the graph represent the authors, the number of articles published by the author determines the size of the nodes and fonts, and the connecting lines between the nodes represent the existence of cooperative relationships between the nodes. Overall, author collaborations in this field show a cluster-like distribution. The largest number of authors was the author collaboration network formed by Jing Li, Ying Wang, and 55 other individuals.

TABLE 5 Top 30 references with the strongest citation bursts.

Clusters	References	Strength	Citations
Mental health status, influencing factors, and coping strategies of the public during COVID-19	Ahorsu D.K., 2022, int j ment health ad, v20, p1537, doi	1,137	410
	Brooks S.K., 2020, lancet, v395, p912, doi	3,493	1,531
	Ettman C.K., 2020, jama netw open, v3, doi	875	365
	Holmes E.A., 2020, lancet psychiat, v7, p547, doi	2,453	834
	Lovibond P.F., 1995, behav res ther, v33, p335, doi	1,027	481
	Pfefferbaum B., 2020, new engl j med, v383, p510, doi	1,637	571
	Rajkumar R.P., 2020, asian j psychiatr, v52, doi	1,697	508
	Salari N., 2020, globalization health, v16, doi	1,351	449
	Torales J., 2020, int j soc psychiatr, v66, p317, doi	1,050	342
	Vindegaard N., 2020, brain behav immun, v89, p531, doi	1,502	491
	Wang C.Y., 2020, int j env res pub he, v17, doi 10.3390/ijerph17051729	3,135	1,053
	Xiong J.Q., 2020, j affect disorders, v277, p55, doi	1,931	650
	Cao W.J., 2020, psychiat res, v287, doi	2,153	663
	Hawryluck L., 2004, emerg infect dis, v10, p1206, doi	1,276	409
	Huang Y.E., 2020, psychiat res, v288, doi	2,295	658
	Mazza C., 2020, int j env res pub he, v17, doi	1,575	399
	Qiu J.Y., 2020, gen psychiat, v33, doi	2,414	687
	Wang C.Y., 2020, brain behav immun, v87, p40, doi	2,109	589
	Wang C.Y., 2020, int j env res pub he, v17, doi 10.3390/ijerph17072459	979	311
Mental health status, influencing factors and coping strategies of healthcare workers during COVID-19	Chew N.W.S., 2020, brain behav immun, v88, p559, doi	1,140	306
	Lai J.B., 2020, jama netw open, v3, doi	3,005	1,040
	Luo M., 2020, psychiat res, v291, doi	1,123	305
	Pappa S., 2020, brain behav immun, v88, p901, doi	1,927	591
	Wu P., 2009, can j psychiat, v54, p302, doi	1,011	301
	Xiang Y.T., 2020, lancet psychiat, v7, p228, doi	1,602	498
	Zhang W.R., 2020, psychother psychosom, v89, p242, doi	1,173	312
	Zigmond A.S., 1983, acta psychiat scand, v67, p361, doi	818	442
Measures of mental health status	Cohen S., 1983, j health soc behav, v24, p385, doi	942	422
	Kroenke K., 2001, j gen intern med, v16, p606, doi	2,864	1,156
	Spitzer R.L., 2006, arch intern med, v166, p1092, doi	3,508	1,391

Research hotspots

Keywords are the essence and distillation of the article's content, which can effectively reflect the research content, purpose, method, object, and results of the article and link them together to reveal the general lineage of the article. If a keyword appears frequently and repeatedly in a research field during a certain period, the research topic characterized by that keyword is considered the research hotspot of that research field. Table 7 lists the top 30 keywords related to the depression research field during the COVID-19 period, and the co-occurrence graph of keywords was obtained by importing the data into VOSviewer, as shown in Figure 8, the larger the corresponding font and node, the greater the weight of its keywords. The keywords "mental health," "anxiety," "lockdown," and "adolescents" are important hotspots in depression-related fields during COVID-19. Through the analysis, the following three main categories of research hotspots on depression during COVID-19 were obtained.

Factors influencing depression during COVID-19

High-frequency keywords included in the study's hotspots were lockdown (338 times), healthcare workers (297 times), physical Activity (187 times), burnout (182 times), older adults (132 times), gender (119 times), and unemployment (25 times). During the COVID-19 pandemic, the prevalence of mental illness was significantly higher than before the pandemic. Studies on the prevalence of depression during the pandemic have focused on factors that influence mental illness. Various

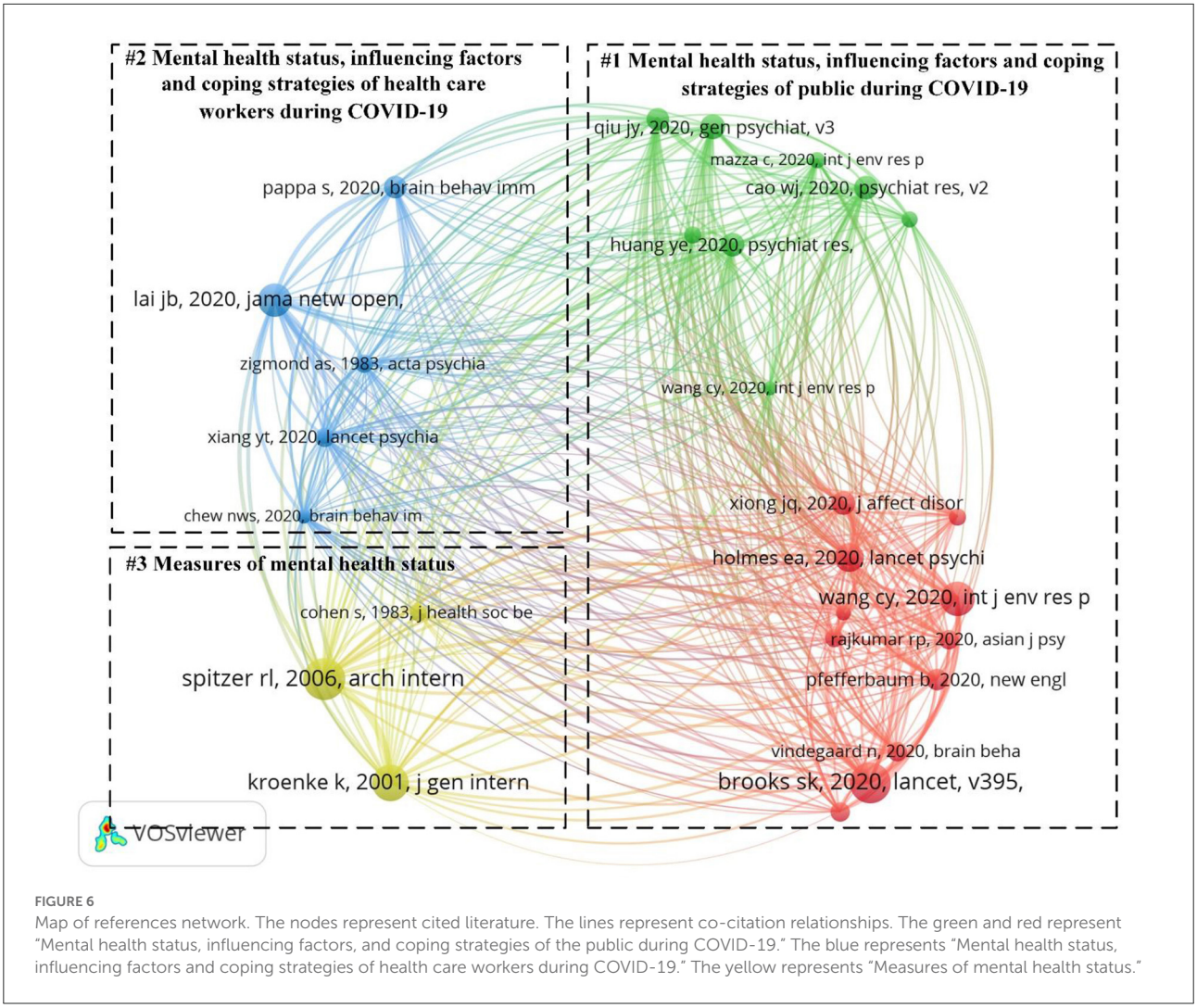

FIGURE 6
Map of references network. The nodes represent cited literature. The lines represent co-citation relationships. The green and red represent "Mental health status, influencing factors, and coping strategies of the public during COVID-19." The blue represents "Mental health status, influencing factors and coping strategies of health care workers during COVID-19." The yellow represents "Measures of mental health status."

TABLE 6 Top 10 most productive authors ranked by number of publications.

Rank	Author	Publication
1	Ligang Zhang	47
2	Ying Wang	46
3	Yaya Liu	40
4	Yutao Xiang	38
5	Teris Cheung	36
6	Mark D. Griffiths	35
7	Yan Zhang	32
8	Jing Li	31
9	Xiangyang Zhang	27
10	Jianwei Wang	27

analytical methods have been used to investigate this issue, and the following factors have been identified:

1. Quarantine policies enacted by governments during the COVID-19 pandemic reduced exercise time and social activities for the population in each country, and the lack of both activities was a significant factor in the elevated prevalence of mental illness in the population (45).
2. During the COVID-19 pandemic, most productive social activities were halted, and the country's population was left with unemployment and job insecurity (46, 47).
3. The sex, age, occupation, and social media use of residents influenced the development of mental illness (47–49).

Problems caused by depression during COVID-19

High-frequency keywords included in this research hotspot were PTSD (310 times), quality of life (240 times), insomnia (177 times), sleep (160 times), suicide (98 times), and alcohol (47 times). During the pandemic, mental illness has also

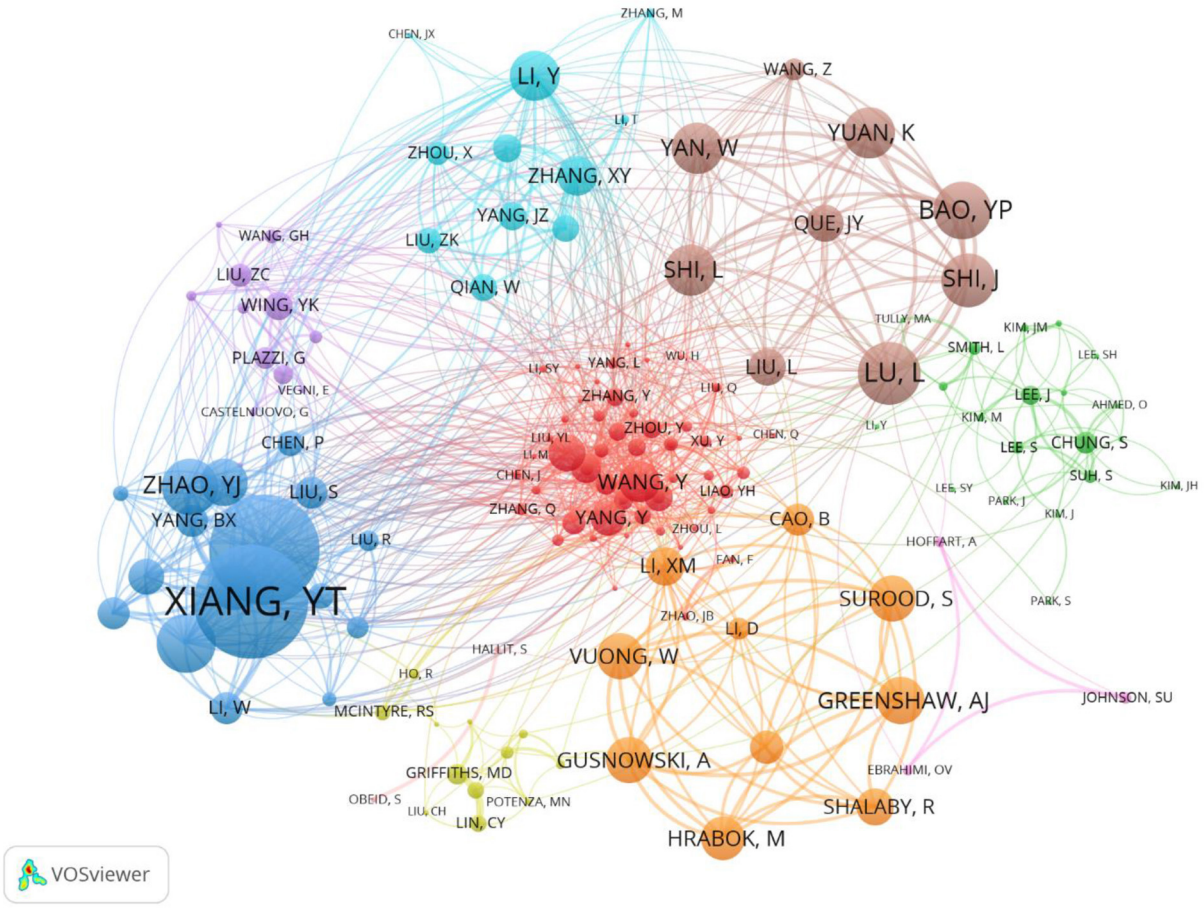

FIGURE 7
Map of co-authors network. The nodes represent authors. Node size indicates the number of articles produced. The lines represent cooperation relationships.

caused problems such as insomnia, alcoholism, suicide, and smartphone addiction (50–52). These seriously affect the quality of life of people, especially adolescents (53); teenagers, college students, older adults (54); health care workers (55–57); and pregnant women (58, 59).

How to deal with depression during COVID-19

The high-frequency keywords included in this research hotspot were resilience (356 times), well-being (282 times), and social support (205 times). The increase in the prevalence of mental health problems, particularly depression, during the COVID-19 pandemic, cannot be ignored; therefore, how should this phenomenon be faced and what measures should be taken to prevent or alleviate it? Some scholars suggest that the phenomenon of "social isolation" caused by home isolation can be alleviated through digital media (60). Additionally, frontline healthcare workers should improve their subjective wellbeing and pay attention to their mental health status (61). For those who are already depressed, interventions to promote resilience should be provided whenever possible (62–64). In addition, authorities should provide adequate supplies to the population during the quarantine period and promote the benefits of public isolation to society.

Emerging trends

The cumulative time zones of the keywords were mapped using COOC, and Figure 9 shows the top 15 high-frequency keywords for 2020–2022. The graph provides an overall picture of changes in the study path (65–68). The size of the circles next to the keywords represents the number of keyword occurrences. The 2020 study concluded that the outbreak and prolonged isolation caused by the COVID-19 pandemic would affect public mental health, particularly the wellbeing of adolescents and healthcare workers, and emphasized that negative emotions should be alleviated through social support and improving

TABLE 7 Top 30 highest frequency keywords related to depression during COVID-19.

Keywords	Frequency	Keywords	Frequency
COVID-19	8,651	Physical activity	187
Depression	3,708	Depressive symptoms	187
Anxiety	2,864	Burnout	182
Mental Health	2,204	Insomnia	177
Stress	933	Quarantine	175
Loneliness	499	Public health	171
Resilience	356	Pregnancy	168
Students	345	Sleep	160
Lockdown	338	Nurse	160
PTSD	310	Older adults	132
Healthcare workers	297	Risk factors	129
Wellbeing	282	Gender	119
Adolescents	274	Children	113
Quality of life	240	Psychological impact	102
Social support	205	Suicide	98

psychological resilience. The 2021 study concluded that the duration of the COVID-19 pandemic was long. The 2022 study focused on the harm caused by depression during COVID-19, such as economic collapse, loss of fixed housing, brain fog, neuropsychiatric disorders, and collective trauma, as well as on coping strategies, including social interaction, social engagement, and good mood regulation strategies.

Discussion

Discussion of the results

In this study, WOS was selected as a search platform for bibliometric analysis of publications, countries, institutions, and keyword counts in the field of depression during COVID-19 and for the presentation of scientific knowledge maps. Statistics show that the literature in this field peaked in 2021. In total, 144 countries, 48,103 authors, and 10,853 research institutions worldwide participated in this study. Of these, the United States, China, and the United Kingdom had the highest total number of publications and strong collaborative relationships, and the main research institutions in each country are universities. In addition, this study specifically focused on exploring the evolution of knowledge structures and research themes. Regarding the development of this study and its hotspot tracking, the important findings are as follows:

First, a general upward trend in research on depression during COVID-19 is evident in terms of research progress. Although this area has been studied for <3 years, it has received widespread attention worldwide due to its specificity. The number of publications in the field of depression during COVID-19 peaked in 2021, and related research in this field entered a period of rapid development. This may be because several studies have found significant changes in the frequency of public psychological problems arising at two time points, before the pandemic and during the embargo. In particular, the prevalence of depression was greatly increased during the embargo (1, 69–74). Moreover, according to the World Health Organization, the pandemic has led to a significant increase in the global prevalence of depression and anxiety disorders by 28 and 26%, respectively (75). COVID-19 has significantly impacted global healthcare, and new research hotspots are gradually shifting from COVID-19 and related clinical studies to studies on its psychological and social impact on humanity (36). Therefore, the shift in research hotspots and the societal impact of COVID-19 have been influenced by COVID-19's significant impact on global healthcare. As a result, an increasing number of scholars have started to conduct research on depression during the COVID-19 pandemic, influenced by the shift in research hotspots and social concerns.

Second, the hotspots of depression research during COVID-19 were significantly concentrated in regions such as the Americas, Western Europe, and South Asia. This may be related to the severity of the COVID-19 pandemic in each region. For example, India, which is in South Asia and had the second-highest total number of people diagnosed with COVID-19 worldwide, had a high prevalence of psychological problems among the population during the COVID-19 pandemic (76). In addition, a study on adults from several countries showed that participants living in Brazil had the most severe symptoms of anxiety and depression (77). This may be related to the severe COVID-19 pandemic experienced in Brazil. Furthermore, several Western European countries have paid considerable attention to the impact of the COVID-19 pandemic on public mental health and have conducted corresponding studies. For example, Bäuerle et al. found that the public mental health burden in Germany significantly increased during the COVID-19 pandemic (78). Notably, panic after infection, social isolation during treatment, and implicit discrimination after recovery were important causes of depression during COVID-19 in confirmed individuals (79, 80).

Finally, the hotspots of depression research during the pandemic could be summarized into three areas: factors influencing depression during COVID-19, consequences of depression during COVID-19, and coping strategies for depression during COVID-19.

Factors influencing depression during COVID-19

To better explain the relationship between depression and COVID-19, the factors influencing the formation of depression during COVID-19 were examined. Regarding social factors, the pressure from rising house prices (81), negative news

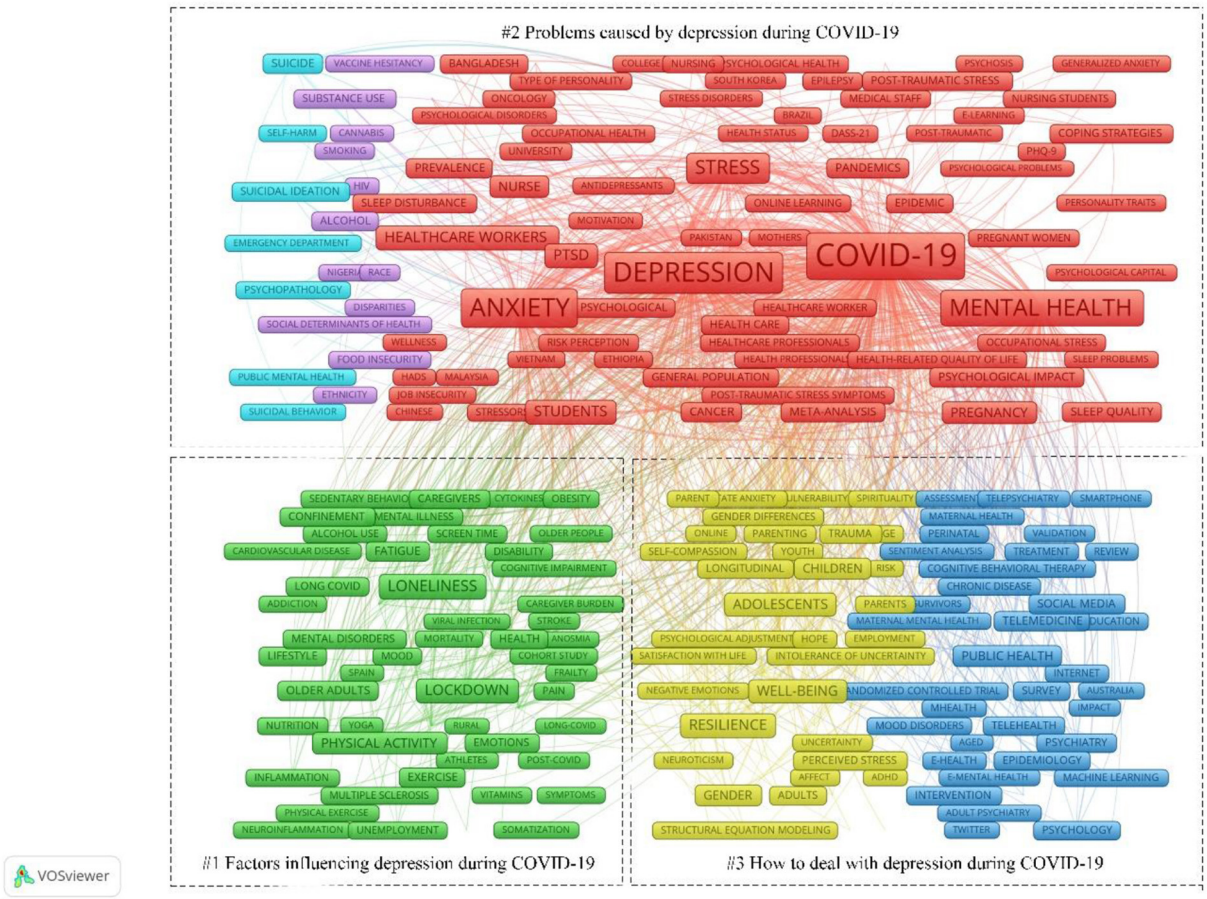

FIGURE 8
Map of keywords. The nodes represent keywords. The lines represent co-occurrence relationships. Green represents "Factors influencing depression during COVID-19." Light blue, purple, and red represent "Problems caused by depression during COVID-19." Dark blue and yellow represent "How to deal with depression during COVID-19."

spread on social media (82), the anxiety caused by social isolation (83, 84), and others are contributing factors to the poor mental health of residents during the pandemic. First, the ecosystem theory proposed by Bronfenbrenner mainly studies the interrelationship between human behavior and the social environment, which treats the social environment in which humans grow up as a kind of social ecosystem, emphasizes the importance of the ecosystem for analyzing and understanding human behavior, and focuses on the interaction between humans and environmental systems and their influence on individual development. Social factors that lead to depression during COVID-19, such as rising housing prices, negative news, and social isolation, change the social environment on which human growth depends. Changes in the social environment inevitably affect individual development and, consequently, have an impact on public mental health.

Regarding characteristic factors, gender, age, and occupation of the residents are conditions for the occurrence of depression during COVID-19 (85). For example, several meta-analytic studies on the prevalence of depression during COVID-19 among frontline healthcare workers have shown that they exhibit higher levels of depression than the general population (86, 87). During the pandemic, healthcare workers not only face a heavy workload but also the risk of contracting COVID-19, and their negative emotions need to be attended to. Additionally, a meta-analytic study by Li et al. found that the prevalence of depression and anxiety disorders among college students has greatly increased (88). According to Erikson's theory of psychological development, college students are still in the sameness-to-role confusion stage, and their psychological development is still in a transitional stage, immature, and vulnerable to disturbance by negative external events. Moreover, during the pandemic, college students are forced to be isolated at home, which interrupts their social activities. They have to also manage their online studies, and all of these contribute to their depressive symptoms.

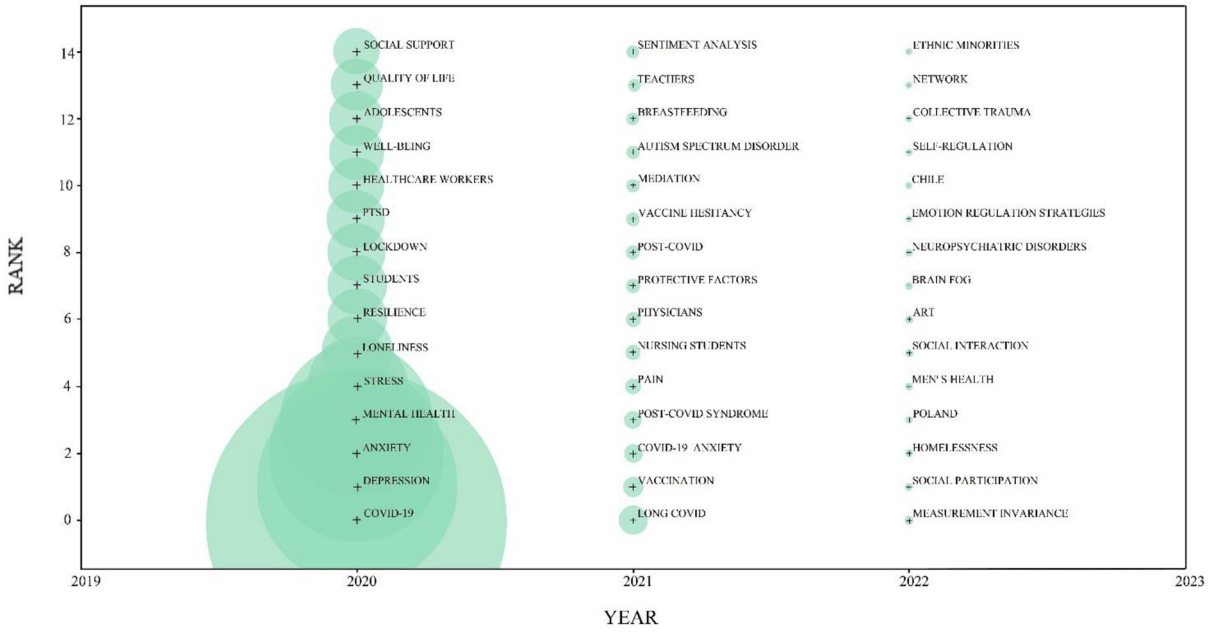

FIGURE 9
Emerging trends of research on depression during COVID-19. The nodes represent keywords. The node size indicates the number of keyword occurrences. The year corresponding to the node is the year in which the keyword first appeared.

Problems caused by depression during COVID-19

Brailovskaia et al. found a significant increase in suicidal ideation and suicide rates among the public during the COVID-19 pandemic (89). The American clinical psychologist Beck (90) proposed a cognitive model of depression that argues that the underlying cognitive schema and cognitive theoretical assumptions of depressed individuals are at the root of patients' negative attitudes. Some individuals with depression may be less depressed; however, sudden negative events in their lives give them a heavy blow, leading to further despair and helplessness. Despair and helplessness are important factors influencing suicide. Therefore, the COVID-19 pandemic, as a sudden negative life event, may be the root cause of helplessness and negative attitudes in depressed patients. Furthermore, several studies have pointed out that the probability of abnormal behaviors, such as insomnia and irregular diet, has increased significantly during the pandemic (91, 92). These studies are consistent with the Theory of Planned Behavior, which suggests that people's intentions or behaviors can be manipulated by attitudes, subjective norms, and perceived behavioral control to target behaviors (93). The negative, desperate, and helpless attitude of depressed individuals can lead to changes in their behavior, which may include loss of appetite, overeating, insomnia, and other abnormal behaviors. The rise in the probability of alcoholism and Internet addictive behavior is also a prevalent feature of COVID-19 (94, 95). Learned helplessness theory suggests that uncontrollable negative events are an important cause of depression. If such negative events are frequent and prolonged, they can lead to an uncontrollable perception that, no matter what one does, one cannot change the outcome. Because of the prolonged preventive and control measures and socioeconomic impacts during the COVID-19 pandemic, people's normal social activities are restricted, and their physical and mental health are damaged, making them prone to psychological burdens and causing them to develop learned helplessness. Alcoholism and Internet addiction are among the behaviors that make patients give up on their efforts and paralyze them.

How to deal with depression during COVID-19

To mitigate the increased prevalence of depression during COVID-19, treatment interventions should be improved (96, 97). Previous studies found that digital socialization, social support, and welfare measures are important in alleviating depression during the COVID-19 pandemic (98). Rose and Rudolph reconstructed the interpersonal context theory based on the interpersonal theory (99), arguing that negative early family experiences can cause individuals to develop negative interpersonal relationship evaluation tendencies and social behavior disorders, which adversely affect subsequent interpersonal skills and thus deepen public depression. Therefore, residents can reduce the incidence of depression

during COVID-19 by constructing good interpersonal relationships. House (100) considers social support as an interpersonal transaction involving emotional care (liking, love, empathy), instrumental assistance (goods or services), information (environment), and assessment (information related to self-assessment). In sociological theory, Virginia (101) states that social support is a reciprocal relationship between individuals and networks that provide psychological, social, and substantive help through social networks. Therefore, to some extent, social support can alleviate the development of depression during COVID-19.

In addition, residents can prevent depression by exercising regularly and actively adjusting their mindset (102, 103). The embodied cognition theory emphasizes the interaction between cognitive processes and the anatomical structure of the body, body movements, and the external environment of the body (104). It is believed that cognition is not only related to the brain, but also to the body, which is the carrier of cognition and cognitive functions. The body can also directly participate in mental processes such as emotion and thinking. Lack of physical exercise, as mentioned earlier, is one of the factors contributing to depression during COVID-19. However, regular exercise can influence the mental health of the public by improving their mood.

Implications

The significance of this study is reflected in the following two aspects: First, this study used COOC (29) and VOSviewer (40) software as tools to conduct a literature econometric analysis and scientific knowledge mapping in the field of depression research during COVID-19, aiming to systematically summarize the trends and research hotspots in this field. Second, as an emerging topic, depression during COVID-19 has not been developed for a long time; however, it has been widely noticed worldwide owing to its specificity (43, 105). In addition, this study adopted a visualization method to quickly locate the key research results in this field. A review of the literature in this area will assist future researchers in further analyzing the causes of depression and finding measures to alleviate depression during COVID-19. It also assists the government in improving the current trend of frequent public psychological problems and provides ideas and references for solving public psychological problems caused by global issues in the future (106, 107).

Limitations and directions for future research

This study has some limitations. First, as an emerging hot topic, the earliest literature on depression during COVID-19 was published in 2020, which was <3 years ago, and scholars' research in this field is limited to the initial stage, which does not perfectly reflect the development and evolutionary trends of this field. Future research should continue to track the literature in this field over the next few years to enrich the research trends and hotspots. Second, the search platform of this study was limited by the WOS platform, the type of literature is specified, and the amount of literature obtained is incomplete. Future research should attempt to join other search platforms, such as PubMed, and compare and analyze the literature retrieved by WOS and PubMed to summarize the patterns.

Through bibliometric analysis and scientific knowledge mapping of the field of depression research during COVID-19, the following aspects may also be of interest in the future. First, most articles in the field of depression research during COVID-19 have been studied using quantitative research methods, and few have been studied using a mixture of qualitative and quantitative research methods (108, 109). Second, by reading the articles, it was established that most of the scales used to assess depression in the field articles were developed before the pandemic. Future research could thus update the depression assessment scales (110). Third, there is a lack of research on the differences in depression during COVID-19 caused by the cross-cultural context (13). Fourth, regarding factors that shape depression during COVID-19, future research should consider multi-layer linear modeling. Feinberg et al. (111) used HLM methods to study effects of public health interventions on families and individuals; in terms of causing problems, there could be a sustained focus on the specific impact of depression on special groups during COVID-19 (112); in terms of coping strategies, longitudinal studies of interventions (113) are warranted, while government (114) and society should also pay sustained attention to those with low levels of depression but are potentially at risk.

Conclusion

This study used COOC and VOSviewer tools for a comprehensive follow-up and visual analysis of the literature in the field of depression during COVID-19. The goal of this study was to systematically review the literature in this area and draw the following conclusions. First, regarding research progress, the field of depression during COVID-19 has been studied for <3 years but has entered a rapid development period. Second, the number of regional publications in the area is related to the severity and importance of the pandemic in each region. Among these, the strongest collaboration is between the United States, China, and the United Kingdom. Finally, regarding research hotspots, the field of depression during COVID-19 is particularly concerned with "factors influencing depression during COVID-19," "consequences of depression during COVID-19," and "coping strategies for depression during COVID-19." The three areas of "depression during

COVID-19" are discussed. Finally, this series of studies on COVID-19 provides a reference for future exploration of public mental health in the context of a global pandemic, as well as helps to forge new pathways for addressing the legacy of human psychological problems after the end of the COVID-19 pandemic and setting a research agenda for future investigations.

Data availability statement

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

Author contributions

JZ, QF, JG, and YX designed the study. QF, JG, and YX performed the analysis and interpreted the data. JZ, XL, YY, YM, and SS reviewed the article and provided comments or suggestions. JZ had primary responsibility for final content. All authors contributed to manuscript and approved the submitted version.

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Conflict of interest

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

Publisher's note

References

1. Wu S, Zhang K, Parks-Stamm EJ, Hu Z, Ji Y, Cui X. Increases in anxiety and depression during COVID-19: a large longitudinal study from China. *Front Psychol.* (2021) 12:706601. doi: 10.3389/fpsyg.2021.706601

2. Gratz KL, Tull MT, Richmond JR, Edmonds KA, Scamaldo KM, Rose JP. Thwarted belongingness and perceived burdensomeness explain the associations of COVID-19 social and economic consequences to suicide risk. *Suicide Life Threat Behav.* (2020) 50:1140–8. doi: 10.1111/sltb.12654

3. Iob E, Steptoe A, Fancourt D. Abuse, self-harm and suicidal ideation in the UK during the COVID-19 pandemic. *Br J Psychiatry.* (2020) 217:543–6. doi: 10.1192/bjp.2020.130

4. Kramer A, Kramer KZ. The potential impact of the Covid-19 pandemic on occupational status, work from home, and occupational mobility. *J Vocat Behav.* (2020) 119:103442. doi: 10.1016/j.jvb.2020.103442

5. Shi L, Que JY, Lu ZA, Gong YM, Liu L, Wang YH, et al. Prevalence and correlates of suicidal ideation among the general population in China during the COVID-19 pandemic. *Eur Psychiatry.* (2021) 64:e18. doi: 10.1192/j.eurpsy.2021.5

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, China. *JAMA.* (2020) 323:1915. doi: 10.1001/jama.2020.6130

7. Bonde JPE. Psychosocial factors at work and risk of depression: a systematic review of the epidemiological evidence. *Occup Environ Med.* (2008) 65:438–45. doi: 10.1136/oem.2007.038430

8. Field T. Postpartum depression effects on early interactions, parenting, and safety practices: a review. *Infant Behav Dev.* (2010) 33:1–6. doi: 10.1016/j.infbeh.2009.10.005

9. Ibrahim AK, Kelly SJ, Adams CE, Glazebrook C. A systematic review of studies of depression prevalence in university students. *J Psychiatr Res.* (2013) 47:391–400. doi: 10.1016/j.jpsychires.2012.11.015

10. Reijnders JSAM, Ehrt U, Weber WEJ, Aarsland D, Leentjens AFG. A systematic review of prevalence studies of depression in Parkinson's disease: the prevalence of depression in PD. *Mov Disord.* (2008) 23:183–9. doi: 10.1002/mds.21803

11. Roy T, Lloyd CE. Epidemiology of depression and diabetes: a systematic review. *J Affect Disord.* (2012) 142:S8–21. doi: 10.1016/S0165-0327(12)70004-6

12. Luppino FS, de Wit LM, Bouvy PF, Stijnen T, Cuijpers P, Penninx BWJH, et al. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. *Arch Gen Psychiatry.* (2010) 67:220. doi: 10.1001/archgenpsychiatry.2010.2

13. Kessler RC, Bromet EJ. The epidemiology of depression across cultures. *Annu Rev Public Health.* (2013) 34:119–38. doi: 10.1146/annurev-publhealth-031912-114409

14. Dimidjian S, Hollon SD, Dobson KS, Schmaling KB, Kohlenberg RJ, Addis ME, et al. Randomized trial of behavioral activation, cognitive therapy, and antidepressant medication in the acute treatment of adults with major depression. *J Consult Clin Psychol.* (2006) 74:658–70. doi: 10.1037/0022-006X.74.4.658

15. Semkovska M, McLoughlin DM. Objective cognitive performance associated with electroconvulsive therapy for depression: a systematic review and meta-analysis. *Biol Psychiatry.* (2010) 68:568–77. doi: 10.1016/j.biopsych.2010.06.009

16. Cindrich SL, Lansing JE, Brower CS, McDowell CP, Herring MP, Meyer JD. Associations between change in outside time pre- and post-COVID-19 public health restrictions and mental health: brief research report. *Front Public Health.* (2021) 9:619129. doi: 10.3389/fpubh.2021.619129

17. Slemon A, McAuliffe C, Goodyear T, McGuinness L, Shaffer E, Jenkins EK. Reddit users' experiences of suicidal thoughts during the COVID-19 pandemic: a qualitative analysis of r/Covid19_support posts. *Front Public Health.* (2021) 9:693153. doi: 10.3389/fpubh.2021.693153

18. Cerami C, Canevelli M, Santi GC, Galandra C, Dodich A, Cappa SF, et al. Identifying frail populations for disease risk prediction and intervention planning in the COVID-19 era: a focus on social isolation and vulnerability. *Front Psychiatry.* (2021) 12:626682. doi: 10.3389/fpsyt.2021.626682

19. Liu C, Liu D, Huang N, Fu M, Ahmed JF, Zhang Y, et al. The combined impact of gender and age on post-traumatic stress symptoms, depression, and insomnia during COVID-19 outbreak in China. *Front Public Health.* (2021) 8:620023. doi: 10.3389/fpubh.2020.620023

20. Hayat K, Arshed M, Fiaz I, Afreen U, Khan FU, Khan TA, et al. Impact of COVID-19 on the mental health of healthcare workers: a cross-sectional study from Pakistan. *Front Public Health.* (2021) 9:603602. doi: 10.3389/fpubh.2021.603602

21. Khatun MF, Parvin MF, Rashid MM, Alam MS, Kamrunnahar M, Talukder A, et al. Mental health of physicians during COVID-19 outbreak in Bangladesh: a web-based cross-sectional survey. *Front Public Health.* (2021) 9:592058. doi: 10.3389/fpubh.2021.592058

22. Alhurishi SA, Almutairi KM, Vinluan JM, Aboshaiqah AE, Marie MA. Mental health outcomes of healthcare providers during COVID-19 pandemic in Saudi Arabia: a cross-sectional study. *Front Public Health.* (2021) 9:625523. doi: 10.3389/fpubh.2021.625523

23. Folayan MO, Ibigbami O, Brown B, El Tantawi M, Aly NM, Ezechi OC, et al. Factors associated with experiences of fear, anxiety, depression, and changes in sleep pattern during the COVID-19 pandemic among adults in Nigeria: a cross-sectional study. *Front Public Health.* (2022) 10:779498. doi: 10.3389/fpubh.2022.779498

24. Eleftheriou A, Rokou A, Arvaniti A, Nena E, Steiropoulos P. Sleep quality and mental health of medical students in Greece during the COVID-19 pandemic. *Front Public Health.* (2021) 9:775374. doi: 10.3389/fpubh.2021.775374

25. Bonsaksen T, Ekeberg Ø, Schou-Bredal I, Skogstad L, Heir T, Grimholt TK. Use of alcohol and addictive drugs during the COVID-19 outbreak in Norway: associations with mental health and pandemic-related problems. *Front Public Health.* (2021) 9:667729. doi: 10.3389/fpubh.2021.667729

26. Miller ER, Olver IN, Wilson CJ, Lunnay B, Meyer SB, Foley K, et al. COVID-19, Alcohol consumption and stockpiling practises in midlife women: repeat surveys during lockdown in Australia and the United Kingdom. *Front Public Health.* (2021) 9:642950. doi: 10.3389/fpubh.2021.642950

27. De Pasquale C, Sciacca F, Conti D, Pistorio ML, Hichy Z, Cardullo RL, et al. Relations between mood states and eating behavior during COVID-19 pandemic in a sample of Italian College Students. *Front Psychol.* (2021) 12:684195. doi: 10.3389/fpsyg.2021.684195

28. Halms T, Strasser M, Kunz M, Hasan A. How to reduce mental health burden in health care workers during COVID-19?–A scoping review of guideline recommendations. *Front Psychiatry.* (2022) 12:770193. doi: 10.3389/fpsyt.2021.770193

29. XueShuDianDi. COOC is a software for bibliometrics and knowledge graph drawing. GitHub. Available online at: https://github.com/2088904822 (accessed November 10, 2022).

30. Qin F, Li J, Zhang C, Zeng G, Huang D, Tan X, et al. Biochar in the 21st century: a data-driven visualization of collaboration, frontier identification, and future trend. *Sci Total Environ.* (2022) 818:151774. doi: 10.1016/j.scitotenv.2021.151774

31. Tan H, Li J, He M, Li J, Zhi D, Qin F, et al. Global evolution of research on green energy and environmental technologies: a bibliometric study. *J Environ Manage.* (2021) 297:113382. doi: 10.1016/j.jenvman.2021.113382

32. You Y, Li W, Liu J, Li X, Fu Y, Ma X. Bibliometric review to explore emerging high-intensity interval training in health promotion: a new century picture. *Front Public Health.* (2021) 9:697633. doi: 10.3389/fpubh.2021.697633

33. Ke L, Lu C, Shen R, Lu T, Ma B, Hua Y. Knowledge mapping of drug-induced liver injury: a scientometric investigation (2010–2019). *Front Pharmacol.* (2020) 11:842. doi: 10.3389/fphar.2020.00842

34. Yeung AWK, Kletecka-Pulker M, Eibensteiner F, Plunger P, Völkl-Kernstock S, Willschke H, et al. Implications of twitter in health-related research: a landscape analysis of the scientific literature. *Front Public Health.* (2021) 9:654481. doi: 10.3389/fpubh.2021.654481

35. Fan J, Gao Y, Zhao N, Dai R, Zhang H, Feng X, et al. Bibliometric analysis on COVID-19: a comparison of research between English and Chinese studies. *Front Public Health.* (2020) 8:477. doi: 10.3389/fpubh.2020.00477

36. Hu S, Wang X, Ma Y, Cheng H. Global research trends in pediatric COVID-19: a bibliometric analysis. *Front Public Health.* (2022) 10:798005. doi: 10.3389/fpubh.2022.798005

37. Al-Jabi SW. Current global research landscape on COVID-19 and depressive disorders: Bibliometric and visualization analysis. *World J Psychiatry.* (2021) 11:253–64. doi: 10.5498/wjp.v11.i6.253

38. Nuryana Z, Murshidi GA, Rahman A. Publication trends related to schizophrenia, mental health, and depression during COVID-19. *Asian J Psychiatry.* (2021) 66:102878. doi: 10.1016/j.ajp.2021.102878

39. Hernández RM, Saavedra-López MA, Calle-Ramírez XM. Latin American authors in the scientific production on depression in times of COVID-19. *Asian J Psychiatry.* (2021) 65:102856. doi: 10.1016/j.ajp.2021.102856

40. van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics.* (2010) 84:523–38. doi: 10.1007/s11192-009-0146-3

41. Zhong H, Zhou Y, Mei SY, Tang R, Feng JH, He ZY, et al. Scars of COVID-19: a bibliometric analysis of post-COVID-19 fibrosis. *Front Public Health.* (2022) 10:967829. doi: 10.3389/fpubh.2022.967829

42. 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

43. Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, et al. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA Netw Open.* (2020) 3:e203976. doi: 10.1001/jamanetworkopen.2020.3976

44. 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. doi: 10.1001/archinte.166.10.1092

45. Bohn L, Gomes S, Neto ESQ, Lage ACSS, de Freitas MDDB, Magalhães FP, et al. Predictors of lower depression levels in older adults during COVID-19 lockdown. *J Appl Gerontol.* (2021) 40:1407–16. doi: 10.1177/0733464821102 5116

46. Ganson KT, Tsai AC, Weiser SD, Benabou SE, Nagata JM. Job insecurity and symptoms of anxiety and depression among US young adults during COVID-19. *J Adolesc Health.* (2021) 68:53–6. doi: 10.1016/j.jadohealth.2020.10.008

47. Levy I, Cohen-Louck K. Predicting individual function during COVID-19 lockdown: depression, fear of COVID-19, age, and employment. *Front Psychol.* (2021) 12:682122. doi: 10.3389/fpsyg.2021.682122

48. Hou F, Bi F, Jiao R, Luo D, Song K. Gender differences of depression and anxiety among social media users during the COVID-19 outbreak in China: a cross-sectional study. *BMC Public Health.* (2020) 20:1648. doi: 10.1186/s12889-020-09738-7

49. Solomou I, Constantinidou F. Prevalence and predictors of anxiety and depression symptoms during the COVID-19 pandemic and compliance with precautionary measures: age and sex matter. *Int J Environ Res Public Health.* (2020) 17:4924. doi: 10.3390/ijerph17144924

50. McPhee MD, Keough MT, Rundle S, Heath LM, Wardell JD, Hendershot CS. Depression, environmental reward, coping motives and alcohol consumption during the COVID-19 pandemic. *Front Psychiatry.* (2020) 11:574676. doi: 10.3389/fpsyt.2020.574676

51. Wardell JD, Kempe T, Rapinda KK, Single A, Bilevicius E, Frohlich JR, et al. Drinking to cope during COVID-19 pandemic: the role of external and internal factors in coping motive pathways to alcohol use, solitary drinking, and alcohol problems. *Alcohol Clin Exp Res.* (2020) 44:2073–83. doi: 10.1111/acer.14425

52. Xu X, Wang W, Chen J, Ai M, Shi L, Wang L, et al. Suicidal and self-harm ideation among Chinese hospital staff during the COVID-19 pandemic: prevalence and correlates. *Psychiatry Res.* (2021) 296:113654. doi: 10.1016/j.psychres.2020.113654

53. Itani MH, Eltannir E, Tinawi H, Daher D, Eltannir A, Moukarzel AA. Severe social anxiety among adolescents during COVID-19 lockdown. *J Patient Exp.* (2021) 8:237437352110383. doi: 10.1177/23743735211038386

54. Arpino B, Pasqualini M. Effects of pandemic on feelings of depression in Italy: the role of age, gender, and individual experiences during the first lockdown. *Front Psychol.* (2021) 12:660628. doi: 10.3389/fpsyg.2021.660628

55. Ahmed MZ, Ahmed O, Aibao Z, Hanbin S, Siyu L, Ahmad A. Epidemic of COVID-19 in China and associated psychological problems. *Asian J Psychiatry.* (2020) 51:102092. doi: 10.1016/j.ajp.2020.102092

56. Greenberg N, Weston D, Hall C, Caulfield T, Williamson V, Fong K. Mental health of staff working in intensive care during Covid-19. *Occup Med.* (2021) 71:62–7. doi: 10.1093/occmed/kqaa220

57. Gilleen J, Santaolalla A, Valdearenas L, Salice C, Fusté M. Impact of the COVID-19 pandemic on the mental health and well-being of UK healthcare workers. *BJPsych Open.* (2021) 7:e88. doi: 10.1192/bjo.2021.42

58. Iyengar U, Jaiprakash B, Haitsuka H, Kim S. One year into the pandemic: a systematic review of perinatal mental health outcomes During COVID-19. *Front Psychiatry.* (2021) 12:674194. doi: 10.3389/fpsyt.2021.674194

59. Silverio SA, Davies SM, Christiansen P, Aparicio-García ME, Bramante A, Chen P, et al. A validation of the postpartum specific anxiety scale 12-item research short-form for use during global crises with five translations. *BMC Pregnancy Childbirth.* (2021) 21:112. doi: 10.1186/s12884-021-03597-9

60. Bermejo-Sánchez FR, Peña-Ayudante WR, Espinoza-Portilla E. Depresión perinatal en tiempos del COVID-19: rol de las redes sociales en Internet. *Acta Medica Peru.* (2020) 37:88–93. doi: 10.35663/amp.2020.371.913

61. Sharif Nia H, Gorgulu O, Naghavi N, Robles-Bello MA, Sánchez-Teruel D, Khoshnavay Fomani F, et al. Spiritual wellbeing, social support, and financial distress in determining depression: the mediating role of impact of event during COVID-19 pandemic in Iran. *Front Psychiatry.* (2021) 12:754831. doi: 10.3389/fpsyt.2021.754831

62. Lv F, Yu M, Li J, Tan J, Ye Z, Xiao M, et al. Young adults' loneliness and depression during the COVID-19 pandemic: a moderated mediation model. *Front Psychol.* (2022) 13:842738. doi: 10.3389/fpsyg.2022.842738

63. Servidio R, Scaffidi Abbate C, Costabile A, Boca S. Future orientation and symptoms of anxiety and depression in Italian university students during the COVID-19 pandemic: the role of resilience and the perceived threat of COVID-19. *Healthcare.* (2022) 10:974. doi: 10.3390/healthcare10060974

64. Yalçin I, Can N, Mançe Çalişir Ö, Yalçin S, Çolak B. Latent profile analysis of COVID-19 fear, depression, anxiety, stress, mindfulness, and resilience. *Curr Psychol.* (2022) 41:459–69. doi: 10.1007/s12144-021-01667-x

65. Zhang Q, Li J, Weng L. A bibliometric analysis of COVID-19 publications in neurology by using the visual mapping method. *Front Public Health.* (2022) 10:937008. doi: 10.3389/fpubh.2022.937008

66. Zhang Q, Weng L, Li J. The evolution of intracranial aneurysm research from 2012 to 2021: Global productivity and publication trends. *Front Neurol.* (2022) 13:953285. doi: 10.3389/fneur.2022.953285

67. Zhang Q, Li S, Liu J, Chen J. Global trends in nursing-related research on COVID-19: a bibliometric analysis. *Front Public Health.* (2022) 10:933555. doi: 10.3389/fpubh.2022.933555

68. Huang D, Wang J, Fang H, Wang X, Zhang Y, Cao S. Global research trends in the subjective well-being of older adults from 2002 to 2021: a bibliometric analysis. *Front Psychol.* (2022) 13:972515. doi: 10.3389/fpsyg.2022.972515

69. Alzueta E, Podhajsky S, Zhao Q, Tapert SF, Thompson WK, de Zambotti M, et al. Risk for depression tripled during the COVID-19 pandemic in emerging adults followed for the last 8 years. *Psychol Med.* (2021) 1–8. doi: 10.1017/S0033291721004062

70. Betancourt-Ocampo D, Toledo-Fernández A, González-González A. Mental health changes in older adults in response to the COVID-19 pandemic: a longitudinal study in Mexico. *Front Public Health.* (2022) 10:848635. doi: 10.3389/fpubh.2022.848635

71. Cassioli E, Rossi E, Castellini G, Sanfilippo G, Silvestri C, Voller F, et al. Psychopathological consequences and dysfunctional behaviours during the COVID-19 epidemic in Italy: a longitudinal study before and after the lockdown. *Eur Psychiatry.* (2021) 64:S96–7. doi: 10.1192/j.eurpsy.2021.282

72. Rehman U, Yildirim M, Shahnawaz MG. A longitudinal study of depression, anxiety, and stress among Indians during COVID-19 pandemic. *Psychol Health Med.* (2022) 1–9. doi: 10.1080/13548506.2021.2023751

73. Saraswathi I, Saikarthik J, Senthil Kumar K, Madhan Srinivasan K, Ardhanaari M, Gunapriya R. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. *PeerJ.* (2020) 8:e10164. doi: 10.7717/peerj.10164

74. Wu J, Wu Y, Tian Y. Temporal associations among loneliness, anxiety, and depression during the COVID-19 pandemic period. *Stress Health.* (2022) 38:90–101. doi: 10.1002/smi.3076

75. Director-General's report to Member States at the 75th World Health Assembly – 23 May 2022 (2022). Available online at: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-address-at-the-75th-world-health-assembly-$-$23-may-2022 (accessed June 15, 2022).

76. Nagabhirava G, Godi SM, Goel AD. Fear, psychological impact, and coping during the initial phase of COVID-19 pandemic among the general population in India. *Cureus.* (2021) 13:e20317. doi: 10.7759/cureus.20317

77. Ding K, Yang J, Chin MK, Sullivan L, Demirhan G, Violant-Holz V, et al. Mental health among adults during the COVID-19 pandemic lockdown: a cross-sectional multi-country comparison. *Int J Environ Res Public Health.* (2021) 18:2686. doi: 10.3390/ijerph18052686

78. Bäuerle A, Teufel M, Musche V, Weismüller B, Kohler H, Hetkamp M, et al. Increased generalized anxiety, depression and distress during the COVID-19 pandemic: a cross-sectional study in Germany. *J Public Health.* (2020) 42:672–8. doi: 10.1093/pubmed/fdaa106

79. Bhanot D, Singh T, Verma SK, Sharad S. Stigma and discrimination during COVID-19 pandemic. *Front Public Health.* (2021) 8:577018. doi: 10.3389/fpubh.2020.577018

80. Piredda M, Fiorini J, Marchetti A, Mastroianni C, Albanesi B, Livigni L, et al. The wounded healer: a phenomenological study on hospital nurses who contracted COVID-19. *Front Public Health.* (2022) 10:867826. doi: 10.3389/fpubh.2022.867826

81. Bower M, Buckle C, Rugel E, Donohoe-Bales A, McGrath L, Gournay K, et al. "Trapped", "anxious" and "traumatised": COVID-19 intensified the impact of housing inequality on Australians' mental health. *Int J Hous Policy.* (2022) 1–32. doi: 10.1080/19491247.2021.1940686

82. Luo T, Chen W, Liao Y. Social media use in China before and during COVID-19: Preliminary results from an online retrospective survey. *J Psychiatr Res.* (2021) 140:35–8. doi: 10.1016/j.jpsychires.2021.05.057

83. Daly Z, Slemon A, Richardson CG, Salway T, McAuliffe C, Gadermann AM, et al. Associations between periods of COVID-19 quarantine and mental health in Canada. *Psychiatry Res.* (2021) 295:113631. doi: 10.1016/j.psychres.2020.113631

84. Kim Y, Kwon HY, Lee S, Kim CB. Depression during COVID-19 quarantine in South Korea: a propensity score-matched analysis. *Front Public Health.* (2022) 9:743625. doi: 10.3389/fpubh.2021.743625

85. Pieh C, Budimir S, Probst T. The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria. *J Psychosom Res.* (2020) 136:110186. doi: 10.1016/j.jpsychores.2020.110186

86. Muller AE, Hafstad EV, Himmels JPW, Smedslund G, Flottorp S, Stensland SØ, et al. The mental health impact of the covid-19 pandemic on healthcare workers, and interventions to help them: a rapid systematic review. *Psychiatry Res.* (2020) 293:113441. doi: 10.1016/j.psychres.2020.113441

87. Olaya B, Pérez-Moreno M, Bueno-Notivol J, Gracia-García P, Lasheras I, Santabárbara J. Prevalence of depression among healthcare workers during the COVID-19 outbreak: a systematic review and meta-analysis. *J Clin Med.* (2021) 10:3406. doi: 10.3390/jcm10153406

88. Li Y, Wang A, Wu Y, Han N, Huang H. Impact of the COVID-19 pandemic on the mental health of college students: a systematic review and meta-analysis. *Front Psychol.* (2021) 12:669119. doi: 10.3389/fpsyg.2021.669119

89. 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) 1–11. doi: 10.1007/s10389-022-01708-0

90. Beck AT, Steer RA, Brown G. Beck depression inventory–II. *American Psychological Association.* (2011). Available from: http://doi.apa.org/getdoi.cfm?doi=10.1037/t00742-000 (accessed November 10, 2022).

91. Niu X, Snyder HR. The role of maladaptive emotion regulation in the bidirectional relation between sleep and depression in college students during the COVID-19 pandemic. *Anxiety Stress Coping.* (2022) 1–14. doi: 10.1080/10615806.2022.2073441

92. Wu H, Li H, Li X, Su W, Tang H, Yang J, et al. Psychological health and sleep quality of medical graduates during the second wave of COVID-19 pandemic in post-epidemic era. *Front Public Health.* (2022) 10:876298. doi: 10.3389/fpubh.2022.876298

93. Shen L, Gu X, Zhang T, Lee J. Adolescents' physical activity and depressive symptoms: a psychosocial mechanism. *Int J Environ Res Public Health.* (2022) 19:1276. doi: 10.3390/ijerph19031276

94. Lee S, Mun IB. How does perceived parental rejection influence cyberbullying by children? A serial mediation model of children's depression and smartphone addiction. *Soc Sci J.* (2022) 1–16. doi: 10.1080/03623319.2022.2070826

95. Sugaya N, Yamamoto T, Suzuki N, Uchiumi C. Alcohol use and its related psychosocial effects during the prolonged COVID-19 pandemic in Japan: a cross-sectional survey. *Int J Environ Res Public Health.* (2021) 18:13318. doi: 10.3390/ijerph182413318

96. Irfan M, Naeem F, Afridi M, Javed A. Prevention of occupational stress in health-care workers during COVID-19 pandemic. *Indian J Psychiatry.* (2020) 62:495. doi: 10.4103/psychiatry.IndianJPsychiatry_844_20

97. Rodríguez-Rey R, Garrido-Hernansaiz H, Collado S. Psychological impact and associated factors during the initial stage of the Coronavirus (COVID-19) pandemic among the general population in Spain. *Front Psychol.* (2020) 11:1540. doi: 10.3389/fpsyg.2020.01540

98. Feng L, Yin R. Social support and hope mediate the relationship between gratitude and depression among front-line medical staff during the pandemic of COVID-19. *Front Psychol.* (2021) 12:623873. doi: 10.3389/fpsyg.2021.623873

99. Rose AJ, Rudolph KD. A review of sex differences in peer relationship processes: Potential trade-offs for the emotional and behavioral development of girls and boys. *Psychol Bull.* (2006) 132:98–131. doi: 10.1037/0033-2909.132.1.98

100. House JS. Barriers to work stress: i. social support. In: Gentry WD, Benson H, Wolff CJ, editors. *Behavioral Medicine: Work, Stress and Health*. Dordrecht: Springer Netherlands. (1985). p. 157–80.

101. Tilden VP, Weinert C. Social support and the chronically III individual. *Nurs Clin North Am.* (1987) 22:613–20. doi: 10.1016/S0029-6465(22)01312-3

102. Pieh C, O'Rourke T, Budimir S, Probst T. Relationship quality and mental health during COVID-19 lockdown Montazeri A, editor. *PLoS ONE.* (2020) 15:e0238906. doi: 10.1371/journal.pone.0238906

103. Zhang Y, Huang L, Luo Y, Ai H. The relationship between state loneliness and depression among youths during COVID-19 lockdown: coping style as mediator. *Front Psychol.* (2021) 12:701514. doi: 10.3389/fpsyg.2021.701514

104. Barsalou LW. Grounded cognition. *Annu Rev Psychol.* (2008) 59:617–45. doi: 10.1146/annurev.psych.59.103006.093639

105. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y, et al. nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen Psychiatry.* (2020) 33:e100213. doi: 10.1136/gpsych-2020-100213

106. Bodrud-Doza Md, Shammi M, Bahlman L, Islam ARMdT, Rahman MdM. Psychosocial and socio-economic crisis in Bangladesh due to COVID-19 pandemic: a perception-based assessment. *Front Public Health.* (2020) 8:341. doi: 10.3389/fpubh.2020.00341

107. Porat T, Nyrup R, Calvo RA, Paudyal P, Ford E. Public health and risk communication during COVID-19—enhancing psychological needs to promote sustainable behavior change. *Front Public Health.* (2020) 8:573397. doi: 10.3389/fpubh.2020.573397

108. Stoichitoiu LE, Pinte L, Ceasovschih A, Cernat RC, Vlad ND, Padureanu V, et al. In-hospital antibiotic use for COVID-19: facts and rationales assessed through a mixed-methods study. *J Clin Med.* (2022) 11:3194. doi: 10.3390/jcm11113194

109. Toran M, Özden B. Are there any changes in mothers' attitudes? Analysis of the impact of the COVID-19 quarantine on child-rearing attitudes. *Child Youth Serv Rev.* (2022) 134:106372. doi: 10.1016/j.childyouth.2022.106372

110. Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD, Pakpour AH. The fear of COVID-19 scale: development and initial validation. *Int J Ment Health Addict.* (2022) 20:1537–45. doi: 10.1007/s11469-020-00270-8

111. Feinberg ME, Mogle J, Lee J, Tornello SL, Hostetler ML, Cifelli JA, et al. Impact of the COVID-19 pandemic on parent, child, and family functioning. *Fam Process.* (2022) 61:361–74. doi: 10.1111/famp.12649

112. Reid G, Ritholtz S. A queer approach to understanding LGBT vulnerability during the COVID-19 pandemic. *Polit Gend.* (2020) 16:1101–9. doi: 10.1017/S1743923X20000707

113. Yang Z, Ji LJ, Yang Y, Wang Y, Zhu L, Cai H. Meaning making helps cope with COVID-19: a longitudinal study. *Personal Individ Differ.* (2021) 174:110670. doi: 10.1016/j.paid.2021.110670

114. Nuryana Z, Xu W, Lu S. Students mental health during COVID-19: Comprehensive government and parental involvement in Indonesia. *Asian J Psychiatry.* (2022) 74:103197. doi: 10.1016/j.ajp.2022.103197

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Socio-economic factors associated with mental health outcomes during the COVID-19 pandemic in South Korea

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Background: Individuals are at an increased risk of adverse mental health outcomes during the COVID-19 pandemic. To reduce the impact on mental health outcomes that were induced by national-level policies, which may influence an individual at the community level, exploring the comprehensive relations between individual and environmental factors are needed. The aim is to examine socio-ecological factors associated with mental health outcomes, including depressive and anxiety symptoms, with the perspective of support to provide interventions that help the community during future disease outbreaks.

Method: From 5 November to 20 November 2020, a cross-sectional and population-based study was conducted to assess the socio-ecological factors of mental health outcomes during the COVID-19 pandemic. A total of 1,000 participants, aged 20–69 years, in Chungnam Region, South Korea, were included in this study. Multiple linear regression models were used to examine the association between socio-ecological factors and mental health outcomes. The primary outcomes were individuals' mental health outcomes which are measured by PHQ-9 and GAD-7 scores.

Results: Of the 1,000 participants, the average PHQ-9 was 4.39, and GAD-7 was 3.21 during the COVID-19 pandemic. Specifically, the participants with moderate or severe levels of PHQ-9 and GAD-7 were 12.6 and 6.8%, respectively. Higher levels of depressive and anxiety symptoms were associated with participants who were single, reported a lower household income, had decreased support from friends or family, and increased stress from the workplace or home. In subgroup analyses by age, gender, and household income, a similar trend was reported in individual and interpersonal-level factors. There were significant associations between regional-level factors, including gross regional domestic product (GRDP), mental health institutions, psychiatrists, nurse-to-population ratios, and individuals' mental health outcomes.

Conclusion: The management of depressive and anxiety symptoms of individuals during the pandemic was better explained by individual and

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interpersonal characteristics rather than regional-level factors, highlighting the need for more policies aimed at these lower levels.

KEYWORDS

COVID-19, pandemics, depression, anxiety, GAD-7 scale, PHQ-9, socio-ecological model of health, support system

Introduction

Due to the coronavirus disease 2019 (COVID-19) pandemic, countries have implemented various policies to prevent the spread, such as social distancing, multiple facility closures, and restrictions on travel. Such policies resulted in many changes in the lifestyles of people across the world. Before the COVID-19 pandemic, there was a case to be made for other infectious diseases (e.g., H1N1 and seasonal influenza) having an impact on public mental health (1, 2). There are multiple studies reporting the physical effects and sequelae, including myalgia, physical inactivity, cough, fever, breathing difficulty, and gastrointestinal symptoms caused by COVID-19 (3–6). Besides the physical effects, significant impacts on mental health including depression, anxiety, and suicidal ideation/behavior were reported around the world (7–17). In addition, unlike the physical effects, the impact on mental health not only affects individuals with direct virus contact but also the general public. In March 2020, in the US, the percentage of adults reporting the negative influence of COVID-19-related stress on their mental health was about 32% which increased to 53% by July 2020 (13). In South Korea, compared with the control group (i.e., matched individuals from the pre-pandemic period in 2019), individuals undergoing self-quarantine during the COVID-19 pandemic reported higher levels of depressive symptoms and a higher prevalence of major depression (14).

Among multiple methods to manage the population's mental health, enforcing a support system is one of the effective methods to implement for the public. There are multiple types of support defined (18). According to Cobb (19), although social support directly or indirectly affects mental health, depending on the type of support (i.e., instrumental, active, or material), the effect differs, and it is important to distinguish. Cobb's primary argument was that we should make a distinction between social support as perceived by an individual and social support as received in the form of resources or participation in supportive activities (18, 19). However, there was no study that investigated the effects of different types of support. Thus, in this study, individual- or interpersonal-level factors were focused on active support (i.e., marital status, support from friends and family, and stress from work and home) and regional-level factors were focused on instrumental or material support (i.e., mental health institution-to-population ratio and psychiatrist-to-population ratio).

Socio-ecological models were developed for a further understanding of the dynamic interrelations among various personal and environmental factors. Individual, interpersonal, and regional characteristics are likely to be connected to mental health outcomes among individuals in the community at various socio-ecological levels (20–22). To date, studies have provided evidence of the importance of factors at each level (22, 23). However, there is an existing gap confirming that, to our knowledge, no factors have been simultaneously examined at any socio-ecological level. Additional studies are needed to understand the range of socio-ecological factors contributing to mental health outcomes among community individuals in South Korea. Thus, this study aims to examine the association between socio-ecological factors (individual, interpersonal, and regional) and the individuals' mental health outcomes related to support in the general Korean population during the COVID-19 pandemic.

Materials and methods

Source of data and study population

This study used data from a cross-sectional survey targeting adults aged 20–69 years in the Chungnam Region of South Korea and investigated their mental health, experiences, and perceptions of the COVID-19 pandemic, and the psychosocial effects of COVID-19. Data were collected *via* conventional face-to-face interviews or an online survey panel. Embrain Public® recruited the online survey panel through the random sampling of residential addresses throughout Korea at the end of October 2020. The participants answered the questionnaires anonymously *via* online survey or face-to-face interviews conducted from 5 November to 20 November 2020. Individuals voluntarily chose to participate by signing up on a panel platform. Online surveys or face-to-face interviews were conducted at the same time, and participants can be selected on how they would like to share their information. Of the 1,000 participants, 610 participated *via* online surveys, and 390 participated *via* face-to-face interviews. All participants provided informed consent prior to completing the study. The study included 16 Korean regional-level administrative districts,

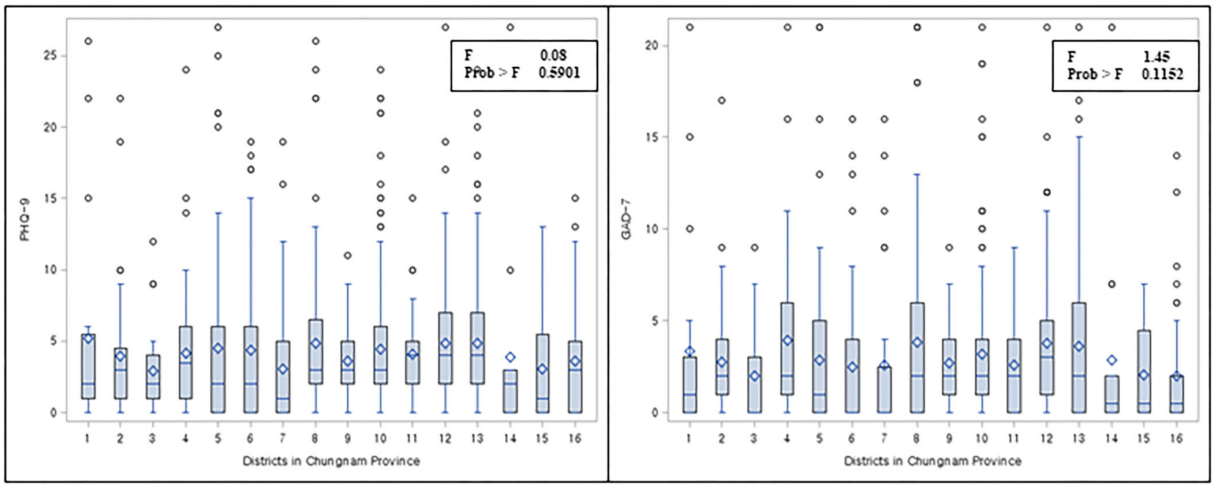

FIGURE 1
Distribution of PHQ-9 and GAD-7 by regional-level districts.

comprising seven cities ("Si"), seven counties ("Gun"), and two districts ("Gu"), to cover the Chungnam region.

Dependent variable

The primary outcome variables were the participants' self-reported depression and anxiety levels. We used the Korean version of the Patient Health Questionnaire-9 (PHQ-9) to measure depressive status (24). The questionnaire consisted of nine items with a 4-point Likert scale ranging from 0 (never) to 3 (nearly every day) assessing the frequency of depressive symptoms over the past 2 weeks. The PHQ-9 score ranges from 0 to 27 points, and higher scores indicate more severe depression (25–27). The Korean version of the Generalized Anxiety Disorder-7 (GAD-7) scale was used to assess anxiety symptoms (28). The GAD-7 is composed of seven items assessing the frequency of anxiety over the past 2 weeks on a 4-point Likert scale ranging from 0 (never) to 3 (nearly every day). The total score of GAD-7 ranges from 0 to 21, and higher scores reflect greater severity of anxiety.

Independent variable

Individual-level factors

Socioeconomic and interpersonal factors were selected based on previous studies on individual levels (15). Socioeconomic factors included age, gender, job status, marital status, average monthly household income, and education level. Since the survey was conducted using two different methods (i.e., face-to-face interview and online survey), the data collection method was controlled. As for interpersonal factors, the researchers collected the variables that measure the negative changes and the self-role disruptions in the participant's life due to COVID-19 (i.e., in social life and home). Specifically, the negative changes depend on whether the support from friends and family members has decreased and the stress from the workplace and home has increased.

Regional-level factors

Regional-level variables included the district's gross regional domestic product (GRDP), the community's mental health utilization indicators (i.e., mental health institution-to-population ratio, psychiatrist-to-population ratio, and nurse-to-population ratio), and the rates of unmet healthcare needs. GRDP is the sum of the market prices of all final goods and services produced within an administrative district for a certain period and is used to determine the economic structure or size. According to the European Parliament, an unmet healthcare need is defined as a state in which there is no existing satisfactory method of prevention, diagnosis, and treatment (29).

Data analysis

One-way ANOVA was conducted to determine whether there were any differences between the PHQ-9 and GAD-7 among districts (Figure 1). Although individuals were nested within region-level administrative districts of Chungnam Region, since there were no statistically significant differences between the districts, the generalized linear model was not

employed. Descriptive statistics were conducted for all variables in the analysis (Table 1), and independent *t*-tests, one-way ANOVA, and chi-square tests were examined for differences between participants in the sample. Multicollinearity was tested, and the highest variance inflation factor (VIF) was 2.8, which is less than 4, meaning there was no excessive multicollinearity reported (30). We theorize that individual, interpersonal, and region-level factors predict changes in the individual's PHQ-9 and GAD-7. Each dependent variable (i.e., PHQ-9 and GAD-7) was modeled as a continuously distributed variable. Multiple linear regression was conducted to investigate the association between socio-ecological factors and mental health outcomes (Table 2). All socio-ecological factors were included simultaneously in adjusted models. Additionally, to investigate the differences in particular populations such as income, gender, and lifespan age, subgroup analyses were conducted (Tables 1–5, respectively). All statistical analyses were conducted in SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). We considered a *p*-value of less than 0.05 to be statistically significant.

Results

The demographic characteristics of the study participants are provided in Table 1. The average age of the study participants was 45.03 years. Among 1,000 participants, 47.2% of them were women, 94% were employed, and 97% were college graduates. During COVID-19, 16.7% of the participants reported a decrease in support from friends, and 7.7% reported a decrease in family support. In addition, 39.5 and 28% of the participants reported that their stress from work and home increased, respectively. For regional-level variables, the average mental health institution-to-population ratio was 3.83 per 1,000 population, the psychiatrist-to-population ratio was 5.95 per 100,000 population, and the nurse-to-population ratio was 2.88 per 1,000 population. The mean of PHQ-9 and GAD-7 scores were 4.39 and 3.21, indicating a low level of depressive and anxiety symptoms, respectively. Each score distribution by each district is presented as a boxplot in Figure 1. No significant differences were identified between the districts (PHQ: $F = 0.88$, $p = 0.5901$; GAD-7: $F = 1.45$, $p = 0.1152$).

The result of the adjusted multiple linear regression analysis is presented in Table 2. The intercept of PHQ-9 and GAD-7 was 7.240 and 5.594, respectively. Among individual factors, those who were married, had an income over 2,000 USD, and who completed the survey face-to-face reported less depressive symptoms (PHQ-9) and anxiety (GAD-7). Participants who were employed showed fewer anxiety symptoms, but there was no statistically significant association reported with depressive symptoms. In addition, participants who reported a decrease in family and friend support and an increase in stress from work and home during COVID-19 reported higher depressive and anxiety symptoms. However, there was no statistically significant association shown between regional-level factors and both PHQ-9 and GAD-7 scores (Table 2).

Table 3 shows the subgroup analysis by lifespan age group. In the age group between 20 and 45, the association with PHQ-9, two individual factors, and three interpersonal factors were statistically significant, showing a similar trend. Two major factors, namely marital status and decreased support from friends, showed a bigger effect size. The association with GAD-7, two individual factors, and three interpersonal factors were statistically significant and showed a similar trend. Female participants reported more anxiety, which differed from the results of multiple linear regression. In the age group over 45, the association with PHQ-9, four individual factors, five interpersonal factors, and one regional-level factor were statistically significant. In the same age group, GAD-7 also showed similar significant associations except for four regional-level factors, including GRDP and healthcare utilization factors, which showed statistical significance. GRDP, the mental health institution-to-population ratio, and the nurse-to-population ratio showed a positive association, while the psychiatrists-to-population ratio showed a negative association.

From Table 4, among the men, marital status, support from friends or family, and stress gained from home during COVID-19 were the main factors with a high impact on PHQ-9 and GAD-7. On the contrary, among the women, monthly household income and stress from home during COVID-19 showed significant associations with PHQ-9 and GAD-7. However, none of the regional-level factors showed a statistically significant association.

Finally, Table 5 shows subgroup analysis by monthly household incomes. Among the participants with incomes less than USD 2,000, decreased support from friends, and increased stress from home were significant factors of depressive symptoms (PHQ-9). On the other hand, individual characteristics such as marital and education statuses contributed to lowering anxiety levels (GAD-7). Finally, participants with more mental health resources in the region (i.e., the mental health institution-to-population ratio) reported fewer depressive symptoms and anxiety. The income of USD 2,000–4,999, employment status, survey method, decreased family support during COVID-19, and increased stress from work and home were statistically significant factors of PHQ-9 and GAD-7 among the groups. Factors particularly related to family or home were found to be significant among the participants with a household income of over USD 5,000.

Discussion

This study aimed to examine the effects of individual, interpersonal, and regional factors at different socio-ecological levels on individuals' mental health status. The mean score of the depression level was 4.29, and the anxiety level was 3.29,

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TABLE 1 Descriptive statistics of all variables in the analysis ($N = 1,000$).

Characteristics	*N*	%	Mean	SD
Mental health status				
PHQ-9	-	-	4.39	± 4.81
GAD-7	-	-	3.21	± 4.02
Individual-level factors				
Age (years)	-	-	45.03	± 13.41
Gender				
Male	528	(52.8)	-	-
Female	472	(47.2)	-	-
Employment status				
Unemployed	60	(6.0)	-	-
Employed	940	(94.0)	-	-
Marital status				
Single, separated, divorced, and widowed	327	(32.7)	-	-
Married, cohabiting and partnered	673	(67.3)	-	-
Education				
Lower than College graduate	394	(39.4)	-	-
College graduate or over	606	(60.6)	-	-
Household income (USD per month)				
< 2,000	104	(10.4)	-	-
2,000 ∼ 4,999	603	(60.3)	-	-
≥ 5,000	293	(29.3)	-	-
Survey method				
Online	610	(61.0)	-	-
Interview	390	(39.0)	-	-
Interpersonal-level factors				
Severe interruption of their role in social life				
No	590	(59.0)	-	-
Yes	410	(41.0)	-	-
Severe interruption of their role at home				
No	872	(87.2)	-	-
Yes	128	(12.8)	-	-
Support from friends during COVID-19				
Same or increased	833	(83.3)	-	-
Decreased	167	(16.7)	-	-
Support from family during COVID-19				
Same or increased	923	(92.3)	-	-
Decreased	77	(7.7)	-	-
Stress from work during COVID-19				
Decreased or same	605	(60.5)	-	-
Increased	395	(39.5)	-	-
Stress from home during COVID-19				
Decreased or same	720	(72.0)	-	-
Increased	280	(28.0)	-	-
Regional-level factors				
Gross Regional Domestic Product (million Won)	-	-	15.80	± 10.46
Unmet healthcare need rates (%)	-	-	5.27	± 2.21
Mental health institution-to-population ratio*	-	-	3.83	± 1.57
Psychiatrist-to-population ratio†	-	-	5.95	± 2.87
Nurse-to-population ratio*	-	-	2.88	± 2.39

COVID-19, coronavirus disease 2019; GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9; SD, Standard deviation; *per 1,000 population; †per 100,000 population.

TABLE 2 Multiple linear regression for the effect of individual and community factors on individual's mental health status.

	PHQ-9			GAD-7		
	β	S.E	*P*-value	β	S.E	*P*-value
Individual-level factors						
Intercept	**7.240**	0.691	<0.0001	**5.594**	0.574	<0.0001
Age (years)	−0.030	0.017	0.0803	−0.007	0.014	0.6437
Gender						
Male	Ref.	-	-	Ref.	-	-
Female	0.171	0.280	0.5414	0.447	0.233	0.0548
Employment status						
Unemployed	Ref.	-	-	Ref.	-	-
Employed	−1.147	0.613	0.0616	**−1.300**	0.509	0.0108
Marital status						
Single, separated, divorced, and widowed	Ref.	-	-	Ref.	-	-
Married, cohabiting and partnered	**−1.662**	0.405	<0.0001	**−1.615**	0.337	<0.0001
Education						
Lower than College graduate	Ref.	-	-	Ref.	-	-
College graduate or over	−0.575	0.307	0.0613	−0.423	0.255	0.0971
Household income (USD per month)						
< 2,000	Ref.	-	-	Ref.	-	-
2,000 ∼ 4,999	**−1.361**	0.494	0.0060	**−0.910**	0.411	0.0270
≥ 5,000	**−1.616**	0.549	0.0033	**−1.102**	0.456	0.0159
Survey method						
Online	Ref.	-	-	Ref.	-	-
Interview	**−1.220**	0.399	0.0023	**−1.165**	0.332	0.0005
Interpersonal-level factors						
Severe interruption of their role in social life						
No	Ref.	-	-	Ref.	-	-
Yes	0.149	0.303	0.6223	0.311	0.252	0.2169
Severe interruption of their role at home						
No	Ref.	-	-	Ref.	-	-
Yes	0.243	0.452	0.5902	−0.184	0.376	0.6244
Support from friends during COVID-19						
Same or increased	Ref.	-	-	Ref.	-	-
Decreased	**1.286**	0.414	0.0019	**0.721**	0.344	0.0363
Support from family during COVID-19						
Same or increased	Ref.	-	-	Ref.	-	-
Decreased	**1.701**	0.574	0.0031	**1.549**	0.477	0.0012
Stress from work during COVID-19						
Decreased or same	Ref.	-	-	Ref.	-	-
Increased	**1.167**	0.299	<0.0001	**0.972**	0.248	<0.0001
Stress from home during COVID-19						
Decreased or same	Ref.	-	-	Ref.	-	-
Increased	**1.527**	0.334	<0.0001	**1.715**	0.277	<0.0001
Regional-level factors						
Gross Regional Domestic Product	0.010	0.016	0.5420	0.019	0.013	0.1536
Unmet healthcare need rates (%)	0.020	0.070	0.7702	−0.010	0.058	0.8579
Mental health institution-to-population ratio*	−0.028	0.133	0.8313	0.138	0.111	0.2135
Psychiatrist-to-population ratio†	−0.066	0.068	0.3335	−0.074	0.056	0.1893
Nurse-to-population ratio*	0.057	0.069	0.4134	0.041	0.057	0.4714

COVID-19, coronavirus disease 2019; GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9; SD, Standard deviation; *per 1,000 population; †per 100,000 population. Bold values indicates those are statistically significant.

TABLE 3 Subgroup analysis of multiple linear regression for the effect of individual and community factors on mental health status by lifespan age group.

	PHQ-9						GAD-7					
	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value
	20 ≤ Age ≤ 45			Age > 45			20 ≤ Age ≤ 45			Age > 45		
Individual-level factors												
Intercept	**7.271**	1.019	<0.0001	**7.849**	0.928	<0.0001	**5.947**	0.854	<0.0001	**5.744**	0.746	<0.0001
Gender												
Male	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Female	0.639	0.469	0.1732	−0.055	0.314	0.8598	**1.029**	0.393	0.0091	−0.101	0.253	0.6906
Employment status												
Unemployed	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Employed	−0.649	0.918	0.4799	**−2.055**	0.781	0.0088	−1.260	0.769	0.1019	**−1.272**	0.628	0.0434
Marital status												
Single, separated, divorced, and widowed	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Married, cohabiting and partnered	**−2.174**	0.492	<0.0001	**−1.403**	0.589	0.0177	**−1.691**	0.413	<0.0001	**−2.138**	0.474	<0.0001
Education												
Lower than College graduate	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
College graduate or over	**−1.100**	0.535	0.0403	−0.071	0.334	0.8324	−0.863	0.448	0.0548	−0.242	0.269	0.3687
Household income (USD per month)												
< 2,000	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
2,000 ∼ 4,999	−1.147	0.774	0.1389	**−1.671**	0.598	0.0054	−1.252	0.648	0.0540	−0.518	0.481	0.2816
≥ 5,000	−1.339	0.845	0.1138	**−1.861**	0.664	0.0053	−1.255	0.708	0.0770	−0.704	0.534	0.1885
Survey method												
Online	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Interview	−0.709	1.035	0.4933	**−1.418**	0.364	0.0001	−1.641	0.867	0.0589	**−1.039**	0.293	0.0004
Interpersonal-level factors												
Severe interruption of their role in social life												
No	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Yes	−0.474	0.490	0.3340	**0.896**	0.348	0.0104	−0.038	0.410	0.9255	**0.787**	0.280	0.0051
Severe interruption of their role at home												
No	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Yes	0.348	0.696	0.6173	0.079	0.543	0.8840	−0.182	0.583	0.7545	−0.064	0.437	0.8831
Support from friends during COVID-19												
Same or increased	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Decreased	**2.257**	0.647	0.0005	**0.000**	0.493	0.9999	**1.457**	0.543	0.0075	−0.360	0.396	0.3642
Support from family during COVID-19												
Same or increased	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Decreased	1.261	0.876	0.1509	**1.647**	0.717	0.0220	1.037	0.734	0.1585	**1.845**	0.577	0.0015
Stress from work during COVID-19												
Decreased or same	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Increased	**1.530**	0.485	0.0017	**0.795**	0.339	0.0196	**1.164**	0.406	0.0043	**0.810**	0.273	0.0032
Stress from home during COVID-19												
Decreased or same	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Increased	**1.657**	0.541	0.0023	**1.298**	0.379	0.0007	**1.942**	0.453	<0.0001	**1.361**	0.305	<0.0001
Regional-level factors												
Gross Regional Domestic Product	−0.020	0.027	0.4658	**0.049**	0.018	0.0071	0.005	0.023	0.8250	**0.036**	0.015	0.0147
Unmet healthcare need rates (%)	−0.076	0.131	0.5584	0.105	0.071	0.1372	−0.128	0.109	0.2443	0.085	0.057	0.1372
Mental health institution-to-population ratio*	−0.316	0.240	0.1882	0.243	0.137	0.0775	0.040	0.201	0.8419	**0.242**	0.110	0.0285
Psychiatrist-to-population ratio†	−0.013	0.120	0.9153	−0.104	0.071	0.1425	−0.017	0.101	0.8684	**−0.137**	0.057	0.0165
Nurse-to-population ratio*	0.094	0.111	0.3967	0.033	0.081	0.6860	−0.072	0.093	0.4407	**0.192**	0.065	0.0033

COVID-19, coronavirus disease 2019; GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9; SD, Standard deviation; *per 1,000 population; †per 100,000 population. Bold values indicates those are statistically significant.

TABLE 4 Subgroup analysis of multiple linear regression for the effect of individual and community factors on mental health status by gender.

	PHQ-9						GAD-7					
	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value
	Male			Female			Male			Female		
Individual factors												
Intercept	**6.523**	0.820	<0.0001	**7.602**	1.478	<0.0001	**4.883**	0.652	<0.0001	**6.524**	1.279	<0.0001
Age (years)	−0.011	0.022	0.6228	**−0.065**	0.028	0.0219	0.019	0.018	0.2898	**−0.051**	0.024	0.0391
Employment status												
Unemployed	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Employed	**−1.557**	0.695	0.0256	−0.393	1.384	0.7764	**−1.615**	0.553	0.0036	−0.898	1.197	0.4537
Marital status												
Single, separated, divorced, and widowed	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Married, cohabiting and partnered	**−1.974**	0.551	0.0004	−1.182	0.610	0.0534	**−1.700**	0.438	0.0001	**−1.438**	0.528	0.0067
Education												
Lower than College graduate	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
College graduate or over	−0.508	0.410	0.2154	−0.854	0.474	0.0720	−0.381	0.326	0.2429	−0.722	0.410	0.0788
Household income (USD per month)												
< 2,000	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
2,000 ∼ 4,999	−0.424	0.718	0.5554	**−2.120**	0.696	0.0025	0.072	0.571	0.9002	**−1.706**	0.602	0.0048
≥ 5,000	−0.880	0.798	0.2706	**−2.236**	0.765	0.0037	−0.179	0.635	0.7775	**−1.846**	0.662	0.0055
Survey method												
Online	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Interview	**−1.095**	0.496	0.0278	−1.167	0.689	0.0909	**−1.086**	0.394	0.0061	−0.956	0.596	0.1093
Interpersonal factors												
Severe interruption of their role in social life												
No	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Yes	0.143	0.421	0.7338	−0.038	0.445	0.9328	0.163	0.335	0.6266	0.302	0.385	0.4336
Severe interruption of their role at home												
No	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Yes	1.070	0.649	0.0999	−0.531	0.636	0.4041	0.283	0.516	0.5840	−0.513	0.550	0.3515
Support from friends during COVID-19												
Same or increased	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Decreased	**1.238**	0.589	0.0361	**1.282**	0.592	0.0309	**0.979**	0.468	0.0371	0.457	0.512	0.3733
Support from family during COVID-19												
Same or increased	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Decreased	**1.819**	0.809	0.0250	1.573	0.833	0.0596	**1.742**	0.643	0.0070	1.261	0.721	0.0808
Stress from work during COVID-19												
Decreased or same	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Increased	**1.306**	0.402	0.0012	**1.039**	0.448	0.0210	**0.894**	0.319	0.0053	**0.989**	0.388	0.0111
Stress from home during COVID-19												
Decreased or same	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Increased	**1.859**	0.476	0.0001	**1.304**	0.483	0.0072	**1.862**	0.378	<0.0001	**1.594**	0.418	0.0002
Regional-level factors												
Gross Regional Domestic Product	0.027	0.022	0.2154	−0.005	0.025	0.8325	0.028	0.017	0.1088	0.012	0.021	0.5810
Unmet healthcare need rates (%)	0.066	0.093	0.4776	−0.016	0.105	0.8776	0.020	0.074	0.7828	−0.029	0.091	0.7497
Mental health institution-to-population ratio*	−0.250	0.180	0.1651	0.220	0.198	0.2686	0.013	0.143	0.9253	0.266	0.172	0.1216
Psychiatrist-to-population ratio†	0.016	0.092	0.8605	−0.151	0.101	0.1353	−0.072	0.073	0.3259	−0.074	0.087	0.3949
Nurse-to-population ratio*	0.002	0.093	0.9867	0.128	0.105	0.2232	0.012	0.074	0.8758	0.087	0.091	0.3403

COVID-19, coronavirus disease 2019; GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9; SD, Standard deviation; *per 1,000 population; †per 100,000 population. Bold values indicates those are statistically significant.

TABLE 5 Subgroup analysis of multiple linear regression for the effect of individual and community factors on mental health status by monthly household income.

	PHQ-9									GAD-7								
	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value
	< USD 2,000			USD 2,000–4,999			≥ USD 5,000			< USD 2,000			USD 2,000–4,999			≥ USD 5,000		
Individual factors																		
Intercept	**4.997**	1.709	0.0044	**6.495**	0.892	<0.0001	3.564	1.918	0.0642	**4.371**	1.493	0.0044	**4.599**	0.738	<0.0001	**3.675**	1.558	0.0190
Age (years)	−0.035	0.061	0.5657	**−0.048**	0.021	0.0249	0.017	0.033	0.6072	−0.013	0.053	0.8085	**−0.015**	0.018	0.4089	0.022	0.027	0.4276
Gender																		
Male	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Female	1.895	1.352	0.1646	−0.039	0.339	0.9081	0.466	0.473	0.3249	2.307	1.181	0.0541	0.199	0.280	0.4789	0.555	0.384	0.1497
Employment status																		
Unemployed	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Employed	−0.455	1.659	0.7844	**−2.367**	0.795	0.0030	2.309	1.691	0.1731	−0.780	1.450	0.5920	**−1.889**	0.658	0.0043	0.880	1.373	0.5223
Marital status																		
Single, separated, divorced, and widowed	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Married, cohabiting and partnered	−3.335	1.754	0.0605	−0.646	0.471	0.1709	**−3.544**	0.772	<0.0001	**−3.934**	1.532	0.0120	−0.732	0.390	0.0613	**−2.932**	0.627	<0.0001
Education																		
Lower than College graduate	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
College graduate or over	−2.068	1.266	0.1061	**−0.775**	0.361	0.0320	0.345	0.600	0.5661	**−2.213**	1.107	0.0487	**−0.302**	0.299	0.3129	−0.190	0.488	0.6964
Survey method																		
Online	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Interview	0.205	1.635	0.9005	**−1.592**	0.515	0.0021	−0.675	0.659	0.3068	−0.441	1.429	0.7586	**−1.373**	0.426	0.0014	−0.815	0.535	0.1289
Interpersonal factors																		
Severe interruption of their role in social life																		
No	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Yes	0.963	1.450	0.5085	0.269	0.366	0.4630	−0.049	0.516	0.9246	2.456	1.267	0.0560	0.272	0.303	0.3696	0.089	0.419	0.8323
Severe interruption of their role at home																		
No	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Yes	4.764	2.625	0.0731	0.882	0.531	0.0977	**−1.554**	0.778	0.0468	0.950	2.294	0.6798	0.407	0.440	0.3553	**−1.456**	0.632	0.0221
Support from friends during COVID-19																		
Same or increased	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Decreased	**3.379**	1.653	0.0440	0.849	0.488	0.0825	1.256	0.798	0.1166	2.740	1.445	0.0613	0.283	0.404	0.4844	0.782	0.648	0.2284
Support from family during COVID-19																		
Same or increased	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Decreased	2.019	2.370	0.3967	**1.509**	0.684	0.0279	**2.191**	1.111	0.0495	0.871	2.071	0.6752	**1.629**	0.567	0.0042	**2.105**	0.902	0.0204
Stress from work during COVID-19																		
Decreased or same	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Increased	1.525	1.533	0.3227	**1.755**	0.360	<0.0001	0.124	0.496	0.8026	0.335	1.340	0.8035	**1.386**	0.298	<0.0001	0.474	0.403	0.2401
Stress from home during COVID-19																		
Decreased or same	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-	Ref.	-	-
Increased	**3.373**	1.571	0.0346	**1.002**	0.397	0.0119	**1.767**	0.593	0.0032	2.117	1.373	0.1267	**1.438**	0.329	<0.0001	**1.899**	0.482	0.0001

(Continued)

TABLE 5 (Continued)

	PHQ-9									GAD-7								
	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value	β	S.E	*P*-value
	< USD 2,000			USD 2,000–4,999			≥ USD 5,000			< USD 2,000			USD 2,000–4,999			≥ USD 5,000		
Regional-level factors																		
Gross Regional Domestic Product	−0.146	0.078	0.0653	0.038	0.020	0.0523	0.012	0.027	0.6571	−0.123	0.068	0.0756	**0.051**	0.016	0.0020	0.000	0.022	0.9841
Unmet healthcare need rates (%)	−0.210	0.331	0.5280	0.081	0.079	0.3072	−0.079	0.142	0.5770	−0.243	0.289	0.4032	0.054	0.066	0.4094	−0.099	0.116	0.3928
Mental health institution-to-population ratio*	**−1.355**	0.593	0.0247	0.051	0.155	0.7406	0.396	0.252	0.1172	**−1.177**	0.518	0.0255	**0.260**	0.128	0.0427	0.357	0.205	0.0825
Psychiatrist-to-population ratio†	0.323	0.293	0.2734	−0.106	0.080	0.1832	−0.199	0.128	0.1211	0.349	0.256	0.1773	−0.124	0.066	0.0612	−0.144	0.104	0.1669
Nurse-to-population ratio*	0.428	0.380	0.2622	0.019	0.083	0.8231	0.017	0.116	0.8852	0.421	0.332	0.2077	−0.002	0.069	0.9809	0.031	0.094	0.7385

COVID-19, coronavirus disease 2019; GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9; SD, Standard deviation; *per 1,000 population; †per 100,000 population; N/A presents that the model did not converge. Bold values indicates those are statistically significant.

indicating, in general, a very mild level of depression and anxiety (31). The average score of PHQ-9 in this study was reported higher compared to the reported results from previous studies (32), and the mean score of GAD-7 was also slightly higher compared to individuals with no mental disorder (28). With all the factors controlled, the intercept of predicted PHQ-9 and GAD-7 were mild-to-moderate levels of depression and anxiety. This difference might be attributable to the unique era of the pandemic and the situation of national-level lockdown and downsizing due to the COVID-19 case burden as compared to another era.

In addition to government measures, South Korea may have been able to effectively regulate COVID-19 because of public support. The current study found that factors at each level of the social-ecological model predicted the individual's depressive and anxiety symptoms during the pandemic in South Korea, confirming previous findings about the applicability of the social-ecological model to various issues (22, 33, 34). Our study results suggest that different efforts in multiple factors are needed to promote the management of mental health, in general. Moreover, although regional factors were identified as non-significant factors in general, for particular groups, such as groups by age and household income, regional factors, including GRDP and healthcare utilization variables, were revealed as significant factors. The factors significantly associated with anticipating the individual's mental health outcomes across the three levels were common in terms of support.

In this study, among intrapersonal factors, four of them were shown as significant factors in the associations with mental health outcomes throughout the analyses. Specifically, compared to the pre-pandemic era, the participants receiving less support from their family or friends or more stress from their workplace or home showed significant prediction with increased PHQ-9 and GAD-7 scores, which reflect a more severe level of depression and anxiety. Social bonds and supportive interactions with others are important for mental health; also, social support can buffer one from the negative consequences of stress (18). In addition, this study revealed the fact that among social support, family or home-related factors (i.e., marital status, support from family, and stress from home) have greater impacts on the individuals' depression and anxiety levels. These features were especially highlighted in several certain groups, including groups over 45 years old, or men, or with household incomes less than USD 2,000 or more than USD 5,000, whereas participants under 45 or with a household income less than USD 2,000 showed that support from friends was a significant factor.

An economic perspective can also be considered as one kind of social support, specifically material support. In general, participants with higher income levels showed lower levels of depressive and anxiety symptoms. Additionally, participants over 45 showed better depressive and anxiety levels in case of a secured financial status (i.e., employed or higher household income) (35–37). Among the women, household income status seemed to be the most significant predictor for their depressive and anxiety levels, whereas, among men, active support factors were significant. This finding may reflect cultural norms present in South Korea. In South Korea, wives are the main decision makers in the household and, therefore, may have been more affected by financial issues (38). In the subgroup analyses of the household incomes, each group highlighted different factors associated with the mental health outcomes of each group member. For example, the high-impact factors on mental health outcomes in low-income groups were related to financial support sources, whereas in middle-income groups, they were

related to the security of the income sources (i.e., job status), and in high-income groups, they were associated with the family relationship. Based on the result interpretation of this study, active support has the main overall effect. However, the effect size may differ depending on the individual's income status since the material supports that affect the individuals' livelihood are different. Therefore, the support policy that considers people's SES is different, and its implementation is a matter to be considered.

Some subgroup analyses showed significant regional factors associated with mental health outcomes; however, those results were mixed. To understand the positive associations of regional factors with mental health status, we conducted an additional correlation analysis between socio-ecological factors and population as a proxy of urbanness and mental health outcomes (Supplementary Figure 1). The correlation result showed that population and mental health outcomes were associated with a higher GRDP and a higher ratio of healthcare personnel to the population. Among participants aged over 45, both PHQ-9 and GAD-7 showed positive associations with GRDP. GRDP measures the economic performance of a region which is an indicator of macro-economic performance in the local economy (39). Moreover, higher GRDP is most likely to be observed in metropolitan areas with large populations (39). In a previous study, participants living in metropolitan areas had lower perceived social support than those in rural areas (40). This is likely to be interpreted as urban communities tend to be more isolating or individualistic. The culture of familism may have decreased more in urban populations than in rural populations, as South Korea rapidly industrializes as a developing nation (40).

Among regional factors, healthcare utilization factors were the ones that showed mixed results; in other words, both positive and negative associations were shown. Specifically, those with a household income of less than 2,000 USD lived in areas with lower healthcare to an institution-to-population ratio and reported higher scores on the PHQ-9 and GAD-7. In South Korea, mental health promotion programs are planned and implemented in "Si," "Gun," and "Gu" to manage community mental health levels *via* community primary mental health clinics. Those programs are mandatory projects conducted in the clinics. According to our study, low household-income individuals are likely to benefit from resources such as greater numbers of mental health institutions provided in their community. Thus, a large supply of local mental health institutions can help provide mental illness prevention services and distribute and apply them prophylactically among low-income individuals (41). On the other hand, the psychiatrist-to-population ratio or nurse-to-population ratio was positively associated with mental health outcomes among participants aged over 45 and household income between 2,000 and 4,999. From the result of the correlation analysis, the psychiatrist-to-population ratio, nurse-to-population ratio, and household income showed positive correlations with the population. Considering those results, the beta coefficients showed in multiple regression analyses may reflect the characteristics of large populations.

This study is the first that examined the association of individual-, interpersonal-, and regional-level factors on the individuals' mental health outcomes in the general Korean population during the COVID-19 pandemic with the perspective of a socio-ecological model. There are some limitations that should be noted. First, this is a representative sample of one region, but not of the entire country or analyzing other regional differences, which threatens generalizability. Second, the main focus of this survey is on the individual and interpersonal factors impacting mental health status; however, the regional-level variables have not been developed with the purpose of the study in mind. Thus, we may omit key community factors with a significant impact on the individuals' depressive symptom management, including satisfaction with community mental health management programs. Third, the study measured mental symptoms using self-reported questionnaires rather than making clinical diagnoses. There may have also been response bias, with nervous individuals stressed by the epidemic and more inclined to engage in the survey. To minimize the response bias, the study survey was designed by a professional survey company with a psychiatrist consultant, and the interview was conducted by trained personnel, to avoid the leading questions. Fourth, since the survey's primary objective was to examine the general depressive mood and anxiety symptoms experienced by the community's residents as a result of COVID-19 during the pandemic, it is vital to evaluate for any pre-existing conditions that might have an impact on mental health or account for them in the analysis. However, the survey was more focused on environmental factors or general sociodemographic factors. The authors strongly suggest that in the next term of the survey, they should collect related pre-conditions that may influence mental health. Finally, due to the different survey methods, participants may have responded differently. There may be a possible social desirability bias (42). Social desirability bias is one of the response biases, the tendency of respondents to answer questions in a way that will be deemed positive by others. It is particularly observed in the questions that require socially desirable responses, which include personality, sexual behavior, and drug usage (42). To reduce the effect of bias, we confounded the survey method as a variable and conducted subgroup analysis by survey method to investigate different tendencies with beta coefficients that were not shown (Supplementary Table 1).

Despite these limitations, our findings have implications for psychological therapies aiming at lowering psychological distress and enhancing mental health and psychological resilience in the face of public health crises. To give evidence-based recommendations on responding to future pandemics in Korea, population-based research considering complex relations

of the individual-, interpersonal-, and regional-level factors on mental health and COVID-19 should be established.

Conclusion

In summary, we conducted a cross-sectional survey study to investigate socio-ecological factors associated with mental health outcomes, PHQ-9 and GAD-7, among 1,000 individuals during the COVID-19 pandemic in South Korea. From the adjusted multiple linear regression model, the study result revealed that the only different significant factor of PHQ-9 and GAD-7 was an individual-level factor which is employment status. Other than the employment status factor, three individual factors (i.e., marital status, monthly household income, and survey method) and four interpersonal factors (i.e., support from friends and family, stress from work and home) had significant associations, but no mental outcomes had significant associations with regional factors. All those factors are related to the economic status and support system of the individual and community. However, as shown in the previous study, individual and interpersonal factors were more adapted to explain the individuals' depressive and anxiety symptoms management during the COVID-19 pandemic than upper-level factors, suggesting the need for additional policies targeting these lower levels (22).

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 Dankook University (DKU 2021-05-038). The patients/participants provided their written informed consent to participate in this study.

Author contributions

SL has made substantial contributions to the conception, design of the work, interpretation of data, drafted the work, substantively revised it, final approval of the version to be published, and agreed to be accountable for the integrity of any part of the work are appropriately investigated and resolved. JL has made substantial contributions to the acquisition and interpretation of data for the work, revising it critically for important intellectual content, final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy. HL has made substantial contributions to the design of the work, the acquisition, analysis, and interpretation of data, substantively revised the work, final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy and integrity of any part of the work are appropriately investigated and resolved. All authors have approved the submitted version and have agreed to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1024751/full#supplementary-material

References

1. Pfefferbaum B, Schonfeld D, Flynn BW, Norwood AE, Dodgen D, Kaul RE, et al. The H1N1 crisis: a case study of the integration of mental and behavioral health in public health crises. *Disaster Med Public Health Prep.* (2012) 6:67–71. doi: 10.1001/dmp.2012.2

2. Douglas PK, Douglas DB, Harrigan DC, Douglas KM. Preparing for pandemic influenza and its aftermath: mental health issues considered. *Int J Emerg Ment Health.* (2009) 11:137.

3. Wang C, Tee M, Roy AE, Fardin MA, Srichokchatchawan W, Habib HA, et al. The impact of COVID-19 pandemic on physical and mental health of Asians: a study of seven middle-income countries in Asia. *PLoS ONE.* (2021) 16:e0246824. doi: 10.1371/journal.pone.0246824

4. Wang C, Tripp C, Sears SF, Xu L, Tan Y, Zhou D, et al. The impact of the COVID-19 pandemic on physical and mental health in the two largest economies in the world: a comparison between the United States and China. *J Behav Med.* (2021) 44:741–759. doi: 10.1007/s10865-021-00237-7

5. Sassone B, Mandini S, Grazzi G, Mazzoni G, Myers J, Pasanisi G. Impact of COVID-19 pandemic on physical activity in patients with implantable cardioverter-defibrillators. *J Cardiopulm Rehabil Prev.* (2020) 40:285. doi: 10.1097/HCR.0000000000000539

6. Alonzi S, La Torre A, Silverstein MW. The psychological impact of preexisting mental and physical health conditions during the COVID-19 pandemic. *Psychol Trauma.* (2020) 12:S236. doi: 10.1037/tra0000840

7. Sade S, Sheiner E, Wainstock T, Hermon N, Yaniv Salem S, Kosef T, et al. Risk for depressive symptoms among hospitalized women in high-risk pregnancy units during the COVID-19 pandemic. *J Clin Med.* (2020) 9:2449. doi: 10.3390/jcm9082449

8. Patabendige M, Gamage MM, Weerasinghe M, Jayawardane A. Psychological impact of the COVID-19 pandemic among pregnant women in Sri Lanka. *Int J Gynaecol Obstetr.* (2020) 151:150. doi: 10.1002/ijgo.13335

9. Durankuş F, Aksu E. Effects of the COVID-19 pandemic on anxiety and depressive symptoms in pregnant women: a preliminary study. *J Mater Fetal Neonatal Med.* (2022) 35:205–11. doi: 10.1080/14767058.2020.1763946

10. Thayer ZM, Gildner TE. COVID-19-related financial stress associated with higher likelihood of depression among pregnant women living in the United States. *Am J Hum Biol.* (2021) 33:e23508. doi: 10.1002/ajhb.23508

11. Silverman ME, Medeiros C, Burgos L. Early pregnancy mood before and during COVID-19 community restrictions among women of low socioeconomic status in New York City: a preliminary study. *Arch Womens Mental Health.* (2020) 23:779–782. doi: 10.1007/s00737-020-01061-9

12. Li W, Yang Y, Liu Z-H, Zhao Y-J, Zhang Q, Zhang L, et al. Progression of mental health services during the COVID-19 outbreak in China. *Int J Biol Sci.* (2020) 16:1732. doi: 10.7150/ijbs.45120

13. Kearney A, Hamel L, Brodie M. *Mental Health Impact of the COVID-19 Pandemic: An Update*. San Franciso, CA: Kaiser Family Foundation (2021).

14. Kim Y, Kwon H-Y, Lee S, Kim C-B. Depression during COVID-19 quarantine in South Korea: a propensity score-matched analysis. *Front Public Health.* (2021) 9:743625. doi: 10.3389/fpubh.2021.743625

15. Lee H, Choi D, Lee JJ. Depression, anxiety, and stress in Korean general population during the COVID-19 pandemic. *Epidemiol Health.* (2022) 44:e2022018. doi: 10.4178/epih.e2022018

16. Yao H, Chen J-H, Xu Y-F. Patients with mental health disorders in the COVID-19 epidemic. *Lancet Psychiatry.* (2020) 7:e21. doi: 10.1016/S2215-0366(20)30090-0

17. Canet-Juric L, Andrés ML, Del Valle M, López-Morales H, Poó F, Galli JI, et al. A longitudinal study on the emotional impact cause by the COVID-19 pandemic quarantine on general population. *Front Psychol.* (2020) 2431:565688. doi: 10.3389/fpsyg.2020.565688

18. Turner RJ, Brown RL. Social support and mental health. In: Scheid T, Brown T, editors. *A Handbook for the Study of Mental Health: Social Contexts, Theories, and Systems.* Cambridge: Cambridge University Press (2010). p. 200–12.

19. Cobb S. Social support and health through life course. In: Riley MW, editor. *Aging From Birth to Death Interdisciplinary Perspective*. Washington, DC: American Association for the Advancement of Science (1979). p. 93–106.

20. Lee JH, Lee H, Kim JE, Moon SJ, Nam EW. Analysis of personal and national factors that influence depression in individuals during the COVID-19 pandemic: a web-based cross-sectional survey. *Global Health.* (2021) 17:1–12. doi: 10.1186/s12992-020-00650-8

21. Ruiz-Pérez I, Bermúdez-Tamayo C, Rodríguez-Barranco M. Socio-economic factors linked with mental health during the recession: a multilevel analysis. *Int J Equity Health.* (2017) 16:1–8. doi: 10.1186/s12939-017-0518-x

22. Hennein R, Mew EJ, Lowe SR. Socio-ecological predictors of mental health outcomes among healthcare workers during the COVID-19 pandemic in the United States. *PLoS ONE.* (2021) 16:e0246602. doi: 10.1371/journal.pone.0246602

23. Jang SH. Social-ecological factors related to preventive behaviors during the COVID-19 pandemic in South Korea. *PLoS ONE.* (2022) 17:e0266264. doi: 10.1371/journal.pone.0266264

24. Shin C, Ko Y-H, An H, Yoon H-K, Han C. Normative data and psychometric properties of the Patient Health Questionnaire-9 in a nationally representative Korean population. *BMC Psychiatry.* (2020) 20:1–10. doi: 10.1186/s12888-020-02613-0

25. McMillan D, Gilbody S, Richards D. Defining successful treatment outcome in depression using the PHQ-9: a comparison of methods. *J Affect Disord.* (2010) 127:122–9. doi: 10.1016/j.jad.2010.04.030

26. Cassin S, Sockalingam S, Hawa R, Wnuk S, Royal S, Taube-Schiff M, et al. Psychometric properties of the Patient Health Questionnaire (PHQ-9) as a depression screening tool for bariatric surgery candidates. *Psychosomatics.* (2013) 54:352–8. doi: 10.1016/j.psym.2012.08.010

27. Ko M, Cho HM, Park J, Chi S, Han C, Yi HS, et al. Impact of the coronavirus disease pandemic on mental health among local residents in Korea: a cross sectional study. *J Korean Med Sci.* (2021) 36:e322. doi: 10.3346/jkms.2021.36.e322

28. Ahn J-K, Kim Y, Choi K-H. The psychometric properties and clinical utility of the Korean version of GAD-7 and GAD-2. *Front Psychiatry.* (2019) 10:127. doi: 10.3389/fpsyt.2019.00127

29. Sandman L, Hofmann B. Why we don't need "Unmet Needs"! on the concepts of unmet need and severity in health-care priority setting. *Health Care Anal.* (2019) 27:26–44. doi: 10.1007/s10728-018-0361-2

30. O'brien RM. A caution regarding rules of thumb for variance inflation factors. *Qual Quant.* (2007) 41:673–90. doi: 10.1007/s11135-006-9018-6

31. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* (2001) 16:606–13. doi: 10.1046/j.1525-1497.2001.016009606.x

32. Kim SY, Yoo DM, Min C, Choi HG. Assessment of the difference in depressive symptoms of the Korean adult population before and during the COVID-19 pandemic using a community health survey. *J Affect Disord.* (2022) 300:130–6. doi: 10.1016/j.jad.2021.12.107

33. Dryhurst S, Schneider CR, Kerr J, Freeman AL, Recchia G, Van Der Bles AM, et al. Risk perceptions of COVID-19 around the world. *J Risk Res.* (2020) 23:994–1006. doi: 10.1080/13669877.2020.1758193

34. Capraro V, Barcelo H. The effect of messaging and gender on intentions to wear a face covering to slow down COVID-19 transmission. *arXiv preprint arXiv:200505467.* (2020) doi: 10.31234/osf.io/tg7vz

35. Samuelsson G, McCamish-Svensson C, Hagberg B, Sundström G, Dehlin O. Incidence and risk factors for depression and anxiety disorders: results from a 34-year longitudinal Swedish cohort study. *Aging Ment Health.* (2005) 9:571–5. doi: 10.1080/13607860500193591

36. Yaka E, Keskinoglu P, Ucku R, Yener GG, Tunca Z. Prevalence and risk factors of depression among community dwelling elderly. *Arch Gerontol Geriatr.* (2014) 59:150–4. doi: 10.1016/j.archger.2014.03.014

37. MacEwen KE, Barling J, Kelloway EK, Higginbottom SF. Predicting retirement anxiety: the roles of parental socialization and personal planning. *J Soc Psychol.* (1995) 135:203–13. doi: 10.1080/00224545.1995.9711424

38. Lee KJ, Um CC, Kim S. Multiple roles of married Korean women: effect on depression. *Sex Roles.* (2004) 51:469–78. doi: 10.1023/B:SERS.0000049235.60839.ef

39. Feriyanto N. Determinant of gross regional domestic product (GRDP) in Yogyakarta special province. *Econ J Emerg Mark.* (2014) 2014:131–40. doi: 10.20885/ejem.vol6.iss2.art6

40. Eom CS, Shin DW, Kim SY, Yang HK, Jo HS, Kweon SS, et al. Impact of perceived social support on the mental health and health-related quality of life in cancer patients: results from a nationwide, multicenter survey in South Korea. *Psychooncol.* (2013) 22:1283–90. doi: 10.1002/pon.3133

41. Fleury M-J, Ngamini Ngui A, Bamvita J-M, Grenier G, Caron J. Predictors of healthcare service utilization for mental health reasons. *Int J Environ Res Public Health.* (2014) 11:10559–86. doi: 10.3390/ijerph111010559

42. Kaushal K. Social desirability bias in face to face interviews. *J Postgrad Med.* (2014) 60:415. doi: 10.4103/0022-3859.143989

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Social participation and mental health of immunocompromised individuals before and after COVID-19 vaccination–Results of a longitudinal observational study over three time points

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Introduction: The coronavirus disease 2019 (COVID-19) pandemic impacted how people perform their daily lives in manifold and sometimes massive ways. Particularly, individuals who are at high risk for a severe disease progression, like immunocompromised people, may have experienced drastic changes in social participation during the pandemic. A COVID-19 basic vaccination may have changed the safety behavior of immunocompromised individuals in terms of infection risk and thereby influence social participation and mental wellbeing.

Methods: This study aims to investigate self-perceived social participation at baseline before and at follow-up 1 and 6 months after basic vaccination. Beginning in March 2021, 274 immunocompromised persons 18 years or older were enrolled in the COVID-19 Contact Immune study (CoCo study) in Lower Saxony, Germany. Measurements were performed at three time points regarding social participation [Index for the Assessment of Health Impairments (IMET)], mental health [Patient Health Questionnaire-4 (PHQ-4)], subjective health status (five-point Likert-scale) and quality of life (five-point Likert-scale).

Results: In total, 126 participants were included in the final analysis. About 60% of the participants showed increasing social participation over time. The greatest increase in social participation was observed within the first month after basic vaccination ($p < 0.001$). During the following 5 months, social participation remained stable. The domains "social activities," "recreation and leisure" and "close personal relationships" were responsible for the overall change in social participation. No association was found between social

participation and mental health, sociodemographic or medical factors (except hypertension).

Discussion: It is unclear why social participation increased after basic vaccination. Perceived vaccine efficacy and a feeling of being protected by the vaccine may have caused relaxed social distancing behaviors. Reducing safety behaviors may, however, increase the risk of a COVID-19 infection for immunocompromised individuals. Further investigations are needed to explore the health-related consequences of more social participation among immunocompromised persons.

KEYWORDS

SARS-CoV-2 vaccination, immunocompromised persons, social participation, mental health status, quality of life, observational study, longitudinal study, COVID-19

1 Introduction

Since the emergence of severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) in Wuhan in December 2019 and the global spread of the virus, the pandemic has greatly changed daily lives and social participation (1–3). To minimize new infections, all social events and contacts outside the household were restricted. The German population was asked to practice social distancing, to observe hygiene regulations and to wear a mask. There were several "lockdowns" in Germany, the first starting 22nd March 2020 for 3 weeks and the last one from 16th December 2020 for about 4 weeks (4). The population subsequently spent a larger part of the day at home with less contact to others (1). The above-mentioned circumstances could have a negative impact on social participation, which in turn is negatively associated with health status and quality of life (5, 6).

The impact of COVID-19 related lockdowns on lifestyle habits and behavioral risk factors cannot be ignored. Immunocompromised individuals as a vulnerable population are particularly at risk for severe COVID-19 and therefore also at a higher risk for psychological distress (7). Also non-pharmacological treatments for mental disorder such as enhancing exercise were restricted during the pandemic (8, 9). Nürnberger et al. reported that immunocompromised individuals as well as women in general have a high level of COVID-19 anxiety (10). For this reason, it is likely that these individuals follow measures more diligently compared to non-immunocompromised individuals or they take additional infection prevention measures even beyond the official requirements. Additionally, family and friends of such persons could be more careful in keeping their distance to avoid the risk of infecting vulnerable loved ones.

Stipulating infection prevention measures that require individuals to reduce social contacts create a difficult tradeoff between physical and mental health. Initial studies confirm this psychological burden (11, 12).

The COVID-19 vaccination is considered the most effective protective measure to prevent severe courses of COVID-19. Recommendations on the number and timing of vaccine doses changed frequently during the pandemic. At the beginning of our study, it was assumed that a basic vaccination was achieved 14 days after the second vaccination. All in Germany licensed COVID-19 vaccines are highly effective in protection against severe and lethal COVID-19 (13–16). At the time of the first vaccinations in 2021, it was assumed that social restrictions could be eased after achieving a high vaccination rate about 80% (17). Today, even higher vaccination rates and booster vaccinations are known to be necessary in presence of highly infective and partly immune-escape SARS-CoV-2 virus variants (18).

Vaccine efficacy in immunosuppressed people remains unclear (19, 20). Due to the new virus variants of concern, vaccine effectiveness has decreased even for immunocompetent persons, in particular against infection and any COVID-19 disease, whilst effectiveness against severe disease remains high (21, 22). Factors influencing social participation could be the number and type of immunosuppressive medications and comorbidities as well as self-perceived vulnerability for a severe COVID-19 course. Due to viral variants of concern, the difficult predictability of the individual case and studies with only small numbers of investigated cases, the vaccine effectiveness for immunocompromised persons remains not entirely clear. Nevertheless, vaccination status may change the perceived importance of safety behaviors and decrease the compliance with measures to limit the spread of the disease.

Abbreviations: COVID-19, coronavirus disease 2019; CoCo Study, corona contact study; GAD-2, Generalized Anxiety Disorder Scale-2; IMET, Index for the Assessment of Health Impairments; PHQ-4, Patient Health Questionnaire-4; PHQ-2, Patient Health Questionnaire-2; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Social participation could increase because of a sense of security, even though the actual level of protection remains uncertain.

Understanding the impact of vaccination on social participation and mental health during the pandemic period will lead to increased understanding of the impact of infection prevention measures upon everyday life and health. This knowledge can be used when planning further measures.

The main hypotheses tested in this study are:

(1) Social participation improves after basic vaccination against COVID-19 and remains improved or continues to improve after 6 months.
(2) Changes in mental health are associated with changes in social participation.
(3) Sociodemographic, medical or pandemic-related factors are associated with changes in social participation.

2 Materials and methods

2.1 Research design and participants

The COVID-19 Contact Immune study (CoCo study) is a longitudinal, prospective, observational study and was conducted at two large university hospitals in Göttingen and Hannover in Germany (23). Beginning in March 2021, we recruited persons who (1) were 18 years or older, (2) able to provide informed consent and (3) immunocompromised due to an immunosuppressive drug therapy. Exclusion criteria were (1) refusal/inability to provide informed consent or (2) contraindications to blood testing. There were no further inclusion or exclusion criteria.

We recruited study participants with newspaper advertisements and posters in hospitals, vaccination centers, and in offices of rheumatologists. Due to vulnerability of immunocompromised people, we organized the study so that participation was possible with very little in-person contact. Interested persons contacted the study center by phone or e-mail. The declaration of consent by the participants could be given by telephone, videocall, or in person during a short interview for information and enrollment purposes. The study team encouraged every participant to comply with all publicly recommended measures and regulations. The signed consent form was returned by mail. The study team send the study materials (e.g., questionnaires and blood sample kits) to recruited participants by mail at the start of the study. Pencil and paper questionnaires assessed the social participation and mental health at three different time points: at enrollment before basic vaccination against COVID-19 (T0) and 1 month (T1) and 6 months (T2) after basic vaccination. There was an additional computer-assisted telephone follow-up from December 2021 until January 2022 to determine if and when the participants got a third vaccine dose. Further information about the CoCo study can be gathered in the study protocol (23).

2.2 Measures

2.2.1 IMET

The Index for the Assessment of Health Impairments (IMET) is based on the International Classification of Functioning, Disability, and Health (24). It was initially developed to collect data about social participation in rehabilitation research. The questionnaire measures if the persons perceive any impairments regarding nine dimensions of their social participation using a 11 level Likert-scale (0–10). Higher scores indicate a greater impairment. The sum score of these nine items describes the overall social participation with a high internal reliability (Cronbach's alpha of 0.90). This instrument was already used during the COVID-19 pandemic by Mergel and Schützwohl to define impairments of social participation in people without and with mental disorders (25). A between group change of 4.41 points between the intervention and control group of a rehabilitation intervention was observed by Hüppe et al. (26).

2.2.2 PHQ-4

The Patient Health Questionnaire-4 (PHQ-4) is an ultra-short questionnaire, consisting of two items collect data about depression (PHQ-2) and two items measure anxiety (GAD-2, Generalized Anxiety Disorder Scale-2). It is a reliable and validated questionnaire that uses four-point Likert scales. Sum scores from 0 to 12 are achievable with higher scores indicating worse psychological health. The specificity of the PHQ-4 is 94.5% and the sensitivity 51.6% at a cutoff of 6 (27). The PHQ-4 has been used in other studies to evaluate mental health during the COVID-19-pandemic (28).

2.3 Sample size calculation

The CoCo study explores the effect of the COVID-19 vaccination on social participation. In Germany, the first COVID-19 vaccine was authorized on December 27, 2020. The COVID-19 CoCo study was registered on the December 30, 2020. Until this date, no study had investigated social participation before and after a COVID-19 vaccination. Therefore, no sample size calculation was done prior to this study. We assume a medium effect size (Cohen's $f = 0.25$) on social participation, measured by the IMET before and after vaccination. Using G Power for sample size calculation, 44 participants would be sufficient with a correlation of 0.5 among the repeated measures and an alpha level of 5% to detect such an effect. Using non-parametric tests, a 15% higher sample size is needed, resulting in 51 participants.

2.4 Statistical analysis

Participants were excluded from statistical analysis if they (a) did not state their immunosuppressive medication or underlying disease, (b) already had a basic COVID-19 vaccination at baseline (14 days or more after two vaccinations or after one in case if the COVID-19 Vaccine Janssen was used), (c) the first and the second questionnaire were completed within an interval of 21 days or less, or (d) participants did not complete the whole IMET questionnaire at all three time points. Sociodemographic and medical are reported with number of participants in each category and the corresponding proportion. Age is reported with mean and standard deviation (SD). For a sensitivity analyses, the participants were divided into two groups: one group in which social participation improved and one group in which social participation remained stable or worsened between T0 (before vaccination) and T2 (6 months after basic vaccination). Between these groups, the sociodemographic (gender, age, school education, city resident size, household) and medical factors (underlying disease, comorbidities, degree of disability, immunosuppression medication, number of immunosuppressants, therapy paused for COVID-19 vaccination) were compared using the Fisher-Exact test for 2×2 contingency tables and the Freeman-Halton extension for larger tables. Median scores with the corresponding interquartile range (IQR) for all included scales and subscales for the three observation points are reported and compared between the three time points using the Quade test because of a non-normal distribution of the data. When testing subscales, the p-value was adjusted using the Bonferroni method. Participants were grouped according to their IMET courses (increased, stable, or decreased social impairments) between T0–T1 and T1–T2 resulting in nine possible courses (**Supplementary material**). Stable social impairment was defined as a maximum IMET sum score difference of one point between two time points.

To test for an association between the third vaccine dose and a change of the IMET score between the timepoints T1 (1 month after basic vaccination) and T2 (6 months after basic vaccination), the Kruskal-Wallis test was performed. Participants without information about the third vaccination were excluded. The IMET scores at baseline were compared to mean scores of persons with an inflammatory bowel disease from 2014 (6) in order to categorize our sample into two groups of participants with lower or higher social participation compared to pre-pandemic levels.

The association between mental health and social participation was tested using repeated measure correlation and McNemar's test for categorized PHQ-4 scores (cutoff score six or higher). Additionally, we compared the incidence of mental health disorders using the PHQ-4 in participants with an increased or decreased/stable social participation. For this analysis, participants with a PHQ-4 score above the cut-off at baseline or with a current self-stated depression were excluded.

Data regarding the COVID-19 incidence in the Göttingen county and the hospitalization rate of COVID-19 cases in Germany were gathered from the Website of Germany's public health institute (29).

All statistical analyses and graphical illustrations were performed using R 4.1.1. Stats (30), rmcorr (31), and ggplot2 (32).

3 Results

The first participant was included on March 28, 2021. The last participant was included in May 20, 2021. No participant completed the survey during the period of national lockdown in Germany.

After applying the in- and exclusion criteria, 126 participants were included in the final analysis (see **Figure 1**). The mean difference between T0 and T1 was 81.6 days (SD: 22.5) and between T0 and T2, 236.5 days (SD: 27.7).

3.1 Participants' characteristics

The majority of participants (70.4%) were female. The mean age was 52.1 years (SD: 13.0). Most (59.5%) had completed high school. Most participants lived in rural areas (41.3%), followed by 26.5% who lived in cities with more than 100,000 inhabitants (**Table 1**).

The most frequent underlying diseases were rheumatological diseases (38.9%), inflammatory bowel diseases (16.7%), psoriasis (15.1%), and multiple sclerosis (14.3%). Two or more immunosuppressive medications were taken by 42% of the participants. Oral Corticosteroids and Methotrexate (MTX) were the most frequently taken medications. About one-quarter of the participants (23.8%) interrupted their immunosuppressive therapy for the COVID-19 vaccination. Hypertension was the most common comorbidity with 42.1%. About 60% of participants had a formally recognized degree of disability.

At the second follow-up, 36.5% of participants had already received a third vaccine dose, 45.2% had only received basic vaccination and 18.3% did not state this information.

Hypertension was the only sociodemographic, medical or pandemic-related variable which differed significantly between participants with increased (62.7%) and participants with decreased or stable (37.3%) social participation ($p = 0.01$).

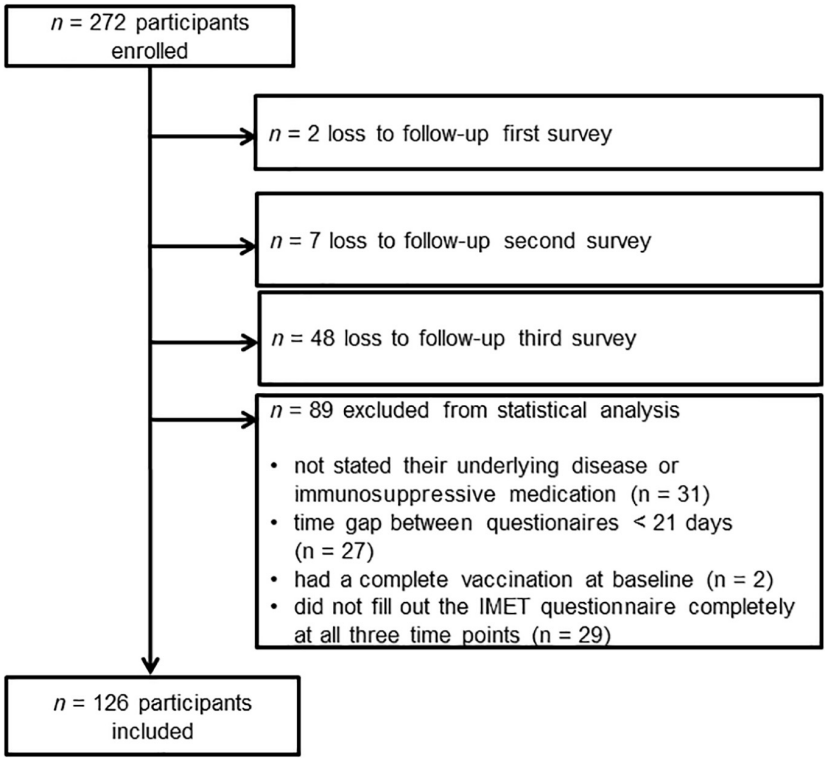

FIGURE 1
Flowchart of participant inclusion and exclusion.

3.2 Measured changes over three timepoints

A significant change between the three timepoints was only observed in the IMET score (see Table 2). *Post hoc* analysis revealed a significant decrease of the IMET scores between T0 and T1 (p = 0.01) and T0 and T2 (p = 0.001). The change between T1 and T2 was not significant. After Bonferroni correction of the p-values, the domains "recreation and leisure," "social activities," and "close personal relationships" showed a significant change. The highest change was observed in the domain "social activities." Over 50% of the participants reported no restrictions in the domain "usual activities of daily life" in all three time points. Identical results could also be obtained when excluding participants with not specified or a low level of school education, single parents, and participants with not specified underlying diseases (n = 101).

3.3 Social participation courses

To give a better insight into the courses of social participation, we describe each possible combination of the change of social participation in Table 3. Furthermore, these courses are shown in the form of a graph in Supplementary Figure 2. One of every six participants (17.5%) showed fewer limitations in their social participation between T0 and T1 as well as between T1 and T2. The median IMET score decreased in this group by 23 points. The majority of all participants, 34.1% experienced fewer limitations in their social participation 1 month after the second COVID-19-vaccination and in the following 5 months the number of limitations to social participation slightly increased again. Nevertheless, compared with their baseline scores, the limitations to social participation decreased in total by a median of five points.

About one-third of the participants showed an increased amount of limitations to social participation between T0 and T2. About one-fourth of all participants (23%) experienced more limitations 1 month after basic vaccination and fewer limitations after 6 months; the median IMET score increased by one point.

58.7% of all participants had fewer limitations to social participation 1 month after basic vaccination. About 10% had a stable social participation and 31.8% experienced more limitations. Of those who experienced more limitations, 20% continued this trend in the next 5 months. Of those who improved (i.e., experienced fewer limitations), about 30% improved further in the next 5 months. The amount of change can be seen in Table 3.

Six months after basic COVID-19-vaccination, 62.6% reported fewer limitations (gray-colored cells in Table 3) and

10.3389/fpsyt.2022.1080106

TABLE 1 Sociodemographic, medical, and pandemic-related characteristics of study participants with increased social participation and participants with decreased or stable social participation.

	All (N = 126) n (%)	SP increased (N = 78) n (%)	SP decreased or stayed stable (N = 48) n (%)	p
Gender				
Male	37 (29.6)	24 (31.2)	13 (27.1)	0.81
Female	88 (70.4)	53 (68.8)	35 (72.9)	
Age, years [mean (SD)]	52.1 (13.0)	50.7 (13.8)	54.4 (11.4)	
<40	28 (22.4)	21 (27.3)	7 (14.6)	0.27
40–65	76 (60.8)	45 (58.4)	31 (64.6)	
>65	21 (16.8)	11 (14.3)	10 (20.8)	
School education				
Low	8 (6.3)	3 (4.1)	5 (10.6)	0.22
Middle	35 (27.8)	18 (24.3)	17 (36.2)	
High	75 (59.5)	51 (68.9)	24 (51.1)	
Not specified	3 (2.4)	2 (2.7)	1 (2.1)	
City resident size				
<5,000	50 (41.3)	32 (41.0)	18 (37.5)	0.65
5,000–20,000	28 (23.1)	14 (18.0)	14 (29.2)	
20,000–100,000	11 (9.1)	7 (9.0)	4 (8.3)	
>100,000	32 (26.5)	21 (26.9)	11 (22.9)	
Household*				
Parenting	26 (20.6)	19 (24.4)	7 (14.6)	0.26
Single parent	2 (1.6)	2 (2.6)	0 (0.0)	0.53
Living alone	22 (17.5)	14 (18.0)	8 (16.7)	1
Care of relatives other than children	16 (12.7)	9 (11.5)	7 (14.6)	0.78
Underlying disease*				
Rheumatological disease	49 (38.9)	30 (38.5)	19 (39.6)	1
Inflammatory bowel disease	21 (16.7)	14 (18.0)	7 (14.6)	0.81
Psoriasis	19 (15.1)	11 (14.1)	8 (16.7)	0.80
Multiple sclerosis	18 (14.3)	14 (18.0)	4 (8.3)	0.19
Solid organ transplant	10 (7.9)	6 (7.7)	4 (8.3)	1
Other	12 (9.5)	4 (5.1)	8 (16.7)	0.051
Comorbidities*				
Hypertension	53 (42.1)	25 (32.1)	28 (58.3)	0.01
Diabetes type 2	6 (4.8)	6 (7.7)	0 (0.0)	0.08
Depression	15 (11.9)	11 (14.1)	4 (8.3)	0.41
Severe obesity	17 (13.5)	11 (14.1)	6 (12.5)	1
Renal insufficiency	9 (7.1)	6 (7.7)	3 (6.3)	1
Chronic pain	23 (18.2)	15 (19.2)	8 (16.7)	0.81
Asthma bronchiale	12 (9.5)	7 (9.0)	5 (10.4)	0.77
Allergies	27 (21.4)	17 (21.8)	10 (20.8)	1
Formal degree of disability (%)[1]				
No impairment (0)	48 (38.4)	31 (39.7)	17 (35.4)	0.86
Low impairment (20–49)	23 (18.4)	15 (19.2)	8 (16.7)	
Moderate impairment (50–74)	43 (34.4)	25 (32.1)	18 (37.5)	
Severe impairment (75–100)	11 (8.8)	6 (7.7)	5 (10.4)	
Immunosuppressive medication*				
Glucocorticosteroids	44 (34.9)	29 (37.2)	15 (31.3)	0.57
Methotrexat	30 (23.8)	20 (25.6)	10 (20.8)	0.67
TNF inhibitor	26 (20.6)	14 (18.0)	12 (25.0)	0.37
Azathioprin	10 (7.9)	6 (7.7)	4 (8.3)	1

(Continued)

TABLE 1 (Continued)

	All (N = 126) n (%)	SP increased (N = 78) n (%)	SP decreased or stayed stable (N = 48) n (%)	p
Tacrolimus and everolimus	9 (7.1)	5 (6.4)	4 (8.3)	0.73
Others	34 (27.0)	21 (26.9)	13 (27.1)	1
Therapy paused for COVID-19 vaccination	30 (23.8)	16 (20.5)	14 (29.2)	0.24
Number of immunosuppressant substances taken				
1	73 (57.9)	41 (52.6)	32 (66.7)	0.3
2	41 (32.5)	28 (35.9)	13 (27.1)	
3 or more	12 (9.5)	9 (11.5)	3 (6.3)	
Booster vaccination				
Before T2	46 (36.5)	31 (39.8)	15 (31.3)	0.51
After T2	57 (45.2)	32 (41.0)	25 (52.1)	
Unknown	23 (18.3)	15 (19.2)	8 (16.7)	

*Multiple selection possible. [1]Based on the German social law measuring physical, mental, and social impairment.

TABLE 2 Median scores and interquartile range of included measures for each observed time point.

Median (IQR)	T0	T1	T2	F
IMET score (N = 126)	**32 (24.75)**	**23.5 (26.75)**	**22 (25)**	**7.42**
Usual activities of daily life[5]	0 (2)	0 (2)	0 (2)	0.60
Family and domestic responsibilities[6]	1 (3)	1 (3.75)	1.5 (3.75)	1.32
Getting things done outside of home[4]*	3 (5)	2 (3)	2 (3.75)	4.49
Daily tasks and obligations[8]	2 (4.75)	2 (4)	2 (4)	0.84
Recreation and leisure[9]	**6 (6.5)**	**3 (5)**	**3 (4)**	**18.15**
Social activities[9]	**9 (5)**	**5 (5)**	**4 (6)**	**30.73**
Close personal relationships[7]	**2 (6)**	**2 (4)**	**1.5 (5)**	**4.91**
Sex life[7]	2 (5)	3 (6)	2 (6)	2.30
Stress and extraordinary strain[2]	3 (4.75)	2 (4)	3 (5)	2.30
PHQ-4 (N = 122)	2.5 (3)	2 (3)	3 (3)	1.39
GAD-2 (N = 124)*	1 (2)	1 (2)	1 (2)	3.25
PHQ-2 (N = 122)	2 (1)	1 (1)	1 (3)	1.16
QoL (N = 126)	3 (2)	3 (2)	3 (2)	1.65
Health status (N = 126)	3 (2)	3 (2)	3 (2)	0.75

Bold: significant change between one of other time points using Quade test. *$P < 0.05$ but not significant after Bonferroni correction. IMET, Index for the Assessment of Health Impairments; PHQ-4, Patient Health Questionnaire-4; PHQ-2, Patient Health Questionnaire-2; GAD-2, Generalized Anxiety Disorder Scale-2. Superscript indicating targeted ICF domain.

37.4% more limitations to social participation. None of the participants remained the same, defined as plus/minus one point on the IMET score after 6 months.

3.4 Association between social participation and mental health

Repeated correlation measures show a small correlation of IMET and PHQ-4 scores comparing the baseline and follow-up time points [r = 0.17, 95% CI (0.05; 0.29)].

The incidence of severe mental health symptoms measured by the PHQ-4 did not change during the time points using the McNemar's test. The incidence of mental disorders between T0 and T2 did not differ significantly between participants with an increased social participation (7 out of 62) and participants with a stable t or decreasing social participation (5 out of 36). Only those participants with a PHQ-4 score below the cut-off point (<6) or without a self-stated depression at T0 (N = 98) were included in this analysis.

3.5 Possible confounding pandemic factors

Figure 2 shows a higher incidence of COVID-19 cases per 100,000 inhabitants at timepoint T0 than at T1. At T2, the incidence is even higher than at T0. With regard to

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TABLE 3 Index for the Assessment of Health Impairments (IMET) score courses between three timepoints and the corresponding median of IMET score for a particular course in parentheses.

		T1 – T2		
		Fewer limitation	**No change**	**More limitations**
T0 – T1	**Fewer limitations**	17.5 (−23)	7.1 (−9)	34.1 (−5)
	No change	4.0 (−21)	0 (–)	5.6 (6)
	More limitation	23.0 (1)	2.4 (7)	6.4 (21)

Data % of all participants (median IMET scores difference T2–T0 in each cell). Cells with gray filling: fewer limitations in social participation (decreased IMET scores).

the levels of hospitalized COVID-19 cases in Germany, a similar course can be observed (**Supplementary Figure 1**). The IMET median scores become lower over all three timepoints, indicating fewer limitations to social participation. No association between the incidence and the limitations of social participation can be seen. These findings can be confirmed by repeated measure correlation [$r = -0.03$ 95% CI. (−0.16; 0.09)].

The distribution between participants who improved between T1 and T2 and participants who worsened or remained the same did not differ when stratified by third vaccine dose before or after T2 ($p = 0.84$). The Wilcoxon test comparing IMET score differences (T0–T2) between those who had a third vaccine dose before and those who had their third vaccination after T2 showed no significant difference ($p = 0.45$).

Those participants whose IMET score at baseline was higher (i.e., more limitations to social participation) compared to pre-pandemic conditions were more likely to improve (67.4%) until T2 than those whose IMET score was lower or at norm (45.2%) ($p = 0.03$). Using the Wilcoxon test, this finding was also confirmed ($p < 0.001$).

4 Discussion

This study focuses on the change in social participation between three time points before a basic COVID-19 vaccination to 6 months after vaccination. About 60% of our participants had an increased social participation (i.e., experienced fewer limitations to social participation) at median about 10 IMET points and 40% had a decreased social participation 6 months after basic COVID-19 vaccination. Sociodemographic and medical factors (except hypertension) did not differ between these two subgroups. The results of this study support the hypothesis that a basic vaccination is associated with increased social participation. The reduction of limitations to social participation may motivate individuals to get vaccinated and consequently increase the vaccination rate. Between 1 and 6 months after the basic vaccination, the level of social participation remains stable. The domains "recreation and leisure," "social activities," and "close personal relationships" were mainly responsible for the reduction of limitations to social participation, whereby "social activities" was the area where limitations decreased most.

The courses of social participation were different within 6 months of basic vaccination. More than the half of the participants had a heterogeneous course. About one-fifth of the participants showed an increase of social participation over all three time points. Nearly one-quarter of all participants reported more limitations 1 month after a full vaccination and fewer limitations 5 months later. With regards to this up and down profile, it is important to note that the actual protection provided by the COVID-19 vaccination is still unclear for immunocompromised individuals in general and even more so on an individual level. A possible explanation for the reduction of limitations at T2 is the fact that participants of the CoCo immune study could see the results of their T1 antibody-test online about 4 weeks after T1. Therefore, at T2, the participants knew if they had developed antibodies against SARS-CoV-2. This may have decreased their sense of vulnerability and improved their social participation–although the study personnel emphasized that the development of antibodies is not synonymous with protection and all participants were advised to continue to observe safety measures. There was no association between social participation and a third vaccination, local COVID-19 incidence rates, or mental health. Those participants whose social participation levels were worse compared to pre-pandemic norm values before a basic COVID-19-vaccination improved more frequently than those whose social participation was better or at the norm.

Most studies investigating social participation among certain COVID-19 risk groups did so in a cross-sectional design at one time point (33–35). Mergel and Schützwohl also observed increased impairments in social participation by using the IMET questionnaire during the first year of the COVID-19 pandemic, when no COVID-19 vaccination was available (25). The median amount of change (10 points) is similar to the change in social participation in a study which investigated the impact of a rehabilitation on the social participation of people with chronic inflammatory bowel diseases (26).

This study did not indicate an association between the change in social participation and several sociodemographic factors. In other studies, the elderly are often described as a vulnerable group with less social participation and less mental

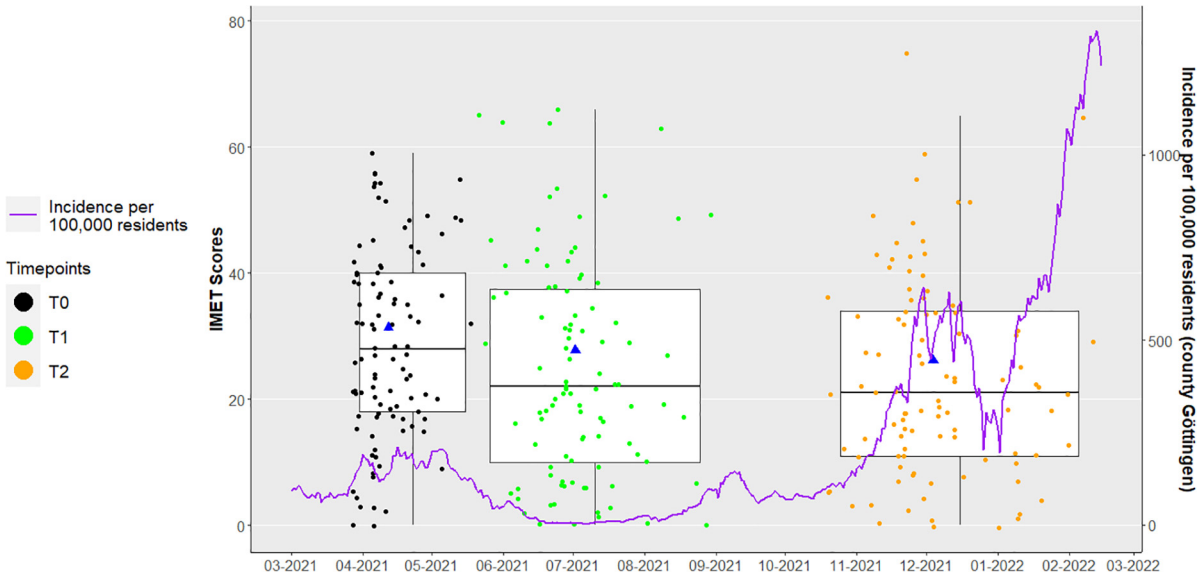

FIGURE 2
Median and mean change of social participation between T0, T1, and T2. Blue triangle: mean Index for the Assessment of Health Impairments (IMET) scores and mean date for each observation point; purple line: secondary Y-Axis [Incidence per 100,000 residents (county Göttingen)].

health during the pandemic (36, 37). In our study, there was no significant impact of age on the change in social participation. This may be explained by the fact that this study only examined the changes of social participation and did not consider the baseline social participation level. Age-related differences may be masked by immunosuppressive medication, as a greater impact of this on social participation is possible.

Gender influenced participation in work life during the COVID-19-pandemic according to Flor et al. Women were more often affected by losing their jobs or dropping out of school (38). Another study found that living in small villages is negatively associated with social participation (39). These findings were not confirmed by our study of participants with a severe chronic illness and immunosuppressive treatment.

Hypertension was the only comorbidity that had a significant influence on the change in social participation. Participants with hypertension were more likely to experience more limitations to their social participation. Deng et al. observed that participants with hypertension had a nearly 4.5-fold higher risk of death when infected with SARS-CoV-2. It seems possible that participants with hypertension have a greater fear of a severe COVID-19 course and therefore restrict themselves to an above-average extent (40). However, the impact of hypertension on social participation or potential confounders need to be investigated further.

Our results do not prove the assumption that mental health is related with changes in social participation. In contrast to our findings, higher incidence rates of depressive symptoms were observed in older people with less social participation during the COVID-19 pandemic by Noguchi et al. (36). This difference can be explained by different participant groups and study settings. Other studies investigated the anxiety and depression levels at one timepoint after a COVID-19 vaccination that improved already after one vaccination dose (41).

Changes in social participation were not correlated to changes in COVID-19 incidence rates. One explanation for this lack of a pandemic-related effect could be that over the course of the pandemic, people got more familiar with digital communication and an accustomed to the pandemic realities (42). Becoming accustomed to the pandemic influences wellbeing and social participation as well (43). The temporary mitigation of the restrictions during the study period could have enabled participants to improve their social participation. Infections with the omicron variant lead to less severe courses of illness and less hospitalizations compared to earlier variants, and in general there were less severe or fatal cases than in the earlier days of the pandemic. Likely due to increasing vaccination levels. Therefore, the threat of a severe COVID-19 course during the omicron phase of the pandemic was likely perceived as lower than in the earlier measurements (44, 45). A common "pandemic fatigue" or getting more used to the situation could have influenced results at the follow-up timepoints.

The COVID-19-vaccination effectiveness in immunocompromised people depends on the underlying condition, immunosuppressant medication, and general health and is therefore variable (46). The currently prevailing omicron variant is less severe but still worrying and a threat to all individuals, especially for immunocompromised people. Loosening safety measures exposes to a high risk of infection (47).

This study has several limitations. Out of 272 recruited participants 126 were included in the final analysis. Due to the recruitment strategy and the loss-to-follow-up the sample of this study is not representative for all immunocompromised people in Germany. We were unable to reach all study participants in our telephone follow-up to gather the information about the third vaccine dose. Also, our sample was recruited as a non-random convenience sample which could lead to a selection bias. However, the CoCo Immune Study represents a true-to-life cross-section of primary care reality.

There is no control group of immunosuppressed individuals who refused COVID vaccination, nor a healthy control group. Such a control group would increase the validity of our results regarding the influence of the COVID-19 vaccination on social participation in immunocompromised people and helped to differentiate disease specific effects from generic phenomena. However, our ethics committee advised against requesting people at high risk for a severe COVID-19 course to stay unvaccinated for 6 months due to the health risks for both participants themselves and others. Sociodemographic and disease-related factors were collected only with the baseline questionnaire. Therefore, the underlying different chronic diseases of the participants may have worsened over the study due to normal chronic disease progression.

There are several factors beside the COVID-19 vaccination that could have confounded our results. The pandemic situation with its measures and restrictions is very quickly changing. The incidence rates of one county may not be sufficiently correlated to the whole pandemic situation. Since the participants' exact place of residence is unknown due to data protection measures, it was impossible to pinpoint the exact local COVID incidence rate for each participants' residential community. Even so, this study is located in the county of Göttingen and most participants come from the greater Göttingen region. The incidence rates in Göttingen, which were similar to the overall incidence rates in Germany though on a usually somewhat lower level. Limitations to social participation could be influenced by changing seasons. Colder outdoor temperatures lead to a higher incidence of contagious diseases other than COVID-19, for which immunosuppressive people are at a high risk. Therefore, perceived social participation could be influenced by the observational timepoint in our study. Due to the long duration of this study, this bias could be minimized. The IMET scale reflects the participants' perceived impairments and not their actual social activities (i.e., how limited the participant feels but not the number of social interactions themselves). The questionnaire was not developed to reflect social participation during a pandemic situation. An improved questionnaire which takes particular pandemic situations into account may lead to more valid results.

5 Conclusion

One month after basic COVID-19 vaccination, social participation increased and then stayed stable for the next 5 months. Social activities, recreation and leisure, and close personal relationships were mainly responsible for changes in social participation following COVID-19 vaccination. Our sample shows a high variability between the individual participants. The protection expected of a COVID-19 vaccination is likely to have increased social participation levels. On the one hand, individual vaccine effectiveness in this particular group is quite unpredictable, and increased social participation comes with a higher risk of infection for immunocompromised individuals, for example, due to less safety behavior. On the other hand, improved social participation may be a convincing argument to motivate immunocompromised people to get vaccinated. These results highlight the heterogeneity of changes in social participation in a homogeneous group during a similar time period. In addition, other factors that might influence social participation need to be investigated in order to target vulnerable groups and plan interventions. Therefore, studies with larger sample sizes or qualitative studies might be useful.

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 Hannover Medical School (9948_BO_K_2021) and University Medical Center Göttingen (29/3/21). The patients/participants provided their written informed consent to participate in this study.

Author contributions

GH and FM: conceptualization. DS and GH: methodology and writing – original draft preparation. DS: formal analysis and visualization. GH, SH, and FM: investigation. SH, FM, MM, EH, FK, JN, KV, and MM: writing – review and editing. FM, SH, and EH: funding acquisition.

All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

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

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.1080106/full#supplementary-material

References

1. Benoy CS. *COVID-19, ein Virus nimmt Einfluss auf unsere Psyche: Einschätzungen und Maßnahmen aus psychologischer perspektive (1st edn, Medizin)*. Stuttgart: Verlag W. Kohlhammer (2020).

2. Bundesministerium für Arbeit und Soziales. *Dritter Teilhabebericht der Bundesregierung über die Lebenslagen von Menschen mit Beeinträchtigungen*. Bonn: Bundesministerium für Arbeit und Soziales (2021).

3. Marston C, Renedo A, Miles S. Community participation is crucial in a pandemic. *Lancet.* (2020) 395:1676–8. doi: 10.1016/S0140-673631054-0

4. Presse- und Informationsamt der Bundesregierung. *Bundesregierung, Besprechung der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder vom 22.03.2020.* Berlin: Presse- und Informationsamt der Bundesregierung (2020).

5. Berger U, Krausslach H, Strauss B. Was zeichnet eine gesundheitsregion von morgen aus? Das verbundprojekt vorteiljena - vorbeugen durch teilhabe. *Psychother Psychos Med Psychol.* (2015) 65:203. doi: 10.1055/s-0035-1552674

6. Deck R, Walther AL, Staupendahl A, Katalinic A. Einschränkungen der teilhabe in der bevölkerung - normdaten für den IMET auf der basis eines bevölkerungssurveys in norddeutschland. *Die Rehabili.* (2015) 54:402–8. doi: 10.1055/s-0035-1559670

7. Odone A, Lugo A, Amerio A, Borroni E, Bosetti C, Carreras G, et al. COVID-19 lockdown impact on lifestyle habits of Italian adults. *Acta Bio Med Atenei Parmensis.* (2020) 91:87–9. doi: 10.23750/abm.v91i9-S.10122

8. 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.* (2018) 9:762. doi: 10.3389/fpsyt.2018.00762

9. Ai X, Yang J, Lin Z, Wan X. Mental health and the role of physical activity during the COVID-19 pandemic. *Front Psychol.* (2021) 12:759987. doi: 10.3389/fpsyg.2021.759987

10. Nürnberger P, Lewinski D, Rothenhäusler H-B, Braun C, Reinbacher P, Kolesnik E, et al. A biopsychosocial model of severe fear of COVID-19. *PLoS One.* (2022) 17:e0264357. doi: 10.1371/journal.pone.0264357

11. Daly M, Sutin AR, Robinson E. Longitudinal changes in mental health and the COVID-19 pandemic: evidence from the UK household longitudinal study. *Psychol Med.* (2020) 2020:1–10. doi: 10.1017/S0033291720004432

12. Schützwohl M, Mergel E. Teilhabemöglichkeit, partizipation, inklusion und psychisches befinden im zusammenhang mit ausgangsbeschränkungen aufgrund SARS-CoV-2. *Psychiat Praxis.* (2020) 47:308–18. doi: 10.1055/a-1202-2427

13. Baden LR, El Sahly HM, Essink B, Kotloff K, Frey S, Novak R, et al. Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine. *N Engl J Med.* (2021) 384:403–16. doi: 10.1056/NEJMoa2035389

14. Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, et al. Safety and efficacy of the BNT162b2 mRNA covid-19 vaccine. *N Engl J Med.* (2020) 383:2603–15. doi: 10.1056/NEJMoa2034577

15. Sadoff J, Gray G, Vandebosch A, Cárdenas V, Shukarev G, Grinsztejn B, et al. Safety and efficacy of single-dose Ad26.COV2.S vaccine against covid-19. *N Engl J Med.* (2021) 384:2187–201. doi: 10.1056/NEJMoa2101544

16. Voysey M, Clemens SAC, Madhi SA, Weckx LY, Folegatti PM, Aley PK, et al. Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, south Africa, and the UK. *Lancet.* (2021) 397:99–111. doi: 10.1016/S0140-67363 2661-1

17. Wichmann O, Scholz S, Waize M, Schmid-Küpke N, Hamouda O, Wieler LH, et al. *Welche Impfquote ist Notwendig, um COVID-19 zu Kontrollieren?* Berlin: Robert Koch-Institut (2021).

18. Koch J, Vygen-Bonnet S, Harder T, Ledig T, Mertens T, Michaelis K, et al. *STIKO-Empfehlung zur COVID-19-Auffrischimpfung mit Einem mRNA-Impfstoff für Personen =?70 Jahre und Bestimmte Indikationsgruppen Sowie Empfehlung zur Optimierung der Grundimmunisierung mit Einem mRNA-Impfstoff nach Vorausgegangener Impfung mit der COVID-19 vaccine Janssen und die Dazugehörige Wissenschaftliche Begründung.* Berlin: Robert Koch-Institut (2021).

19. Boyarsky BJ, Werbel WA, Avery RK, Tobian AAR, Massie AB, Segev DL, et al. Antibody response to 2-dose SARS-CoV-2 mRNA vaccine series in solid organ transplant recipients. *JAMA.* (2021) 325:2204–6. doi: 10.1001/jama.2021.7489

20. Krasselt M, Wagner U, Nguyen P, Pietsch C, Boldt A, Baerwald C, et al. Humoral and cellular response to COVID-19 vaccination in patients with autoimmune inflammatory rheumatic diseases under real-life conditions. *Rheumatology.* (2022) 2022:89. doi: 10.1093/rheumatology/keac089

21. Andrews N, Stowe J, Kirsebom F, Toffa S, Rickeard T, Gallagher E, et al. Covid-19 vaccine effectiveness against the omicron (B.1.1.529) variant. *N Engl J Med*. (2022) 386:1532–46. doi: 10.1056/NEJMoa2119451

22. World Health Organization. *Tracking SARS-CoV-2 Variants*. Genf: World Health Organization (2022).

23. Dopfer-Jablonka A, Steffens S, Müller F, Mikuteit M, Niewolik J, Cossmann A, et al. SARS-CoV-2-specific immune responses in elderly and immunosuppressed participants and patients with hematologic disease or checkpoint inhibition in solid tumors: study protocol of the prospective, observational CoCo immune study. *BMC Infect Dis*. (2022) 22:403. doi: 10.1186/s12879-022-07347-w

24. Deck R, Mittag O, Hüppe A, Muche-Borowski C, Raspe H. *IMET- Index zur Messung von Einschränkungen der Teilhabe: ZPID (Leibniz Institute For Psychology Information)-Testarchiv*. Trier: ZPID (Leibniz Institute for Psychology Information) - Testarchiv (2011).

25. Mergel E, Schützwohl M. A longitudinal study on the COVID-19 pandemic and its divergent effects on social participation and mental health across different study groups with and without mental disorders. *Soc Psychiatry Psychiatr Epidemiol*. (2021) 56:1459–68. doi: 10.1007/s00127-021-02025-9

26. Hüppe A, Steimann G, Janotta M, Langbrandtner J, Eisemann N, Bokemeyer B, et al. Auf dem prüfstand: stationäre medizinische rehabilitation bei chronisch entzündlichen darmerkrankungen. *Die Rehabili*. (2016) 55:248–55. doi: 10.1055/s-0042-109590

27. Tillinger J. *Der PHQ-4 zur Messung von Depressivität und Angst bei Operativen Patienten der Anästhesieambulanz*. Berlin: Universitätsmedizin Berlin (2015).

28. Hüfner K, Tymoszuk P, Ausserhofer D, Sahanic S, Pizzini A, Rass V, et al. Who is at risk of poor mental health following coronavirus disease-19 outpatient management? *Front Med*. (2022) 9:792881. doi: 10.3389/fmed.2022.792881

29. Robert Koch-Institut. *7-tage-Inzidenzen nach Bundesländern und Kreisen*. Berlin: Robert Koch-Institut (2022).

30. R Core Team. *R: a language and environment for statistical computing : reference index*. Vienna: R Foundation for Statistical Computing (2013).

31. Bakdash JZ, Marusich LR. Repeated measures correlation. *Front Psychol*. (2017) 8:456. doi: 10.3389/fpsyg.2017.00456

32. Hadley W. *Ggplot2: elegrant graphics for data analysis (Use R!)*. Switzerland: Springer (2016).

33. Balchin C, Tan AL, Wilson OJ, McKenna J, Stavropoulos-Kalinoglou A. Participation in physical activity decreased more in people with rheumatoid arthritis than the general population during the COVID-19 lockdown: a cross-sectional study. *Rheumatol Int*. (2022) 42:241–50. doi: 10.1007/s00296-021-05054-4

34. Cheema M, Mitrev N, Hall L, Tiongson M, Ahlenstiel G, Kariyawasam V. Depression, anxiety and stress among patients with inflammatory bowel disease during the COVID-19 pandemic: australian national survey. *BMJ Open Gastroenterol*. (2021) 8:581. doi: 10.1136/bmjgast-2020-000581

35. Michaud K, Wipfler K, Shaw Y, Simon TA, Cornish A, England BR, et al. Experiences of patients with rheumatic diseases in the united states during early days of the COVID-19 pandemic. *ACR Open Rheumatol*. (2020) 2:335–43. doi: 10.1002/acr2.11148

36. Noguchi T, Hayashi T, Kubo Y, Tomiyama N, Ochi A, Hayashi H. Association between decreased social participation and depressive symptom onset among community-dwelling older adults: a longitudinal study during the COVID-19 pandemic. *J Nutr Health Aging*. (2021) 25:1070–5. doi: 10.1007/s12603-021-1674-7

37. Sato K, Kondo N, Kondo K. Pre-pandemic individual- and community-level social capital and depressive symptoms during COVID-19: a longitudinal study of Japanese older adults in 2019-21. *Health Place*. (2022) 74:102772. doi: 10.1016/j.healthplace.2022.102772

38. Flor LS, Friedman J, Spencer CN, Cagney J, Arrieta A, Herbert ME, et al. Quantifying the effects of the COVID-19 pandemic on gender equality on health, social, and economic indicators: a comprehensive review of data from march, 2020, to september, 2021. *Lancet*. (2022) 2022:6736. doi: 10.1016/S0140-673600008-3

39. Pisula P, Salas Apaza JA, Baez GN, Loza CA, Valverdi R, Discacciati V, et al. Estudio cualitativo sobre los adultos mayores y la salud mental durante el confinamiento por COVID-19 en buenos aires, argentina - parte 1. *Medwave*. (2021) 21:e8186. doi: 10.5867/medwave.2021.04.8186

40. Deng G, Yin M, Chen X, Zeng F. Clinical determinants for fatality of 44,672 patients with COVID-19. *Crit Care*. (2020) 24:179. doi: 10.1186/s13054-020-02902-w

41. Perez-Arce F, Angrisani M, Bennett D, Darling J, Kapteyn A, Thomas K. COVID-19 vaccines and mental distress. *PLoS One*. (2021) 16:e0256406. doi: 10.1371/journal.pone.0256406

42. Teramura A, Kimura Y, Hamada K, Ishimoto Y, Kawamori M. COVID-19-related lifestyle changes among community-dwelling older adult day-care users: a qualitative study. *Int J Environ Res Public Health*. (2021) 19:256. doi: 10.3390/ijerph19010256

43. Esposito C, Di Napoli I, Agueli B, Marino L, Procentese F, Arcidiacono C. Well-being and the COVID-19 pandemic. *Eur Psychol*. (2021) 26:285–97. doi: 10.1027/1016-9040/a000468

44. Nyberg T, Ferguson NM, Nash SG, Webster HH, Flaxman S, Andrews N, et al. Comparative analysis of the risks of hospitalisation and death associated with SARS-CoV-2 omicron (B.1.1.529) and delta (B.1.617.2) variants in England: a cohort study. *Lancet*. (2022) 399:1303–12. doi: 10.1016/S0140-673600462-7

45. Twohig KA, Nyberg T, Zaidi A, Thelwall S, Sinnathamby MA, Aliabadi S, et al. Hospital admission and emergency care attendance risk for SARS-CoV-2 delta (B.1.617.2) compared with alpha (B.1.1.7) variants of concern: a cohort study. *Lancet Infect Dis*. (2022) 22:35–42. doi: 10.1016/S1473-309900475-8

46. Niehues T, Bogdan C, Hecht J, Mertens T, Wiese-Posselt M, Zepp F. Impfen bei immundefizienz : anwendungshinweise zu den von der ständigen impfkommission empfohlenen impfungen(I) grundlagenpapier. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz*. (2017) 60:674–84. doi: 10.1007/s00103-017-2555-4

47. Michelen M, Manoharan L, Elkheir N, Cheng V, Dagens A, Hastie C, et al. Characterising long COVID: a living systematic review. *BMJ Global Health*. (2021) 6:5427. doi: 10.1136/bmjgh-2021-005427

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Mental health status of early married girls during the COVID-19 pandemic: A study in the southwestern region of Bangladesh

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Background: Due to unemployment, the prolonged lockdown during the COVID-19 pandemic caused panic and deepened poverty, especially among lower-class and marginal people. The related financial crises led to harmful practices such as the early marriage of adolescent girls, which deteriorated these girl's mental state.

Aims: This study attempted to assess the prevalence of mental health problems among early married girls and determine the associated predictors of the growing mental health burden.

Methods: This cross-sectional survey was conducted during the third wave of the COVID-19 pandemic in Dumuria Upazila in the Khulna district of Bangladesh. Data were collected purposively from 304 girls who were married off during the COVID-19 pandemic, this was carried out between 22 July and 31 August 2022 by administering a semi-structured interview schedule, with mental health measured by the depression, anxiety, and stress scale 21 (DASS 21). The data were analyzed using IBM SPSS Statistics (version 25), and multiple linear regression was executed in order to predict mental health problems among early married girls.

Results: The findings show that the overall prevalence of depression, anxiety, and stress among early married girls during the COVID-19 pandemic in Bangladesh was 60.9% (95% CI: 0.554–0.663), 74.7% (95% CI: 0.698–0.796), and 23.7% (95% CI: 0.189–0.285). The prevalence was relatively higher among girls from the *Sanatan* (Hindu) religion and younger girls than among Muslim and older girls, respectively. The multiple linear regressions indicate that age, age at marriage, duration of the marriage, spousal occupation, intimate partner violence (IPV), and subjective happiness were the critical predictors of mental health problems among early married girls.

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Conclusion: Early marriage, along with various adverse outcomes, i.e., IPV, maladjustment, and poor subjective happiness, has resulted in heightened mental health problems for young girls. Policymakers should implement coercive measures to prevent early marriage, especially during social, economic, political, and health crises; in addition, more research is recommended in order to explore the mechanisms that make early married girls psychologically vulnerable and thus formulate protective and preventive programs for addressing such vulnerabilities.

KEYWORDS

mental health, depression, anxiety, stress, DASS-21, early marriage, COVID-19, Bangladesh

Introduction

The outbreak of coronavirus disease (COVID-19) in late 2019 in China led to havoc across the world, resulting in the loss of over 6.5 million people; around 610 million have been infected globally in the subsequent years (1). In Bangladesh, the number of deaths from COVID-19 was around 30,000, the confirmed cases in the country numbered 0.2 million (2). The absence of therapeutic measures compelled the World Health Organization–the global watchdog of health issues–to declare a global pandemic on 11 March 2020 (3) and to advocate the most stringent non-therapeutic measures, including "lockdown," "social distancing," "face mask," and "work from home" for the general population as well as longer-term "isolation" and "quarantine" for those infected with or suspected of having COVID-19 in order to curb the risk of "human-to-human" infection (4, 5). This prolonged "home confinement" as well as the constant "fear of infection" adversely affected the mental health of people globally (6–8). In Bangladesh, there was a spike in mental health disorders during the COVID-19-induced lockdown. For example, a study in April 2020 indicated that university students were suffering from depression (45.9%), anxiety (51%), sleep disturbance (27.1%), and fear of COVID-19 (86%) during the early stage of the COVID-19 pandemic. Another study in May 2020 found that the prevalence of depression and anxiety was 82.3 and 81.8%, respectively, among university students (9). Teachers were also experiencing heightened mental health problems during the pandemic (10). The existing literature suggests that exposure to "misinformation" through social and electronic media (11), uncertainty over academic and professional careers (12), and financial constraints (13–16) were the key factors for growing mental disorders among the adult population.

In addition to affecting mental health conditions, the pandemic has also increased various harmful practices, particularly in developing countries; early marriage is one of these. A report in late 2020 stated that due to the pandemic, around 1.3 to 2.5 million underage girls were at risk of being married off over the next five years (17). Another report, by the United Nations Population Fund (UNFPA), estimated that an additional 13 million early marriages would occur between 2020 and 2030 due to the COVID-19 pandemic (18). In South Asia, around 0.2 million girls are expected to become child brides (19). Maharashtra in India, for example, witnessed a 78% spike in early marriage (20), while in Bangladesh, more than 1,000 early marriages were reported in different regions between March and June 2020 –the first wave of the COVID-19 pandemic (21). The intensified poverty and financial crises caused by COVID-19 have forced many families to have their underage girls married off (20, 21). A study on fishermen in the southwestern regions of Bangladesh indicated that people were forced to marry off their school-going daughters in order to reduce the burden on their households (15), as the most underprivileged and marginalized people were struggling to afford basic amenities, i.e., expenditure for food, clothing, and education, due to job loss (14, 16, 20–22). The immediate consequence of early marriage is multifaceted. Studies indicate that early married girls are subject to different types of violence, including physical, sexual, and emotional (23). In addition, coercive sex by the partner and unwanted pregnancy at an immature age can also lead to various health complexities and loss of life (24). In fact, some girls suffer from extensive traumatic experiences, such as marital maladjustment and psychological distress (24–26), which may lead them to suicide due to the unhappiness in their lives (27).

Although there are studies that have investigated mental health issues and their predictors among adolescents during the COVID-19 pandemic in Bangladesh (28) and other developed and developing countries (29) such as China (30), the United States (31), and the United Kingdom (32), no study to the best of the authors' knowledge has attempted to ascertain the mental health of early married girls. This study, therefore, is designed to assess the prevalence and possible predictors of mental health problems among early married girls in Bangladesh during the COVID-19 pandemic. The study will help policymakers to identify the potential predictors

of mental health problems among early married girls and to devise remedies, i.e., social, economic, legal, cultural, and psychological, in order to prevent mental health burdens on girls and deter possible early marriage through awareness at family and community levels.

Materials and methods

Study settings and participants

This cross-sectional study was carried out in Dumuria Upazila, a sub-district of the Khulna district in Bangladesh. Khulna is the southwestern regional hub; it has a population of 2.32 million, of which 66.5% reside in rural areas (33, 34). Among the 14 Upazila in the Khulna district, Dumuria is the most populated (0.31 million) and geographically the second largest (454.2 km^2) Upazila (34, 35). During the COVID-19 pandemic, over 3,000 schoolgirls, mostly in Class VII and Class X, became child brides in the Khulna district alone. The highest number of these child marriages (751) took place in Dumuria Upazila (36); therefore, it was selected as the study area (see **Supplementary Figure 1**). However, some specifications were set out when selecting the participants: each participant must be (i) a girl; (ii) married off under 18 years of age during the COVID-19 pandemic; and (iii) a resident of Dumuria Upazila. Considering these criteria, the data were collected purposively using a semi-structured interview schedule from a total of 330 early married girls, out of which 304 were retained for this study following careful scrutiny of the responses.

Ethical clearance

This study was approved by the institutional ethical clearance committee (Reference No. KUECC–2022/08/24). The participants responded to this cross-sectional study by filling out a written informed consent form in the first section of the interview schedule, following verbal assent from their guardians, i.e., parents, spouse, or in-laws. All participants responding voluntarily to the interview schedule were provided with information in the consent form concerning the research purpose, anonymity, confidentiality of information, and the right to revoke participation without prior justification.

Procedures

In this study, the data were collected by administering a semi-structured interview schedule containing nine mutually inclusive modules; these were designed following careful review of the relevant literature. Each module had specific questions: modules one, two, three, and four consisted of socio-demographic information about the participants, their parents, their spouses, and their in-laws, respectively; module five highlighted the possible reasons for early marriage; and modules six, seven, eight, and nine focused on intimate partner violence (IPV), marital adjustment, mental health issues, and subjective happiness, respectively. The data were collected in the home settings of the participants by a group of 12 trained data enumerators, during the period from 22 July to 31 August 2022; each interview lasted for around 25 min.

Measures

Socio-demographic information

In this study, the socio-demographic information included age (in years), religion ("Islam" or "*Sanatan* (Hindu)"), education (years of schooling), age at first marriage (in years), duration of marriage (in years), whether the participants had dropped out of school ("yes" or "no"), age of spouse (in years), education of spouse (years of schooling), occupation of spouse ("manual labor/farmer" or "service/business"), and income of spouse (monthly in BDT).

Marital adjustment scale

The martial adjustment of the early married girls was assessed by the short marital adjustment scale (SMAS) developed by Locke and Wallace (37) and adapted for Bangladeshi couples by Khatun, Deeba (38). The SMAS is a 15-item self-reported measure that can be used for both partners or just one partner (37). Item 1 measures marital happiness on a seven-point response scale, items 2 to 8 were measured on a six-point scale, and items 9 to item 15 were measured by a tailored scale for each item (37). The overall internal consistency of SMAS was Cronbach's $\alpha = 0.723$.

Intimate partner violence

The IPV scale was drawn from the World Health Organization's multi-country study on women's health and domestic violence (39). The IPV scale comprised of 12 items using a five-point Likert scale, where "1" = never, "2" = rarely, "3" = sometimes, "4" = very often, and "5" = always. It measured physical (5 items), sexual (3 items) and emotional (4 items) violence, and a higher score reflects frequent violence by an intimate partner. The overall internal consistency of the IPV scale in this study was Cronbach's $\alpha = 0.929$.

Subjective happiness scale

The subjective happiness of the early married girls was measured by the subjective happiness scale (SHS) developed by Lyubomirsky and Lepper (40). The SHS consisted of four items on a seven-point Likert scale; a higher composite score from the SHS reflects greater happiness. The overall internal consistency of SHS was Cronbach's $\alpha = 0.897$, while the internal consistency

of the original SHS varied from 0.79 to 0.94 based on culture, language, and occupation (40).

Depression, anxiety, and stress scale 21

The mental health of early married girls was measured by the widely used depression, anxiety, and stress scale 21 (DASS 21) developed by Lovibond and Lovibond (41). The initial DASS assessed the symptoms of depression, anxiety, and stress and consisted of 42 items, measured on a four-point Likert scale, with 14 items used for each sub-scale (41). Later, Henry and Crawford (42) developed a shorter version–the DASS 21–with seven items used for each sub-scale. The sum of scores of the seven items for each sub-scale was estimated to indicate the presence of negative emotional states, i.e., depression, anxiety, and stress. A score ≥10 of indicates the presence of depression symptoms, a score of ≥8 reflects the presence of anxiety symptoms, and a score of ≥15 signifies the presence of stress symptoms among the participants. It is important to note that DASS 21 is a suitable and reliable scale for measuring the symptoms of mental health problems among adolescents (43, 44). The overall Cronbach's α (alpha) of DASS 21 in this study was 0.931, reflecting an excellent internal consistency (45), and the internal consistency of each sub-scale was Cronbach's α = 0.820, Cronbach's α = 0.817, and Cronbach's α = 0.795 for depression, anxiety, and stress, respectively.

Analysis

The data were analyzed in two consecutive phases using IBM SPSS Statistics (Version 25) for Windows. Descriptive statistics, i.e., frequency and percentage analysis, were calculated to present the socio-demographic information of the participants. The prevalence of depression, anxiety, and stress was estimated at a 95% confidence interval (CI). Simple linear regression (SLR) and multiple linear regression (MLR) analysis with unstandardized (B) and standardized Coefficient (β), at 95% CI, were utilized to identify the risk factors associated with mental health problems among early married girls, i.e., depression, anxiety, and stress. The different factors were statistically significant when the *p*-value was <0.05.

Results

Socio-demographic information

Table 1 shows the socio-demographic information of the early married girls. The average age of the participants was 17.1 years (±1.42), and more than 70% of the participants were Muslim (73.7%). With an average length of schooling of around 5 years (±3.41), the participants were married off, on average, at the age of 15 years (±1.24). Regarding the girls' spouses, it is apparent that the average age of the spouse was 25.8 years (±3.64), with around 9 years of schooling on average (±3.15). More than half of the spouses were engaged in manual labor or farming (55.6%); their monthly average income was BDT 16,591 (±6,175.49).

Prevalence of depression, anxiety, and stress among early married girls

The overall prevalence of depression, anxiety, and stress among early married girls in Bangladesh was 60.9% (95% CI: 0.554–0.663), 74.7% (95% CI: 0.698–0.796), and 23.7% (95% CI: 0.189–0.285). The prevalence of depression (72.7 versus 56.8%), anxiety (76.6 versus 74%), and stress (37.7 versus 18.9%) among girls married at or before 14 years of age was higher than in girls married at or after 15 years of age (see Figure 1). Likewise, the prevalence of depression (67.5 versus 58.5%), anxiety (77.5 versus 73.7%), and stress (30 versus 21.4%) was higher among *Sanatan* (Hindu) girls than among Muslim girls.

Determinants of depression among early married girls

Table 2 shows the SLR and MLR models with unstandardized and standardized coefficients with 95% CI. In the MLR model, the age, religion, age at first marriage, duration of the marriage, income of spouse, marital adjustment, IPV, and subjective happiness of the participants were found to be significantly associated with depression during the COVID-19 pandemic [R^2 Adjusted = 0.320, F (13,290) = 10.517, $p < 0.000$]. A one unit increase in the age of early married girls

TABLE 1 Socio-demographic information of the participants.

Variables	*f* (%)	Statistics *M* and SD	Max–Min
Age		17.1 and 1.42	19–13
Religion			
Sanatan (Hindu)	80 (26.3)		
Islam	224 (73.7)		
Education		5.1 and 3.41	9–0
Age at first marriage		15.3 and 1.24	17–12
Duration of marriage		2.0 and 0.74	3–1
Age of spouse		25.8 and 3.64	36–19
Education of spouse		8.9 and 3.15	17–0
Occupation of spouse			
Manual labor/farmer	169 (55.6)		
Service/business	135 (44.4)		
Monthly income of spouse		16592.1 and 6175.49	40,000–8,000

f, frequency; *M*, mean; *SD*, standard deviation; Max, maximum; Min, minimum; Number in the parentheses are percentage.

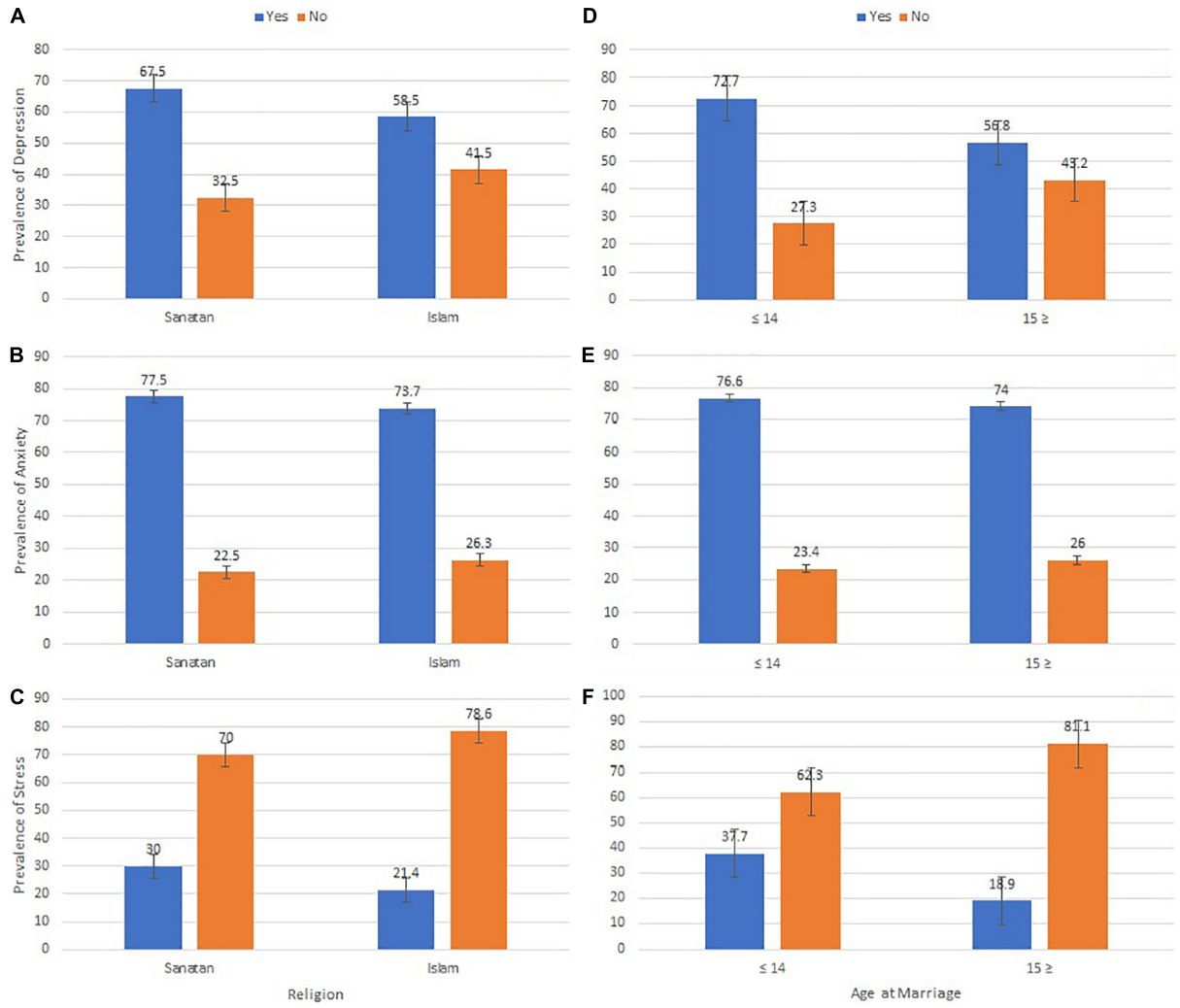

FIGURE 1
Prevalence and standard error of depression **(A,D)**, anxiety **(B,E)**, and stress **(C,F)** among early married girls in Bangladesh.

indicates a 1.88 unit increase in depression among the girls, controlling the effect of all other covariates. Girls who followed Islam as their religion were 1.565 units less depressed than girls who followed *Sanatan* (Hindu) as their religion. A one unit increase in age at first marriage among the girls indicates a 1.993 unit decrease in depression among the early married girls. Again, a one unit increase in the duration of marriage is likely to decrease depression by 1.358 units among early married girls.

Furthermore, the income of the spouse was related to depression among early married girls, those whose spouses had more income were less likely to be depressed than those whose spouses' incomes were low. A one unit increase in marital adjustment demonstrates a decrease in depression by 0.030 units among early married girls. Also, early married girls with a one unit increase in IPV had depression 0.120 units higher than those with no/less IPV. Moreover, a one unit increase in subjective happiness for early married girls led to a 0.125-unit decrease in depression.

Determinants of anxiety among early married girls

Table 3 shows the SLR and MLR models with unstandardized and standardized coefficients with 95% CI. In the MLR model, the age, age at first marriage, duration of the marriage, education of spouse, IPV, and subjective happiness of the participants were found to be significantly associated with anxiety during the COVID-19 pandemic [R^2 Adjusted = 0.342, F (13,290) = 11.618, $p < 0.000$]. A one unit increase in the age of early married girls indicates 1.653 units increase in anxiety among the girls, controlling the effect of all other variables.

TABLE 2 Predicting depression among early married girls during the pandemic.

Variables	Simple linear regression						Multiple linear regression					
	B	β	*t*	*p*-value	95% CI		B	β	*t*	*p*-value	95% CI	
					Lower	Upper					Lower	Upper
Age	−0.246	−0.073	−1.265	0.207	−0.629	0.137	1.883	0.556	3.231	**0.001**	0.736	3.030
Religion												
Sanatan (Hindu)[Ref]												
Islam	−1.923	−0.176	−3.110	**0.002**	−3.140	−0.706	−1.565	−0.143	−2.833	**0.005**	−2.653	−0.478
Education	0.117	0.083	1.439	0.151	−0.043	0.276	−0.041	−0.029	−0.566	0.572	−0.183	0.101
Age at first marriage	−0.635	−0.163	−2.873	**0.004**	−1.070	−0.200	−1.993	−0.512	−3.403	**0.001**	−3.146	−0.841
Duration of marriage	0.319	0.049	0.853	0.394	−0.418	1.056	−1.358	−0.208	−2.188	**0.029**	−2.579	−0.136
Dropout												
No[Ref]												
Yes	−2.366	−0.107	−1.864	0.063	−4.865	0.132	−1.241	−0.056	−1.115	0.266	−3.431	0.949
Age of spouse	−0.211	−0.160	−2.812	**0.005**	−0.359	−0.063	−0.075	−0.056	−1.017	0.310	−0.219	0.070
Education of spouse	−0.423	−0.276	−4.993	**0.000**	−0.589	−0.256	−0.141	−0.092	−1.679	0.094	−0.306	0.024
Occupation of spouse												
Manual labor/farmer [Ref]												
Service/business	0.177	0.018	0.319	0.750	−0.918	1.273	0.241	0.025	0.507	0.612	−0.694	1.177
Income of spouse	−0.00002	−0.311	−5.696	**0.000**	−0.0003	−0.0002	−0.00009	−0.116	−2.041	**0.042**	−0.0002	−0.000003
Marital adjustment	−0.083	−0.360	−6.702	**0.000**	−0.108	−0.059	−0.030	−0.128	−1.982	**0.048**	−0.059	0.000
Intimate partner violence	0.215	0.415	7.927	**0.000**	0.162	0.269	0.120	0.231	3.999	**0.000**	0.061	0.179
Subjective happiness	−0.339	−0.352	−6.537	**0.000**	−0.440	−0.237	−0.125	−0.130	−1.996	**0.047**	−0.248	−0.002

CI, confidence interval; Ref, reference category. Bold values are significant at 5% level of significance.

A one unit increase in age at early marriage leads to a decrease in anxiety by 1.326 units among early married girls. Therefore, the duration of marriage impacts anxiety, and a one unit increase in the duration of marriage demonstrates a 1.240 unit decrease in anxiety among the girls. Higher spousal education impacts anxiety level, and a one unit increase in spouse education reduces anxiety by 0.290 units among early married girls. Also, early married girls who faced less/no IPV faced less anxiety; their anxiety level increased by 0.120 units with a one unit increase in IPV. Moreover, anxiety level is decreased by 0.165 units with a one unit increase in subjective happiness among the girls.

Determinants of stress among early married girls

Table 4 indicates the SLR and MLR models with unstandardized and standardized coefficients with 95% CI. In the MLR model, the age at first marriage, education of spouse, IPV, and subjective happiness of the participants were found to be significantly associated with stress during the COVID-19 pandemic [R^2 Adjusted = 0.289, F (13,290) = 9.081, $p < 0.000$]. A one unit increase in age at early marriage demonstrates a 1.370 unit decrease in stress level among early married girls. Higher spousal education impacts this stress level; a one unit increase in the spouse's education level indicates a 0.205 unit decrease in the stress level among the girls. In addition, a one unit increase in IPV led to a 0.107 unit increase in stress level among early married girls. Moreover, early married girls with a one unit increase in subjective happiness are 0.120 units less likely to be stressed.

Discussion

This study aimed to assess the prevalence of mental health problems among early married girls in Bangladesh during the COVID-19 pandemic and to identify the possible predictors of growing mental health issues. The findings of the study suggested that the prevalence of depression, anxiety, and stress symptoms among early married girls in Bangladesh was 60.9, 74.7, and 23.7%, respectively, and these issues are more prevalent among early married girls from the *Sanatan* (Hindu) religion and among those married earlier, i.e., 14 years or under. A recent national mental health survey in 2019 indicated that the prevalence of mental health disorders among Bangladeshi children between the ages of 7 and 17 years was 12.6%; 11.5% of girls were suffering from mental health problems, of which 5.3% were experiencing anxiety and another

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TABLE 3 Predicting anxiety among early married girls during the pandemic.

Variables	Simple linear regression						Multiple linear regression					
	B	β	*t*	*p*-value	95% CI		B	β	*t*	*p*-value	95% CI	
					Lower	Upper					Lower	Upper
Age	0.052	0.016	0.271	0.786	−0.323	0.426	1.653	0.499	2.951	**0.003**	0.550	2.755
Religion												
Sanatan (Hindu)[Ref]												
Islam	−0.817	−0.077	−1.335	0.183	−2.021	0.387	−0.700	−0.066	−1.319	0.188	−1.746	0.345
Education	0.117	0.012	0.009	0.155	0.877	−0.144	−0.106	−0.700	−1.530	0.127	−0.243	0.030
Age at first marriage	−0.635	−0.203	−0.053	−0.928	0.354	−0.633	−1.326	−0.349	−2.356	**0.019**	−2.434	−0.218
Duration of marriage	0.319	0.364	0.057	0.996	0.320	−0.355	−1.240	−0.195	−2.079	**0.038**	−2.414	−0.066
Dropout												
No[Ref]												
Yes	−2.373	−0.109	−1.914	0.057	−4.814	0.067	−1.341	−0.062	−1.254	0.211	−3.446	0.764
Age of spouse	−0.117	−0.091	−1.583	0.114	−0.263	0.029	−0.017	−0.013	−0.245	0.807	−0.156	0.121
Education of spouse	−0.510	−0.341	−6.310	**0.000**	−0.669	−0.351	−0.290	−0.194	−3.594	**0.000**	−0.448	−0.131
Occupation of spouse												
Manual labor/farmer												
Service/business	0.418	0.044	0.770	0.442	−0.651	1.487	0.376	0.040	0.823	0.411	−0.523	1.275
Income of spouse	−0.0002	−0.286	−5.180	**0.000**	−0.0003	−0.0001	0.00008	−0.099	−1.762	0.079	−0.0002	0.000009
Marital adjustment	−0.087	−0.383	−7.197	**0.000**	−0.110	−0.063	−0.027	−0.118	−1.866	0.063	−0.055	0.001
Intimate partner violence	0.218	0.431	8.302	**0.000**	0.167	0.270	0.120	0.237	4.174	**0.000**	0.064	0.177
Subjective happiness	−0.381	−0.406	−7.714	**0.000**	−0.478	−0.284	−0.165	−0.176	−2.747	**0.006**	−0.284	−0.047

CI, confidence interval; Ref, reference category. Bold values are significant at 5% level of significance.

0.5% were enduring depression (46). A study in Bangladesh during the COVID-19 pandemic showed that the prevalence of depression, anxiety, and stress among adolescents was 67.1, 49.4, and 40.7%, respectively (28). A Chinese study showed a significant increase in mental health problems, i.e., anxiety (54.4%), sensitivity (46%), and phobia (10.1%), among adolescents during the COVID-19 pandemic (30). From the findings of the current study as well as the existing literature, it is evident that adolescents, particularly early married girls, have experienced heightened mental health problems during the COVID-19 pandemic. For unmarried adolescents, the source of this mental distress could be prolonged home confinement and isolation, uncertainty over academic career, fear of infection, and consistent exposure to negative news on electronic and social media (11, 12, 47, 48). For early married girls, on the other hand, the source of mental distress could be various stressful life events and growing household responsibilities, including the struggle to adjust to their spouse and in-laws, forced sexual relations, and the possibility of IPV (49, 50).

The findings of this study showed that age was the key predictor of the presence or absence of depression and anxiety symptoms among early married girls in Bangladesh during the COVID-19 pandemic. It is evident that the higher the age of the early married girls, the higher the presence of depression and anxiety symptoms. A study on Jordanian women indicated that young women felt remorseful about their marriage, over which they had no control, and that these marriages led them to "feelings of being completely lost" as they were barely ready, either physically or mentally, for the marriage (50). Meanwhile, Fakhari, Allahverdipour (49) concluded that early marriage adversely affected the mental health of early married girls, particularly those in their early teens, as they often struggled to adjust to the cultural norms, beliefs, and practices associated with marriage. Moreover, being unprepared for married life, the young girls did not have any knowledge about running family affairs smoothly (50); therefore, they were suddenly overburdened with household responsibilities for which they were not ready, and thus, suffered from various mental health problems including anxiety and depression. It is, therefore, necessary to address the mental health status of early married girls, whether younger or older teenagers, especially in countries where early marriage is more prevalent as a cultural practice. This will help to minimize stressful life events, including marital maladjustment and conflict, marital rape, IPV, and the possibility of loss of valuable lives.

It is evident from this study that the age at marriage and duration of marriage, rather than the age of the early married girls, that has a negative influence on their mental health; this means that higher age at marriage lowers the likelihood of depression, anxiety, and stress symptoms among

TABLE 4 Predicting stress among early married girls during the pandemic.

Variables	Simple linear regression						Multiple linear regression					
	B	β	*t*	*p*-value	95% C1		B	β	*t*	*p*-value	95% CI	
					Lower	Upper					Lower	Upper
Age	−0.425	−0.132	−2.318	**0.021**	−0.786	−0.064	1.096	0.341	1.937	0.054	−0.018	2.209
Religion												
Sanatan (Hindu)[Ref]												
Islam	−0.926	−0.089	−1.559	0.120	−2.059	0.243	−0.744	−0.072	−1.387	0.166	−1.800	0.312
Education	0.070	0.052	0.906	0.366	−0.082	0.221	−0.086	−0.064	−1.226	0.221	−0.224	0.052
Age at first marriage	−0.711	−0.192	−3.408	**0.001**	−1.122	−0.300	−1.370	−0.371	−2.410	**0.017**	−2.489	−0.251
Duration of marriage	0.072	0.012	0.202	0.840	−0.628	0.772	−0.835	−0.135	−1.385	0.167	−2.020	0.351
Dropout												
No [Ref]												
Yes	−2.675	−0.127	−2.224	**0.027**	−5.041	−0.308	−1.562	−0.074	−1.446	0.149	−3.688	0.564
Age of spouse	−0.193	−0.153	−2.695	**0.007**	−0.333	−0.052	−0.102	−0.081	−1.433	0.153	−0.242	0.038
Education of spouse	−0.448	−0.308	−5.628	**0.000**	−0.604	−0.291	−0.205	−0.141	−2.513	**0.013**	−0.365	−0.044
Occupation of spouse												
Manual labor/farmer [Ref]												
Service/business	0.156	0.017	0.296	0.768	−0.884	1.196	0.137	0.015	0.297	0.766	−0.771	1.045
Income of spouse	−0.0002	−0.265	−4.770	**0.000**	−0.0003	−0.0001	−0.00003	−0.046	−0.787	0.432	−0.0001	0.00005
Marital adjustment	−0.071	−0.322	−5.917	**0.000**	−0.094	−0.047	−0.010	−0.047	−0.720	0.472	−0.039	0.018
Intimate partner violence	0.198	0.403	7.653	**0.000**	0.147	0.249	0.107	0.218	3.684	**0.000**	0.050	0.164
Subjective happiness	−0.347	−0.381	−7.154	0.000	−0.443	−0.252	−0.194	−0.212	−3.191	**0.002**	−0.313	−0.074

CI, confidence interval; Ref, reference category. Bold values are significant at 5% level of significance.

these girls. Likewise, a longer duration of marriage reduces the presence of depression and anxiety symptoms among early married girls. A study conducted on early married girls in Ethiopia and Niger found a positive relationship between age at marriage and psychological wellbeing (51). John, Edmeades (51) observed that girls above the age of 15 years had better mental health, including lower depression and anxiety, as they were more ready to take on marital responsibilities, including partners' sexual demands and childbearing and rearing duties, than those in their early teens. Another study on Pakistani women indicated that early married women showed more psychological distress than late married women, as the former found it difficult to maintain stable communication with their spouses, which negatively affected their mutual understanding and marital adjustment (25). Baysak, Yorguner (27), in contrast, found that early married women, irrespective of their age at marriage and duration of the marriage, experienced a wide range of psychiatric problems due to unexpected life events, including physical, sexual, verbal, and emotional abuse from spouses and in-laws.

Intimate partner violence significantly influenced the mental health of the early married girls; the higher the degree of IPV, the greater the presence of depression, anxiety, and stress symptoms among the participants. A study on the prevalence of domestic violence among married couples in Bangladesh during the COVID-19 pandemic suggests that women experience more domestic violence than men, and that this doubled during the pandemic (52). Like adults, girls were exposed to violence at home due to school closures, home confinement, family stress generated from job loss, financial struggles, and early marriage (53). Studies suggest that the growing prevalence of IPV during the pandemic was triggered by financial insecurity, growing debt, unmet sexual demands, frequent arguments, and prolonged home confinement with partners (15, 16, 50, 52, 54); all of these have significantly affected the mental stability of the victims of IPV (54). In order to protect early married girls against IPV, it is necessary for child protection agencies and community leaders to monitor and detect ill treatment of early married girls and to take necessary action to reduce their risk of being mistreated, whether physically or mentally.

Meanwhile, it is apparent from this study that subjective happiness among early married girls reduces their mental health burdens, including depression, anxiety, and stress symptoms. It is well documented that early married girls who are happy with their marriage do not experience traumatic mental health issues. For example, Mrayan and Obeisat (50) found that when early married girls experienced upward mobility–a change in social status and positive treatment from their spouse–they felt happy

and did not report mental health issues. Another study found a direct inverse association between a supportive relationship with a partner and depression (55). The authors further noted that a supportive relationship with a partner reduces financial needs and stressful life events and enables a warm relationship with friends and other relatives (55).

Other factors that predicted the presence or absence of mental health issues among early married girls were their religion, spousal characteristics such as education, income, and marital adjustment. The findings indicate that higher spousal income reduced depression symptoms among early married girls, while higher education among spouses minimized anxiety symptoms. Likewise, Muslim early married girls reportedly experienced less depression symptoms, while better marital adjustment also reduced depression symptoms among early married girls. Generally, educated husbands with secure and stable incomes or wealth were less likely to mistreat their wives (56), and it is well evidenced that people with more supportive partners experience less mental stress, as documented by Horwitz, McLaughlin (55). However, marital adjustment, according to Shaud and Asad (25), is subject to age at marriage, as early married girls showed more deference and higher psychological stress compared to late married women. A recent study in Bangladesh suggests that housewives with stable household incomes, the lion's share of which was contributed by their spouses, experienced fewer mental health issues during the COVID-19 pandemic (57). In this study, however, the causal relationship between spousal attributes and the marital adjustment of early married girls has not been untangled. It is also evident that compared to *Sanatan* (Hindu) early married girls, Muslim girls showed fewer depression symptoms. In the *Sanatan* (Hindu) religion, the role of women is strictly limited, i.e., submissive; dowry, e.g., "costly garments and ornaments," is a strict custom, to be paid by the bride's family to that of the groom (58). Demand for dowry from grooms or failure to provide dowry by the bride's family may result in heightened depressive symptoms among early married *Sanatan* (Hindu) girls, because domestic violence and even homicide as a result of unpaid dowry is common in the Hindu community (58).

Strengths and limitations

To interpret the results of this study, certain limitations need to be considered. Age at marriage and mental health status, i.e., depression, anxiety, and stress, were self-reported, which may be subject to recall and social desirability bias. In addition, the cross-sectional nature of the survey may limit the direct and indirect causal relationship between mental health problems and socio-demographic and marital issues. Despite these limitations, this study provides a unique contribution to the literature by assessing the prevalence and associated factors of mental health problems among early married girls during the COVID-19 pandemic. Furthermore, in this study, globally standardized and validated tools were used to measure the mental health problems, marital adjustment, IPV, and subjective happiness of early married girls. However, a more empirical study at the national level is needed to understand the mechanism.

Conclusion and implication

This study demonstrates that early married girls have experienced heightened mental health problems and that their age, age at marriage, duration of marriage, spousal attributes including education and income, marital adjustment, IPV, and subjective happiness are the key predictors of mental health problems. From the findings, it should be clear to policymakers, community leaders, parents, and young men and women that early marriage leads to grave mental health outcomes. Therefore, they should play decisive roles in reducing the likelihood of early marriage by promoting education for girls and challenging cultural practices and social norms with harmful ramifications. These actors should raise awareness and introduce deterrents in the form of rules and regulations in order to reduce early marriage and to enable women to contribute to the national economy using their full potential. Policymakers also need to pay attention to financially poor and marginalized households, as underaged boys and girls from such families are more vulnerable to early marriage, and this may have a detrimental impact on their mental health and harm their natural cognitive development by affecting their immediate wellbeing. In addition to preventive measures against early marriage, policymakers also need to develop a support system for early married girls, with special focus on poverty-stricken household where economic insecurity together with harsh home environment affects female adolescents, in order to address the risk factors associated with early marriage. Meanwhile, it is also important to take into account the fact that after marriage the presence of financial hardship and IPV in home settings worsening female adolescent's mental health status; therefore, necessary strategies should be placed in order to improving these girls' social status and minimizing their mental health problems.

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 Khulna University Ethical Clearance

Committee, KUECC-2022/08/24. Written informed consent to participate in this study was provided by the participants, following the verbal assent of local guardians.

Author contributions

JN: conceptualization, investigation, data curation, and writing – original draft. T-E-AS: methodology, resources, supervision, and writing – original draft. BA and MI: data curation, formal analysis, software, and writing – original draft. MR: software and writing – original draft. MTH: conceptualization, investigation, data curation, formal analysis, methodology, resources, software, supervision, and writing – original draft. All authors writing – review and editing, contributed to the article, and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.1074208/full#supplementary-material

SUPPLEMENTARY FIGURE 1
Map of the study area.

References

1. World Health Organization. *COVID-19 Weekly Epidemiological Update*. Geneva: World Health Organization (2022).

2. World Health Organization. *COVID-19: Morbidity and Mortality Weekly Update (MMWU) no. 129*. Dhaka: World Health Organization (2022).

3. World Health Organization. *WHO Director-General's Opening Remarks at the Media Briefing on COVID-19–11 March 2020*. Geneva: World Health Organization (2020).

4. Onyeaka H, Anumudu C, Al-Sharify Z, Egele-Godswill E, Mbaegbu P. COVID-19 pandemic: a review of the global lockdown and its far-reaching effects. *Sci Prog.* (2021) 104:368504211019854. doi: 10.1177/00368504211019854

5. Violato C, Violato E, Violato E. Impact of the stringency of lockdown measures on covid-19: a theoretical model of a pandemic. *PLoS One.* (2021) 16:e0258205. doi: 10.1371/journal.pone.0258205

6. Santomauro D, Mantilla Herrera A, Shadid J, Zheng P, Ashbaugh C, Pigott D, et al. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *Lancet.* (2021) 398:1700–12. doi: 10.1016/S0140-6736(21)02143-7

7. Chekole Y, Abate S. Global prevalence and determinants of mental health disorders during the COVID-19 pandemic: a systematic review and meta-analysis. *Ann Med Surg (Lond).* (2021) 68:102634. doi: 10.1016/j.amsu.2021.102634

8. Kuriala G. Covid-19 and its impact on global mental health. *Sens Int.* (2021) 2:100108. doi: 10.1016/j.sintl.2021.100108

9. Islam M, Barna S, Raihan H, Khan M, Hossain M. Depression and anxiety among university students during the COVID-19 pandemic in Bangladesh: a web-based cross-sectional survey. *PLoS One.* (2020) 15:e0238162. doi: 10.1371/journal.pone.0238162

10. Hossain M, Islam M, Jahan N, Nahar M, Sarker M, Rahman M, et al. Mental health status of teachers during the second wave of the COVID-19 pandemic: a web-based study in Bangladesh. *Front Psychiatry.* (2022) 13:938230. doi: 10.3389/fpsyt.2022.938230

11. Hossain M, Ahammed B, Chanda S, Jahan N, Ela M, Islam M. Social and electronic media exposure and generalized anxiety disorder among people during COVID-19 outbreak in Bangladesh: a preliminary observation. *PLoS One.* (2020) 15:e0238974. doi: 10.1371/journal.pone.0238974

12. Ela M, Shohel T, Shovo T, Khan L, Jahan N, Hossain M, et al. Prolonged lockdown and academic uncertainties in Bangladesh: a qualitative investigation during the COVID-19 pandemic. *Heliyon.* (2021) 7:e06263. doi: 10.1016/j.heliyon.2021.e06263

13. Akter R, Akter M, Hossain M, Ahsan M. Socio-environmental factors affecting mental health of people during the COVID-19 in coastal urban areas of Bangladesh. In: Ramanathan A, Sabarathinam C, Jonathan M, Prasanna M, Kumar P, Arriola F editors. *Environmental Resilience and Transformation in Times of COVID-19: Climate Change Effects on Environmental Functionality*. Cambridge: Elsevier Inc (2021). p. 49–61. doi: 10.1016/B978-0-323-85512-9.00011-5

14. Halim S, Mridha S, Nasrin N, Islam M, Hossain M. Socioeconomic crisis and mental health stress among the middle-income group during the covid-19 pandemic. *Soc Spectr.* (2022) 42:119–34. doi: 10.1080/02732173.2022.2081639

15. Hossain M, Lima T, Ela M, Khan L, Ahmed F, Shovo T, et al. Livelihood challenges and healthcare-seeking behavior of fishermen amidst the COVID-19

pandemic in the Sundarbans mangrove forest of Bangladesh. *Aquaculture.* (2022) 546:737348. doi: 10.1016/j.aquaculture.2021.737348

16. Lima T, Ela M, Khan L, Shovo T, Hossain M, Jahan N, et al. Livelihood and health vulnerabilities of forest resource-dependent communities amidst the COVID-19 pandemic in Southwestern regions of Bangladesh. In: Ramanathan A, Sabarathinam C, Jonathan M, Arriola F, Prasanna M, Kumar P editors. *Environmental Resilience and Transformation in time of COVID-19*. Cambridge: Elsevier Inc (2021). p. 343–56. doi: 10.1016/B978-0-323-85512-9.00027-9

17. Save the Children. *The Global Girlhood Report 2020" How COVID-19 is Putting Progress in Peril*. London: Save the Children (2020).

18. United Nations Population Fund, Johns Hopkins University, Victoria University. *Impact of the COVID-19 Pandemic on Family Planning and Ending Gender-Based Violence, Female Genital Mutilation and Child Marriage*. New York, NY: United Nations Population Fund (UNFPA) (2020).

19. Cousins S. 2.5 million more child marriages due to COVID-19 pandemic. *Lancet.* (2020) 396:1059. doi: 10.1016/S0140-6736(20)32112-7

20. Paul P, Mondal D. Child marriage in India: a Human rights violation during the COVID-19 pandemic. *Asia Pac J Public Health.* (2021) 33:162–3. doi: 10.1177/1010539520975292

21. Afrin T, Zainuddin M. Spike in child marriage in Bangladesh during COVID-19: determinants and interventions. *Child Abuse Negl.* (2021) 112:104918. doi: 10.1016/j.chiabu.2020.104918

22. Islam M, Nahar M, Ibn Anik S, Barna S, Hossain M. Changes in dietary patterns among Bangladeshi adult population during the COVID-19 pandemic: a web-based cross-sectional study. *Heliyon.* (2022) 8:e10349. doi: 10.1016/j.heliyon.2022.e10349

23. Hong Le M, Tran T, Nguyen H, Fisher J. Early marriage and intimate partner violence among adolescents and young adults in Viet Nam. *J Interpers Violence.* (2014) 29:889–910. doi: 10.1177/0886260513505710

24. Sezgin A, Punamäki R. Impacts of early marriage and adolescent pregnancy on mental and somatic health: the role of partner violence. *Arch Womens Ment Health.* (2020) 23:155–66. doi: 10.1007/s00737-019-00960-w

25. Shaud S, Asad S. Marital adjustment, convergent communication patterns, and psychological distress in women with early and late marriage. *Curr Psychol.* (2020) 39:2326–33. doi: 10.1007/s12144-018-9936-1

26. Hajihasani M, Sim T. Marital satisfaction among girls with early marriage in Iran: emotional intelligence and religious orientation. *Int J Adolesc Youth.* (2019) 24:297–306. doi: 10.1080/02673843.2018.1528167

27. Baysak E, Yorguner N, Kandemir G, Denizman I, Akvardar Y. Is early marriage practice a problem for women living in Istanbul? A qualitative study. *Arch Womens Ment Health.* (2021) 24:243–50. doi: 10.1007/s00737-020-01067-3

28. Afrin S, Nasrullah S, Dalal K, Tasnim Z, Benzadid M, Humayra F, et al. Mental health status of adolescents in-home quarantine: a multi-region, cross-sectional study during COVID-19 pandemic in Bangladesh. *BMC Psychol.* (2022) 10:116. doi: 10.1186/s40359-022-00819-3

29. Banati P, Jones N, Youssef S. Intersecting vulnerabilities: the impacts of COVID-19 on the psycho-emotional lives of young people in low- and middle-income countries. *Eur J Dev Res.* (2020) 32:1613–38. doi: 10.1057/s41287-020-00325-5

30. Qin J, Ding Y, Gao J, Wu Y, Lv H, Wu J. Effects of COVID-19 on mental health and anxiety of adolescents aged 13–16 years: a comparative analysis of longitudinal data from China. *Front Psychiatry.* (2021) 12:695556. doi: 10.3389/fpsyt.2021.695556

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

32. Hu Y, Qian Y. COVID-19 and adolescent mental health in the United Kingdom. *J Adolesc Health.* (2021) 69:26–32. doi: 10.1016/j.jadohealth.2021.04.005

33. Bangladesh Bureau of Statistics. *Population Distribution and Internal Migration in Bangladesh*. Dhaka: Ministry of Planning (2015).

34. Bangladesh Bureau of Statistics. *Population and Housing Census 2011: Zila Report Khulna*. Dhaka: Statistics and Informatics Division, Ministry of Planning (2015).

35. Bangladesh Bureau of Statistics. *Bangladesh Population and Housing Census 2011: Community Report Khulna*. Dhaka: Statistics and Informatics Division, Ministry of Planning (2015).

36. Molla H. *3,000 Students Become Child Brides in Khulna During Pandemic*. Dhaka: Dhaka Tribune (2021).

37. Locke H, Wallace K. Short marital adjustment and prediction tests: their reliability and validity. *Marriage Fam Living.* (1959) 21:251–5. doi: 10.2307/348022

38. Khatun M, Deeba F, Tushar T. Psychometric properties of lock-Wallace short marital adjustment scale (LWSMAS) for Bangladeshi couples. *Dhaka Univ J Biol Sci.* (2019) 28:159–65. doi: 10.3329/dujbs.v28i2.46502

39. García-Moreno C, Jansen H, Ellsberg M, Heise L, Watts C. *WHO Multi-Country Study on Women's Health and Domestic Violence Against Women: Initial Results on prevalence, Health Outcomes and Women's Responses*. Geneva: World Health Organization (2005).

40. Lyubomirsky S, Lepper H. A measure of subjective happiness: preliminary reliability and construct validation. *Soc Indic Res.* (1999) 46:137–55.

41. Lovibond P, Lovibond S. The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behav Res Ther.* (1995) 33:335–43. doi: 10.1016/0005-7967(94)00075-U

42. Henry J, Crawford J. The short-form version of the depression anxiety stress scales (DASS-21): construct validity and normative data in a large non-clinical sample. *Br J Clin Psychol.* (2005) 44:227–39. doi: 10.1348/014466505X29657

43. Le M, Tran T, Holton S, Nguyen H, Wolfe R, Fisher J. Reliability, convergent validity and factor structure of the DASS-21 in a sample of Vietnamese adolescents. *PLoS One.* (2017) 12:e0180557. doi: 10.1371/journal.pone.0180557

44. Shaw T, Campbell M, Runions K, Zubrick S. Properties of the DASS-21 in an Australian community adolescent population. *J Clin Psychol.* (2017) 73:879–92. doi: 10.1002/jclp.22376

45. DeVellis R. *Scale Development: Theory and Application*. 2nd ed. Thousand Oaks, CA: Sage Publications Inc (2003).

46. National Institute of Mental Health. *National Mental Health Survey 2019*. Dhaka: National Institute of Mental Health (NIMH), World Health Organization (WHO) and Bangladesh Bureau of Statistics (BBS) (2021).

47. Hossain M, Jahan N, Ahammed B, Shohel T, Shovo T, Khan B, et al. A psychometric evaluation of fear of COVID-19 scale (FCV-19S). *Hellenic J Psychol.* (2022) 19:40–52.

48. Hossain M, Nishu N, Jahan N, Saadia H, Ela M, Moshrur-Ul-Alam Q, et al. Challenges of participating in online education/distance learning amidst the COVID-19 pandemic in Bangladesh: the response from students and teachers. In: Islam M, Santosh Kumar B, Lamhot N editors. *Handbook of Research on Asian Perspectives of the Educational Impact of COVID-19*. Hershey, PA: IGI Global (2022). p. 254–81. doi: 10.4018/978-1-7998-8402-6.ch015

49. Fakhari A, Allahverdipour H, Esmaeili E, Chattu V, Salehiniya H, Azizi H. Early marriage, stressful life events and risk of suicide and suicide attempt: a case–control study in Iran. *BMC Psychiatry.* (2022) 22:71. doi: 10.1186/s12888-022-03700-0

50. Mrayan L, Obeisat S. The lived experience of early marriage in Jordan: the perspective of adolescent girls and young women. *SAGE Open.* (2021) 11:21582440211048895. doi: 10.1177/21582440211048895

51. John N, Edmeades J, Murithi L. Child marriage and psychological well-being in Niger and Ethiopia. *BMC Public Health.* (2019) 19:1029. doi: 10.1186/s12889-019-7314-z

52. Soron T, Ashiq M, Al-Hakeem M, Chowdhury Z, Ahmed H, Chowdhury C. Domestic violence and mental health during the COVID-19 pandemic in Bangladesh. *JMIR Form Res.* (2021) 5:e24624. doi: 10.2196/24624

53. Maalla M'jid N. Hidden scars: the impact of violence and the COVID-19 pandemic on children's mental health. *Child Adolesc Psychiatry Ment Health.* (2020) 14:33. doi: 10.1186/s13034-020-00340-8

54. Dahal M, Khanal P, Maharjan S, Panthi B, Nepal S. Mitigating violence against women and young girls during COVID-19 induced lockdown in Nepal: a wake-up call. *Global Health.* (2020) 16:84. doi: 10.1186/s12992-020-00616-w

55. Horwitz A, McLaughlin J, White H. How the negative and positive aspects of partner relationships affect the mental health of young married people. *J Health Soc Behav.* (1998) 39:124–36. doi: 10.2307/2676395

56. Hossain M, Abdulla F, Rahman A, Khan H. Prevalence and determinants of wife-beating in Bangladesh: evidence from a nationwide survey. *BMC Psychiatry.* (2022) 22:9. doi: 10.1186/s12888-021-03652-x

57. Sagar S, Nusrat F, Rashid M, Ghosh P, Sultana M, Ahsan A, et al. Mental health status of married women during COVID-19 pandemic in Bangladesh: a cross-sectional study. *Heliyon.* (2022) 8:e08785. doi: 10.1016/j.heliyon.2022.e08785

58. Sharma I, Pandit B, Pathak A, Sharma R. Hinduism, marriage and mental illness. *Indian J Psychiatry.* (2013) 55(Suppl. 2):S243–9. doi: 10.4103/0019-5545.105544

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A systematic review and meta analysis on burnout in physicians during the COVID-19 pandemic: A hidden healthcare crisis

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Objective: This systematic review and meta-analysis aims to explore overall prevalence of burnout among physicians during early and late COVID-19 pandemic and geographical differences in burnout.

Methods: This review was registered prospectively with PROSPERO (CRD42022327959). A comprehensive search of several databases, including Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily, Ovid Embase, Ovid Cochrane Central Register of Controlled Trials, Ovid Cochrane Database of Systematic Reviews, PsycINFO, and Scopus, spanning from December 2019 to May 2022 was conducted. Eligible studies included physicians or medical professionals including physicians that worked directly or indirectly with COVID-19 patients, whilst reporting burnout outcomes using a validated scale. Literature that did not include physicians or did not occur in a hospital setting were excluded. Literature including medical students were also excluded.

Results: Forty-five observational studies were included, all of which were cross-sectional studies. The pooled estimate of overall prevalence of burnout was 54.60% (95% CI: 46.7, 62.2). Mean emotional exhaustion, depersonalization, and personal accomplishment was found to be 22.06% (95% CI: 18.19, 25.94), 8.72 (95% CI: 6.48, 10.95) and 31.18 (95% CI: 27.33, 35.03) respectively. Frontline workers displayed higher rates of burnout than second-line healthcare workers (HCW) (OR: 1.64, 95% CI: 1.13, 2.37). Studies from the early pandemic period reported burnout prevalence of 60.7% (95% CI: 48.2, 72) compared to a prevalence of 49.3% (95% CI: 37.7, 60.9) from the late pandemic period. Geographically, burnout was highest amongst Middle East and North Africa (MENA) studies (66.6%, 95% CI: 54.7, 78.5), followed by Europe (48.8%, 95% CI: 40.3, 57.3) and then South America (42%, 95% CI: −0.4, 84.4). Lastly, burnout prevalence overall (OR = 0.77, 95% CI: 0.36, 1.67) emotional exhaustion (MD = −0.36, 95% CI: −4.64, 3.91), depersonalization (MD = −0.31, 95%

CI: −1.80, 1.18), and personal accomplishment (MD = 0.55, 95% CI: −0.73, 1.83) were found comparable between physicians and nurses.

Conclusion: COVID-19 has had significant consequences on HCW burnout. Further research is needed to examine early signs of burnout and to develop effective coping strategies.

KEYWORDS

burnout, healthcare workers, COVID-19, systematic review, meta-analysis, physicians

1. Introduction

With the Corona virus disease 2019 (COVID-19) pandemic caused by Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) slowly easing its grip on global healthcare concerns and nearing its resolution, attention is now shifting toward the long term imprint this crisis has left worldwide.

One such imprint is job burnout, a psychological syndrome that stems from extended exposure to work-related stressors that occur in workers who interact with other individuals in some capacity, typically that of staff-client. Due to this, job burnout is observed across a variety of occupational sectors, including healthcare, social services, and education and its effects compromise not only the individual but the society as a whole (1).

Measurement of burnout is divided into three distinct dimensions: emotional exhaustion, feelings of cynicism (depersonalization), and a sense of ineffectiveness (lack of personal accomplishment) (2), as described by the most widely used burnout scale, the Maslach Burnout Inventory (MBI) (1). With emotional exhaustion, workers feel emotionally spent and have a sense of apathy regarding their work. Depersonalization is characterized as negative and cynical feelings toward oneself and those one interacts with. These contemptuous feelings are often related to feeling emotionally depleted, hence the correlation between depersonalization and emotional exhaustion. Lack of personal accomplishment describes an overall feeling of unsatisfaction with oneself and their work (1). Other validated scales used for measuring burnout have similar outcomes, including the Professional Quality of Life (ProQOL) scale (3), the Oldenburg Burnout Inventory (OLBI) (4), the Copenhagen Burnout Inventory (CBI) (5), the Stanford Professional Fulfillment Index (PFI) (6, 7).

Individuals with burnout suffer harmful effects of negative emotions, substance abuse and suicidal ideation (8). In physicians, this domino effect may manifest as medical errors, longer recovery times and increased physician turnover due to reduced physician productivity (9). Consequently, these effects pose a greater economic burden to the healthcare system by increasing healthcare costs for replacement of vacancies from resignations (10). Burnout does not only affect physicians, but also carries a toll on all healthcare workers (HCW); frontline workers and nurses in certain countries may be at higher risk of developing burnout. During the pandemic, frontline and second-line HCW were exposed to varying levels of stressors. Frontline workers are defined as those working directly with COVID-19 patients, while second-line workers are defined as HCW with no direct exposure to COVID-19 patients. Though both groups experienced psychological effects due to the nature of their work, frontline workers were more vulnerable due to their proximity with COVID-19 patients (11), (12). Additionally, burnout affects physicians and nurses differently, given that nurses are more intensely exposed to their patients and thus experience more work-related stressors (13). HCW burnout levels have also been shown to be higher in lower income countries than in middle or high income countries (14).

It is not entirely clear whether HCW were more vulnerable to burnout during early pandemic period, when there was shortage of personal protective equipment (PPE), limited knowledge about the illness, and no proper prevention treatment (15, 16) or during the later stages when the prolonged stress accumulated, and the number of infected individuals rose exponentially (17).

The issues of physician burnout have been adequately studied, and have shown a negative effect on depression, stress, mood disorders, suicides, and poor patient quality care (18–20). This remains true for other healthcare professions, as high nurse burnout has been linked with increased turnover, leading to nurse shortage and poorer patient care outcomes (21). Although these phenomena have been studied, measures have not been taken to alleviate this issue. Understanding the subtle differences in burnout domains between different groups and at different geographical locations could provide valuable guidance in developing effective intervention strategies.

As frontline HCW continue to respond to the COVID-19 outbreak, it is of utmost importance that we invest immediately in the psychological wellness of HCW. Burnout in medical professionals has generally been overlooked and the novelty of the COVID-19 outbreak presents a gap in understanding burnout prevalence trends in healthcare in such unforeseen situations. It is in the best interest of public health to start acting on this issue now before the burnout-related effects progress any further. Therefore, the aim of this meta-analysis is to explore burnout prevalence in HCW, focusing on physicians, during the COVID-19 pandemic as well as differences in burnout prevalence according to region, COVID-19 timelines, and healthcare profession (whether nurse or physician) to better understand this hidden healthcare crisis.

2. Methods

2.1. Search strategy and data sources

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines

(22). A comprehensive search of several databases from December 2019 to May 2022 was conducted for pertinent English language publications. The databases included Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily, Ovid Embase, Ovid Cochrane Central Register of Controlled Trials, Ovid Cochrane Database of Systematic Reviews, PsycINFO, and Scopus. The search strategy was designed and conducted by an experienced librarian. Controlled vocabulary with keywords was used to search for studies describing COVID-19 and physician burnout. **Supplementary Item 1** outlines the search strategy listing all the search terms used and how they are combined. This review was registered prospectively with PROSPERO (CRD42022327959).

2.2. Eligibility criteria and quality assessment

Eligible studies were observational studies that met all the following inclusion criteria: (1) Studies of physicians or medical healthcare professionals including physicians who were frontline workers or a mix of frontline and second-line workers during the COVID-19 pandemic in a hospital setting; (2) Reported burnout outcomes using a validated questionnaire. With regards to study designs, original, observational studies excluding case reports, case series, abstracts, conference abstracts, and articles that were not reported in English. The study also excluded medical school students and studies that did not delineate results between medical and non-medical HCW (e.g., administration, security staff). There was no comparison group in our study. The quality of each study was independently evaluated by two authors (MM and OS-O) using the Newcastle Ottawa Assessment Scale. The scale assesses sample Selection (representativeness of the target population, sample size, comparability between respondents and non-respondents, and outcome ascertainment), Comparability (comparability between subjects in different outcome groups), and Outcomes (method of measurement of outcome and statistical test used). A maximum of one star can be given to a study in each of the categories under Selection and Outcome, and a maximum of two stars can be given for Comparability (23). The difference in the determination of quality was resolved by discussion with a third author until a consensus was reached (RM). Results of the quality assessment of all included studies are shown in **Supplementary Item 2**.

2.3. Questionnaires

2.3.1. Maslach burnout inventory

The MBI scale measures burnout with 22 items measuring three dimensions: nine items measuring emotional exhaustion, five measuring depersonalization, and eight measuring personal accomplishment. Traditionally, high scores on both emotional exhaustion and depersonalization and low scores on personal accomplishment were associated with increased burnout risk (24). Each item is measured using a five- or seven-point Likert scale depending on the study. Some of the included studies used a modified MBI were only one (emotional exhaustion) (25) or two (emotional exhaustion and depersonalization) (26, 27) of the MBI subscales were used to evaluate burnout in their population.

2.3.2. Professional quality of life

The ProQOL scale measures the effects of traumatic stress experience on work burnout, compassion satisfaction, and compassion fatigue. Each subscale has ten items and cut-offs depend on the type of Likert scale used. Traditionally, a five-point Likert scale is employed, and for each subscale, moderate levels of burnout are indicated by scores of 23–41, whereas scores over 41 indicate high levels (28).

2.3.3. Oldenburg burnout inventory

The OLBI consists of two subscales, exhaustion, and disengagement, measured by eight positively and negatively framed items each. It is used as an alternative to the MBI so that the subscales of depersonalization and personal accomplishment are seen as consequences of stress and coping (29). The OLBI scale generally uses a four-point Likert scale going from one (strongly agree) to four (strongly disagree). Higher scores are associated with worse burnout symptoms and in most studies, burnout is defined as positive when the total score is greater or equal to 21 (30).

2.3.4. Copenhagen burnout inventory

The CBI consists of nineteen items and three different subscales which apply to a greater range of occupational sectors; personal related burnout (six items), work-related burnout (seven items), and client-related burnout (six items) (31). The work-related burnout sector uses a 5-point Likert scale, with higher scores indicating higher levels of burnout (32).

2.3.5. Stanford professional fulfillment index

The Stanford PFI was developed to evaluate both burnout and physician professional well-being at work, with the two domains of burnout represented as interpersonal disengagement and work-exhaustion (33). Hence, the PFI is a sixteen-items scale with four items assessing work-exhaustion, six items evaluating professional fulfillment, and six items assessing interpersonal disengagement. Possible burnout scores range from zero to forty for burnout and zero to 24 for professional fulfillment (34).

2.3.6. Mini-Z survey

The Mini-Z burnout survey is a twelve-item measurement scale, with items one through eleven being five- point Likert scale assessing job satisfaction, stress, burnout, satisfactory control of working conditions, satisfactory time available for documentation of cases, chaos, professional value alignment with those of the department heads, good teamwork, time spent on electronic medical record at home, and gender or racial discrimination. Item 12 is the following open question: "Tell us more about your stresses and what we can do to minimize them" (7).

2.4. COVID timelines

In this paper, early pandemic period referred to the onset of the pandemic until August 2020, while late pandemic period referred

to September 2020 onward, based off of general trends of the first (February 2020 to August 2020), second (September 2020 to Mid-February 2021), and third (Mid-February 2021 to June 2021) COVID-19 waves (35).

2.5. Geographical locations

We categorized studies into six regions, three with high income countries: Europe (Cyprus, France, Italy, Romania, Russia, and Spain), North America (Canada and the USA), and Australia, and three with middle/low-income countries: Asia (China, India, Malaysia, Pakistan, Singapore, South Korea, Taiwan, Turkey), Middle East and North Africa (MENA) (Egypt, Iran, Jordan, Qatar, Saudi Arabia), and South America (Argentina and Brazil).

2.6. Statistical analysis

The pooled means and proportions of our data were analyzed using a random, inverse variance method for continuous data and the Mantel-Haenszel method for dichotomous data. The heterogeneity of effect size estimates across the studies was quantified using the Q statistic and the I^2 index ($P < 0.10$ was considered significant). A value of I^2 of 0–25% indicates minimal heterogeneity, 26–50% moderate heterogeneity, and 51–100% substantial heterogeneity (36). Data analysis was performed using Open Meta analyst software (CEBM, Brown University, Providence, Rhode Island, USA) and RevMan software version 5.4 (Review Manager (RevMan) [Computer program]. The Cochrane Collaboration, 2020, Copenhagen, Denmark). If mean and standard deviation (SD) were unavailable, median was converted to mean using the formulas from the Cochrane Handbook for Systematic Reviews of Interventions (37). Authors were contacted three times to obtain additional information such as the exact Likert scale used in the MBI scale, clarification of setting (hospital or outpatient), and whether the population included only medical healthcare workers or non-medical staff as well. Publication bias was assessed using a funnel plot (38).

2.7. Data extraction

Following a thorough reading of the articles, the necessary information was retrieved using the summary and collection form. The title, responsible author, the sample size of the study, country and time of the study, study design, study participants based on their patient-facing roles (doctor, nurse, and other clinical), exposure of the participants to COVID-19 patients in the workplace, diagnostic instrument, and findings were all provided on this form. For each of the selected articles, summary forms were filled.

Necessary information was extracted from the articles and rechecked by two authors (MM and OS-O). The extraction included general information about the studies (title, author, study year and timeline of data collection, country, study design, and study setting), population characteristics (sample size, population gender, mean age, and professional role i.e., physician, nurse, or allied healthcare worker) and outcomes which included reported scores on the respective burnout scales used in each study.

3. Results

3.1. Identification and selection of studies

A literature search of several databases following PRISMA guidelines yielded 2,361 records, from which 2,147 records were eliminated by title and abstract screening. The remaining 163 records were then assessed for full text screening and 45 records were finally included in the study. Out of these 45 included studies, twenty were utilized for quantitative analysis. The PRISMA flow diagram is shown in **Supplementary Item 3**.

3.2. Study characteristics

All the 45 observational studies included were cross-sectional. A total of 29,785 medical healthcare professionals were included in the study population. Mean age range of workers was 27–47 years. A total of 27 (8, 26, 27, 39–59) studies included both frontline and second-line workers in their studies, while twelve studies (24, 25, 28, 60–68) had only frontline workers and six (32, 69–73) did not delineate between frontline and second-line workers. In terms of regions, fifteen (33.3%) of studies (28, 41, 45, 47, 51, 55, 56, 58, 59, 63, 67, 68, 71, 72, 74) took place in Asia. Europe (8, 26, 42, 48, 53, 57, 60, 62, 66, 69, 73) was represented by 11 (24.4%) studies while the Middle East and North Africa (MENA) (25, 32, 39, 44, 46, 49, 50, 64, 65, 70) were represented by ten (22.2%) studies each. South America (24, 40, 52, 54, 61, 75), North America (27, 76), and Australia (43) were represented by six (13.3%), two (4.4%), and one (2.2%) study respectively. Burnout results between nurses and physicians were compared in fourteen studies (32, 42, 43, 53, 55, 56, 62, 63, 67–71, 74). Twenty-eight studies (8, 25, 27, 28, 32, 39, 40, 42–44, 47, 49, 50, 52, 53, 55–59, 62, 63, 65, 67, 68, 70, 73, 75) conducted data collection during the early stages of the COVID-19 pandemic and fifteen (24, 26, 41, 44–46, 48, 51, 54, 60, 62, 66, 69, 71, 74, 76) studies were conducted during the later stages. Two studies (26, 61) did not specify the time of data collection. Burnout was measured using a variety of questionnaires. Thirty studies (8, 24–27, 39–42, 44, 46, 48, 49, 53, 54, 57–59, 61–64, 66, 68, 70–72, 74, 76) used the MBI questionnaire or some variation of it. All other information regarding sample size, timeline of data collection, and age distribution are included in **Table 1**.

3.3. Pooled estimated prevalence of burnout and its main domains

As shown in **Figure 1**, overall burnout was evaluated among thirteen studies (8, 24, 39, 40, 44, 48, 49, 57, 61, 66, 69, 70, 76) with MBI or a modified MBI, and the prevalence was 54.6% (95% CI: 46.7, 62.2, I^2 = 96.12%). Mean emotional exhaustion, depersonalization, and personal accomplishment were found to be 22.06 (95% CI: 18.19, 25.94, I^2 = 98.81%), 8.72 (95% CI: 6.48, 10.96, I^2 = 99.16%), and 31.18 (95% CI: 27.33, 35.03, I^2 = 99.34%) respectively.

TABLE 1 Study and baseline characteristics.

Citation	Timeline	Year of publication	Country	Burnout tool	Frontline (% of frontline)	Second-line (% of second-line)	Setting	Sample size (n)	Study participants role	Age (SD)*	Married/ Partner	Female (n)
Akova et al. (74)	1 Sep 2021–1 Oct 2021	2022	Turkey	MBI (5-point Likert)	852 (84.4)	163 (15.6)	NR	1,015	Nurse (252) Physicians (569) Medical Assistants (388)	NR	738	482
Alsulimani et al. (32)	Jun 2020-Aug 2020	2021	Saudi Arabia	CBI	NR	NR	ICU (55) ER (102)	640	Nurse (301) Physicians (71) Residents (226) Medical assistants (42)	NR	NR	NR
Alwashmi and Alkhamees (39)	27 May 2020–8 Aug 2020	2021	Saudi Arabia	MBI (7-point Likert)	26 (25.7)	75 (74.3)	NR	101	Physicians (43) Residents (58)	NR	65	56
Appiani et al. (40).	6 May 2020–8 Aug 2020	2021	Argentina	MBI (unspecified Likert range)	138 (45.7)	164 (54.3)	ER (10)	302	Physicians (152) Residents (103) Department Head (47)	NR	NR	155
Asghar et al. (41)	17 Nov 2020–1 Jan 2021	2021	Pakistan	MBI (7-point Likert)	52 (59.8)	35 (40.2)	NR	87	Physicians (18) Residents (69)	30.87 (7.34)	45	47
Azoulay et al. (69)	30 Oct 2020–1 Dec 2020	2021	France	MBI (7-point Likert)	NR	NR	ICU (845)	845	Nurse (412) Physicians (175) Residents (97)	33	NR	571
Babamiri et al. (70)	16 May 2020–22 May 2020	2022	Iran	MBI (7-point Liker	NR	NR	NR	242	Nurse (86) Physicians (76) Medical Assistant (80)	NR	NR	NR
Di Mattei et al. (42)	9 May 2020–13 Jul 2020	2021	Italy	MBI (7-point Likert)	331 (35.9)	590 (64.1)	NR	921	Nurse (362) Physicians (99) Medical Assistants (105)	NR	NR	NR
Dobson et al. (43)	16 Apr 2020–13 May 2020	2021	Australia	SPFI	120 (41.4)	170 (58.6)	NR	290	Nurse (86) Physicians (99) Medical Assistants (105)	NR	NR	223
Enea et al. (60)	19 Oct 2020–28 Oct 2020	2021	Romania	CBI	110 (100)	NR	ICU (110)	110	Nurse (39) Physicians (76) Medical assistants (2)	43.64 (12.09)	23	88
Etesam et al. (44)	First half of the year 2020	2021	Iran	MBI (7-point Likert)	100 (82)	22 (18)	COVID wards (149)	122	NR	NR	NR	NR
Fumis et al. (24).	10 Dec 2020–23 Dec 2020	2021	Brazil	MBI (5-point Likert)	51 (100)	NR	ICU (51)	51	Physicians (51)	37 (7.41)	39	20

(Continued)

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TABLE 1 (Continued)

Citation	Timeline	Year of publication	Country	Burnout tool	Frontline (% of frontline)	Second-line (% of second-line)	Setting	Sample size (n)	Study participants role	Age (SD)*	Married/ Partner	Female (n)
Gupta et al. (45)	1 Aug 2020–15 Dec 2020	2021	India	Mini-Z	664 (41.1)	951 (58.9)	NR	1615	Nurse (509) Physicians (263) Medical assistants (223)	37.74 (10.73)	1211	631
Haji Seyed Javadi et al. (46)	10 Dec 2020–16 Apr 2021	2021	Iran	MBI (7-point Likert)	187 (48.7)	197 (51.3)	NR	384	Nurse (293) Physicians (39) Medical Assistants (52)	40.01 (11.90)	299	NR
Ibar C et al. (61)	Not specified	2021	Argentina	MBI (7-point Likert)	133 (100)	NR	NR	133	Nurse (925) Physicians (34) Residents (35) Medical Assistants (39)	NR	NR	NR
Ismail et al. (25)	Apr 2020-Aug 2020	2021	Egypt	MBI (7-point Likert 1–7)	150 (100)	NR	NR	150	Physicians (150)	28.6 (10.8)	60	20
Jiang et al. (28)	Mar 2020–Apr 2020	2021	China	ProQOL	219 (100)	NR	ICU (73)	219	Nurse (219)	31.17 (4.99)	145	176
Kanneganti et al. (47)	29 May 2020–13 Jul 2020	2022	Singapore, Malaysia, India, Malaysia	OLBI	471 (17)	2, 301 (83)	NR	2,772	Nurse (1,470) Physician (878) Medical Assistants (424)	33.3 (8.2)	NR	NR
Kapetanos et al. (62)	May 2020–Jun 2020	2021	Cyprus	MBI (7-point Likert)	351 (100)	NR	NR	351	Nurse (277) Physicians (49) Medical assistants (25)	NR	NR	248
Karacan et al. (63)	1 May 2020–30 Jun 2020	2021	Turkey	MBI (unspecified 7-point Likert)	497 (100)	NR	ICU (86) ER (89)	497	Nurse (97) Physicians (150) Residents (76) Medical Assistants (174)	NR	NR	NR
Kashtanov et al. (48)	Jan 2021–Jul 2021	2022	Russia	MBI (7-point Likert)	956 (75.9)	303 (24.1)	ICU (889)	1,259	Nurse (492) Physicians (767)	36.28 (12.03)	NR	575
Khan et al. (76)	Aug 2020–Oct 2020	2021	Canada	MBI (7-point Likert)	49 (19.7)	200 (80.3)	ICU (16)	249	Physicians (249)	NR	NR	122
KhoodoruthMAS et al. (50)	17 May 2020–16 Jun 2020	2021	Qatar	ProQOL	80 (63)	47 (37)	NR	127	Residents (127)	NR	62	48
Kim et al. (51)	Apr 2021–May 2021	2021	South Korea	ProQOL	178 (72.1)	69 (27.9)	ER (247)	247	ER Physician (137) Residents (110)	NR	NR	63
Mendonça et al. (75)	Apr 2020–Apr 2020	2021	Brazil	OLBI	973 (69.9)	419 (30.1)	NR	1,392	Residents (1,392)	27.9 (3.0)	NR	1,010

(Continued)

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TABLE 1 (Continued)

Citation	Timeline	Year of publication	Country	Burnout tool	Frontline (% of frontline)	Second-line (% of second-line)	Setting	Sample size (n)	Study participants role	Age (SD)*	Married/ Partner	Female (n)
Mosolova et al. (26)	Not specified	2020	Russia	MBI-EE and DP	455 (41.2)	650 (58.8)	NR	1,105	Nurses (164) Physicians (941)	34 (12.59)	NR	742
Mousavi-Asl et al. (64)	Not specified	2020	Iran	MBI (7-point Likert)	87 (100)	NR	COVID-19 special wards (87)	87	NR	30.86 (0.63)	49	22
Mutleq et al. (65)	1 May 2020–20 May 2020	2020	Jordan	OLBI	124 (100)	NR	NR	124	Nurse (39) Physicians (39)	NR	29	95
Naldi et al. (53)	27 Apr 2020–May 2020	2021	Italy	MBI (7-point Likert 1–7)	563 (70.6)	234 (29.4)	NR	797	Nurse (469) Physicians (328)	NR	564	599
Queiroz de Paiva Faria AR et al. (54)	Nov 2020–Nov 2020	2021	Brazil	MBI (5-point Likert)	82 (65.1)	44 (34.9)	COVID-19 ward (49) ICU (33)	126	Physicians (126)	NR	88	81
Ruiz-Fernanadez MD et al.(73)	Mar 2020-April 2020	2020	Spain	ProQOL	NR	NR	ICU (65) Emergency department (76) Regular hospital care (140) COVID-19 Unit (30)	311	NR	NR	NR	NR
Sarikhani et al. (49)	Mar 2020–Jan 2021	2021	Iran	MBI (7-point Likert)	326 (75.5)	106 (24.5)	COVID-19 (283)	432	Physicians (212) Residents (220)	31.32 (8.89)	162	222
Shiu et al. (55)	12 Mar 2020–29 Mar 2020	2021	Taiwan	Single Item Study	560 (39.4)	861 (60.6)	NR	1,421	Nurse (1,064) Physicians (357)	36.64 (8.13)	NR	1,159
Singh et al. (27)	21 Jun 2020–21 Aug 2020	2022	USA	MBI (modified 7-point)	494 (79.7)	126 (20.4)	NR	620	Nurse (524) Residents (96)	46.51 (13.3)	464	300
Steil et al. (52)	Apr 2020	2022	Brazil	OLBI	1,926 (62.7)	1,145 (37.3)	NR	3,071	Residents (3,071)	28 (3.2)	NR	2,311
Stocchetti et al. (66)	11 Jan 2021–28 Jan 2021	2021	Italy	MBI (7-point Likert)	136 (100)	NR	ICU (136)	136	Nurse (84) Physicians (52)	39.1 (11.25)	86	79
Teo et al. (56)	12 Mar 2020–21 Apr 2020	2021	Singapore	One item Physician Work Life Scale	781 (76.1)	245 (23.9)	N	1,026	Nurse (822) Physicians (204)	35.1 (10.27)	NR	799
Torrente et al. (57)	21 Apr 2020–3 May 2020	2021	Spain	MBI- (5-point Likert)	377 (58.6)	266 (41.4)	NR	643	Nurse (172) Physicians (408) Medical assistant (63)	NR	491	472
Treluyer and Tourneaux (8)	1st week May 2020–11 May 2020	2021	France	MBI (8-point Likert)	136 (40)	204 (60)	NR	340	Physicians (340)	27 (2.22)	242	285

(Continued)

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TABLE 1 (Continued)

Citation	Timeline	Year of publication	Country	Burnout tool	Frontline (% of frontline)	Second-line (% of second-line)	Setting	Sample size (n)	Study participants role	Age (SD)*	Married/ Partner	Female (n)
Tuna and Ozdin S (58)	23 Apr 2020–27 Apr 2020	2021	Turkey	MBI (5-point Likert)	188 (46.3)	218 (53.7)	NR	406	Physicians (406)	42.9 (10.1)	297	189
Turan et al. (60)	May 2020–Jul 2020	2022	Turkey	MBI (5-point Likert)	33 (82.5)	7 (17.5)	ER (5)	40	ER physicians (5) Physicians (40)	40 (6.35)	38	13
Yilmaz et al. (63)	1 Oct 2020–31 Oct 2020	2021	Turkey	MBI (5-point Likert)	NR	NR	NR	479	Nurse (192) Physicians (287)	NR	381	NR
Zakaria et al. (67)	8 May 2020–15 May 2020	2021	Malaysia	The questionnaire form was adopted from Michelle Post, Public Welfare, Vol. 39, No. 1, 1981, American Public Welfare Association. – Burnout N value	216 (100)	NR	ER (216)	216	ER physicians (4) Nurse (142) Physicians (37) Medical Assistants (37)	30	NR	148
Zhang et al. (68)	18 Feb 2020–4 Mar 2020	2021	China	MBI (7-point Likert)	1,081 (100)	NR	NR	1,081	Nurses (642) Physicians (314) Medical assistants (125)	NR	NR	NR
Zhou et al. (72)	Oct 2020–Oct 2020	2022	China	MBI (7-point Likert)	NR	NR	NR	3,203	Nurse (1,794) Physicians (829) Medical assistants (580)	NR	NR	NR

CBI, Copenhagen burnout inventory; ER, emergency room; Hrs/wk, hours worked per week; ICU, intensive care unit; MBI, Maslach burnout inventory; Mini-Z, zero burnout program; NR, not reported; OLBI, Oldenburg burnout inventory; ProQOL, professional quality of Life; SD, standard deviation; SPFI, Stanford professional fulfillment index; Yrs, years.

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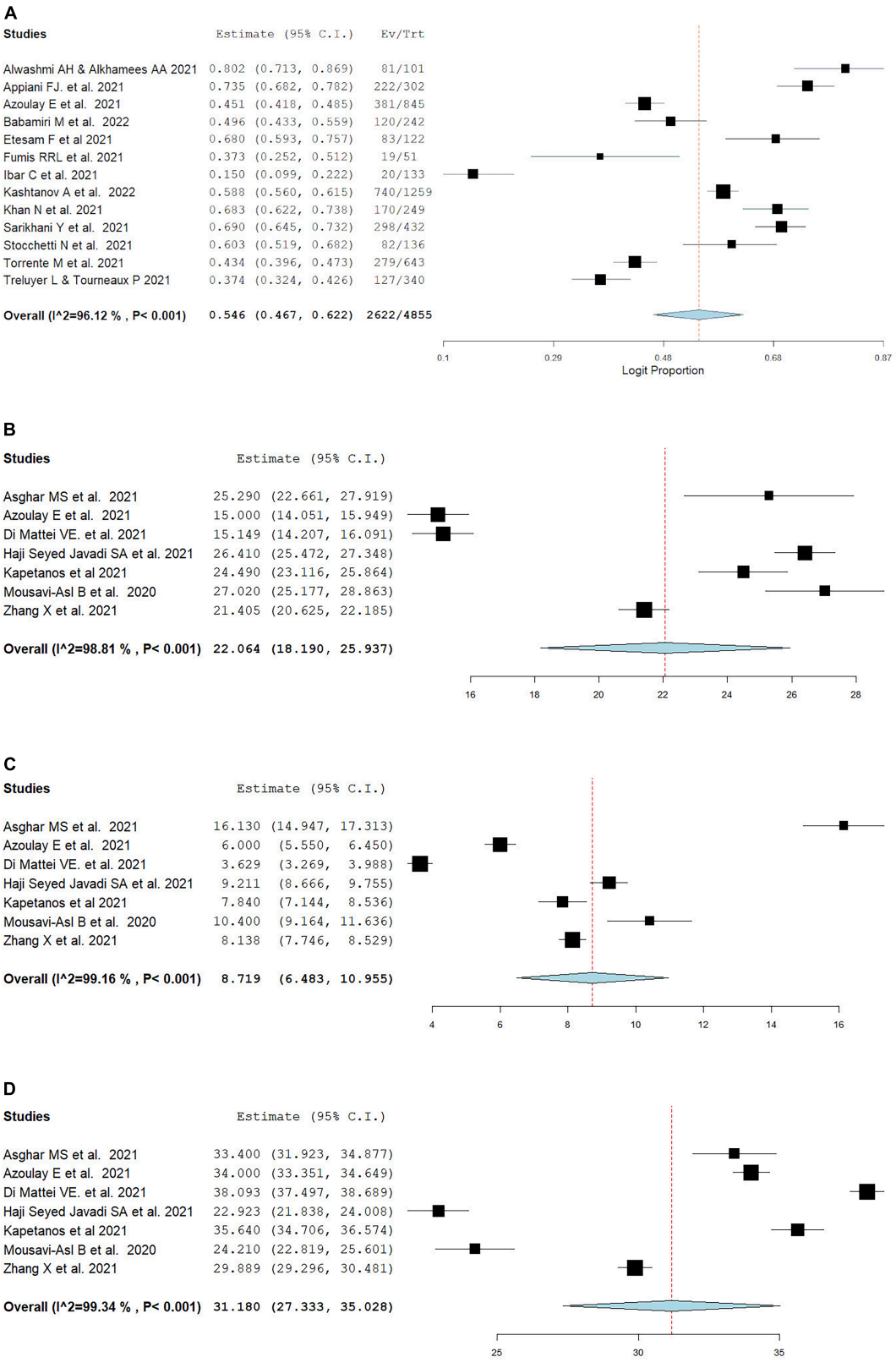

FIGURE 1
Pooled estimate of overall burnout in healthcare workers according to the Maslach burnout inventory by **(A)** overall prevalence, **(B)** emotional exhaustion, **(C)** depersonalization, **(D)** personal accomplishment.

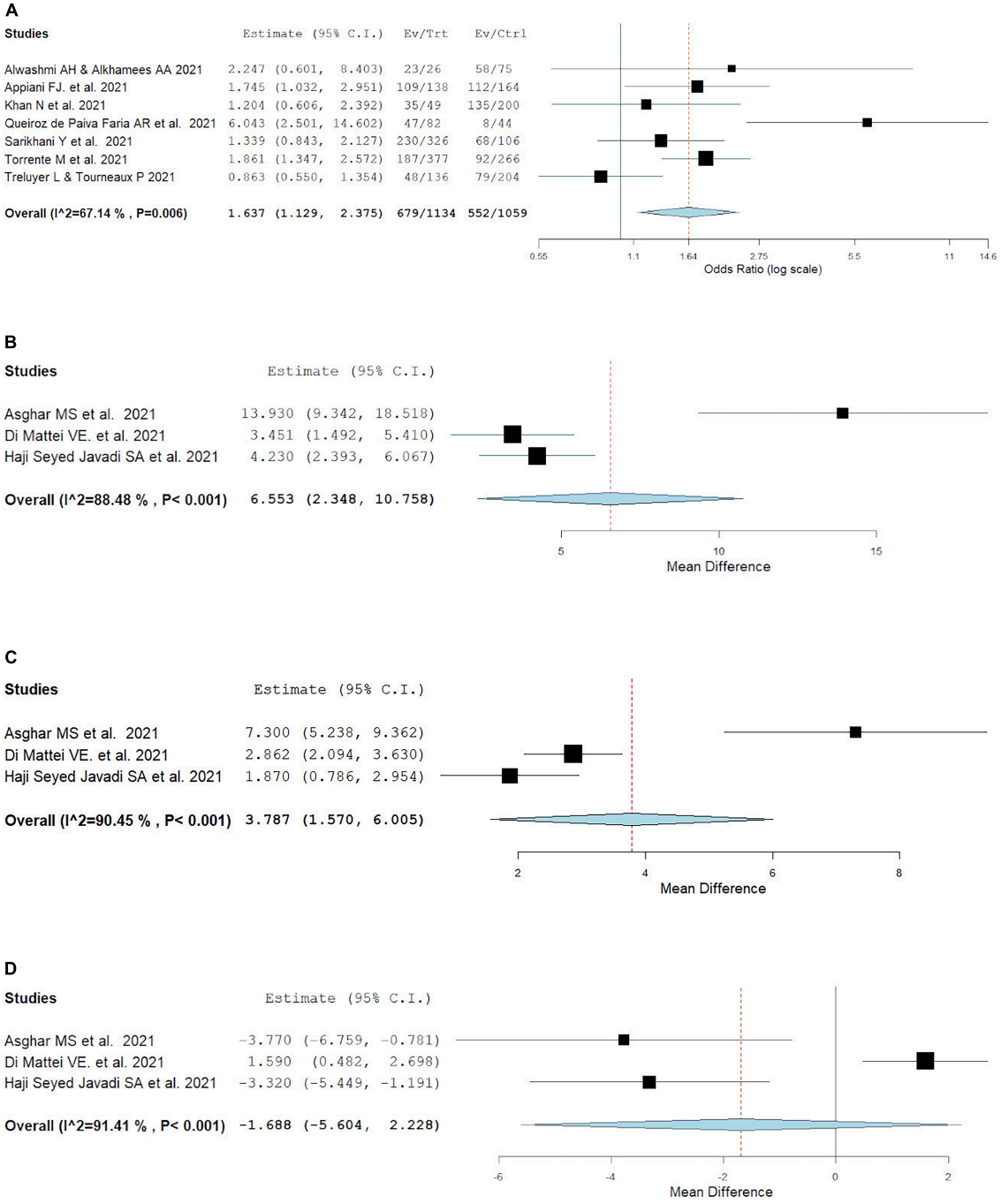

FIGURE 2
Pooled estimate of burnout in frontline vs second-line healthcare workers according to Maslach burnout inventory by **(A)** overall prevalence, **(B)** emotional exhaustion prevalence, **(C)** depersonalization prevalence, **(D)** personal accomplishment prevalence.

3.4. Burnout in frontline vs second-line HCW

Overall burnout was evaluated with the MBI scale, and the frontline workers had a higher rate of burnout compared to second-line HCW (OR: 1.64, 95% CI: 1.13, 2.38, I^2 = 67.14%), as can be seen in Figure 2. Mean emotional exhaustion and depersonalization were found to be higher in frontline than in second-line HCW (MD = 6.55, 95% CI: 2.35, 10.76, I^2 = 88.48%) and (MD = 3.79, 95% CI: 1.57, 6.01, I^2 = 90.45%) respectively. Mean personal accomplishment had comparable levels in frontline workers versus second-line workers (MD = −1.69, 95% CI: −5.60, 2.23, I^2 = 91.41%).

3.5. Prevalence of burnout during early vs late pandemic

Overall burnout prevalence in the early wave of the pandemic was found to be 60.7% (95% CI: 48.2, 72.0%, I^2 = 96.7%) of the population, as evident in Figure 3. Overall burnout in the later

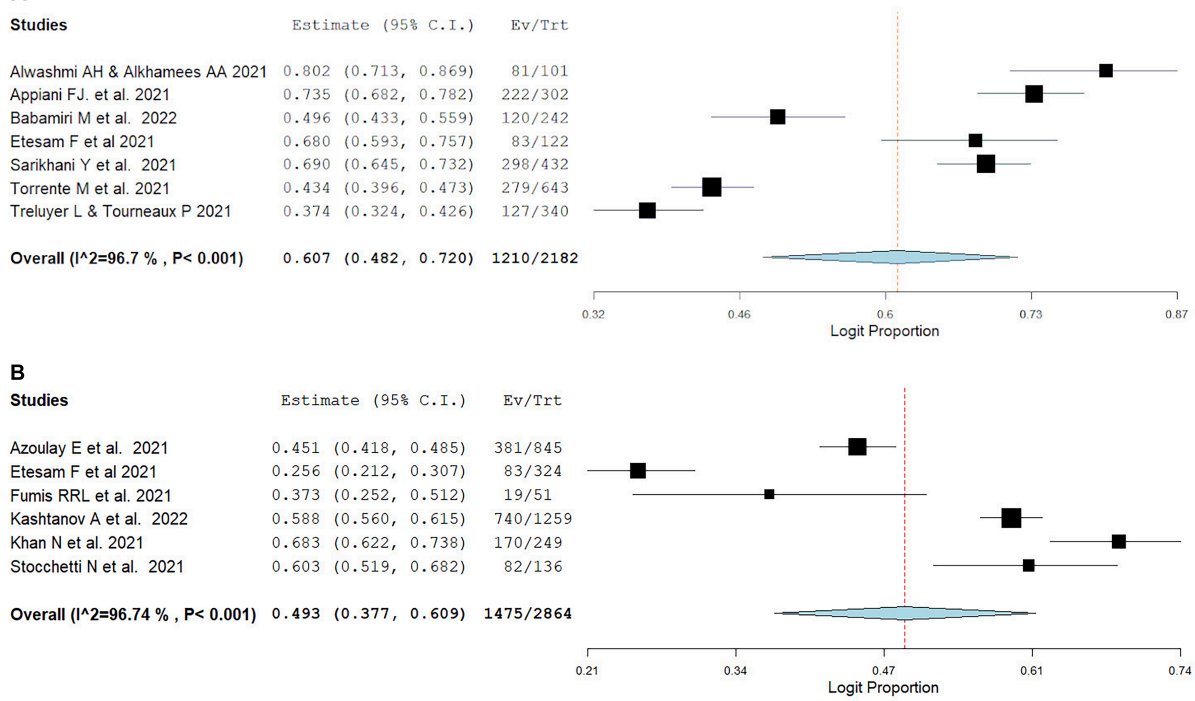

FIGURE 3
Pooled estimate of burnout prevalence according to the Maslach burnout inventory in **(A)** early pandemic period, **(B)** late pandemic period.

pandemic period was shown to be prevalent in 49.3% (95% CI: 37.7, 60.9%, I^2 = 96.74%) of the population.

3.6. Prevalence of burnout in different geographical locations

As can be seen in Figure 4, burnout prevalence among HCW was highest amongst MENA studies (66.6%, 95% CI: 54.7, 78.5%, I^2 = 92.67%), second highest prevalence was observed in Europe (48.8%, 95% CI: 40.3, 57.3%, I^2 = 95.27%) reporting burnout, and finally the lowest burnout prevalence was found in South America (42%, 95% CI: −0.4, 84.4%, I^2 = 99.08%). We could not estimate the pooled prevalence in Asian studies because they used different scales to measure burnout.

3.7. Prevalence of burnout among nurses vs physicians

Fourteen studies compared burnout outcomes between physicians and nurses. Among fourteen studies, four studies (42, 62, 68, 69) reported emotional exhaustion, depersonalization, and personal accomplishment prevalence, while two studies (69, 70) reported overall MBI burnout. In comparison to nurses, physicians had comparable rates of overall burnout rate (OR = 0.77, 95% CI: 0.36, 1.67, I^2 = 78.11%). Emotional exhaustion, depersonalization, and personal accomplishment mean result were also comparable between physicians and nurses (MD = −0.36, 95% CI: −4.64, 3.91, I^2 = 92.5%) (MD = −0.31, 95% CI: −1.80, 1.18, I^2 = 85.51%) (MD = 0.55, 95% CI: −0.73, 1.83, I^2 = 66.41%), as showcased in Figure 5.

4. Discussion

The COVID-19 pandemic has proven to be an enormous burden on healthcare systems across the globe, placing considerable strain on the psychological well-being of all healthcare workers (HCW) involved. The results of this meta-analysis demonstrate that more than half of HCW experienced burnout at some point during the pandemic. As expected, frontline, compared to second-line HCWs, were found to have higher rates of burnout. In addition, burnout prevalence was shown to be higher during the early pandemic as compared to late and specifically in MENA countries. Finally, physicians and nurses were found to be comparable in overall burnout and all its domains. This meta-analysis specifically examines the prevalence of specific burnout domains which could be utilized as potential targets for therapeutic intervention. To our knowledge, no previous meta-analysis has investigated burnout based on frontline versus second-line HCW, nurses versus physician, early versus late pandemic waves, as well as between regions. Additionally, previous reviews included medical and non-medical healthcare workers, in and out of hospital setting, while this review focused specifically on medical healthcare staff within a hospital setting. The cut-off scores for low, moderate, and high levels of the MBI subdomains used in this review may be found in Supplementary Item 4.

Lack of personal accomplishment, defined as having a negative outlook on the worth of one's work (1), was found to be the most affected domain during the COVID-19 pandemic out of the three subscales of the MBI. Indeed, the mean score for personal

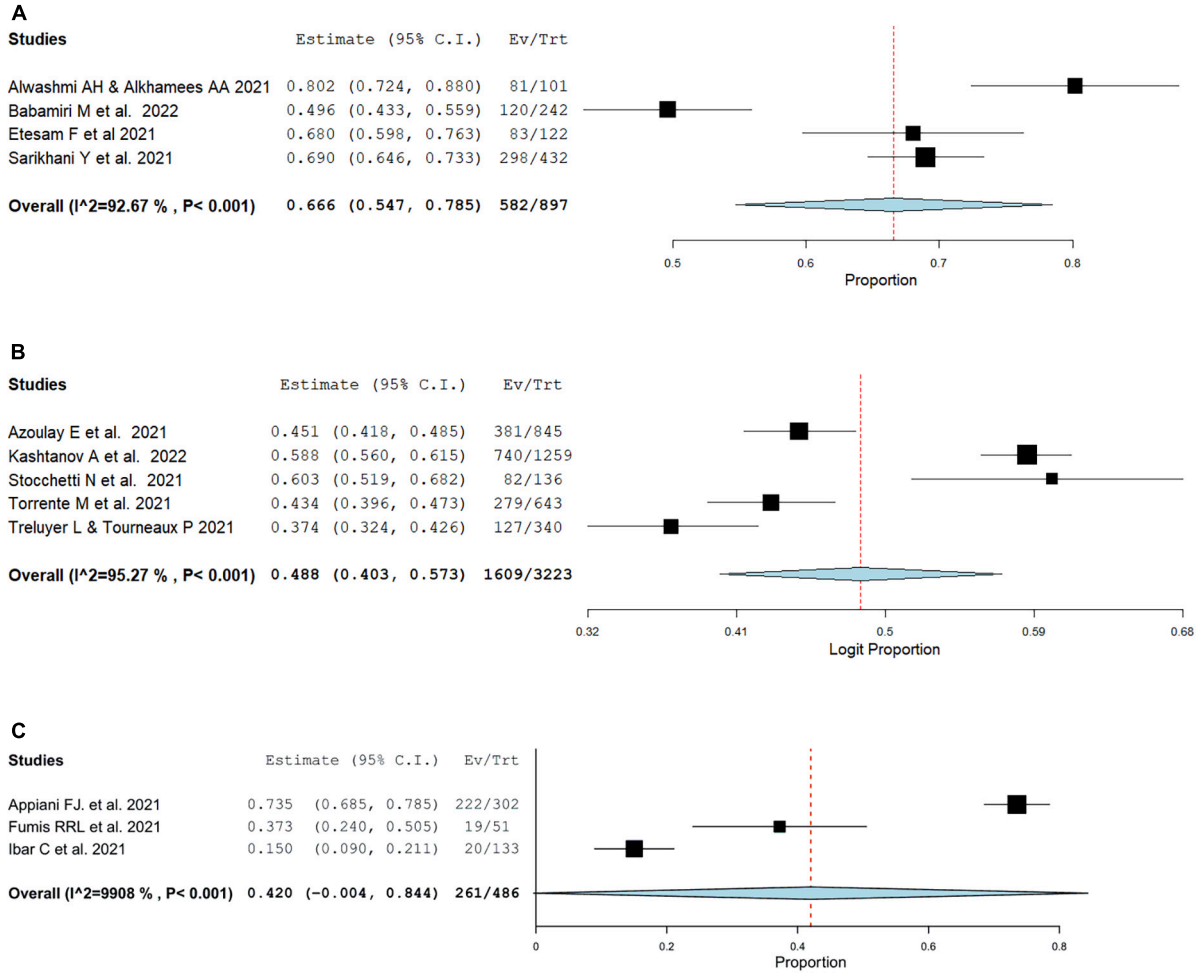

FIGURE 4
Pooled estimate of burnout prevalence according to Maslach burnout inventory in **(A)** MENA, **(B)** Europe, **(C)** South America. Asian studies forest plots could not be pooled due to burnout scale discrepancy.

accomplishment referred to a low score as per MBI subscale cut-off ranges, while mean scores for emotional exhaustion and depersonalization were found to indicate moderate levels (77). Increased stress levels are linked to reduced personal accomplishment and feelings of low self-esteem (78). This could be due to increased workload, inadequate protective personal equipment, increased risk of infection, emotional strain of caring for patients suffering alone in confinement (79), and difficult decision making due to scarce resource allocation (80). All these factors were undoubtedly experienced by HCWs during the pandemic, which could lead to a reduced level of effectiveness of care that may affect one's outlook on their accomplishments as healthcare providers, especially in the case of frontline workers (54).

Frontline workers were at higher risk of experiencing burnout compared to their second-line worker colleagues. They also experienced higher mean scores for emotional exhaustion and depersonalization. Aside from fear of getting infected or spreading the infection to their loved ones, frontline HCW became the target of stigmatization in their communities, with people viewing this group as a possible cause of virus transmission (81). Frontline workers also experienced increased workload coupled with the unique demands of a novel pandemic and reported elevated levels of psychological outcomes such as depression, post-traumatic disorder, and anxiety (12). This in turn provides feasible rationale for the disparity in reported burnout levels seen between frontline and second-line HCWs. However, shortage of HCWs also led to increased workload of second-line workers, leading to higher prevalence of poor sleep quality and anxiety seen in this cohort (82). Further insight into prolonged high workload effect on the mental health and well-being of HCWs could be elucidated by comparing burnout prevalence in early and late pandemic periods.

The early pandemic period was found to be associated with higher prevalence of burnout compared to late pandemic period. However, a study by Melnikow et al. explored burnout prevalence in the first and second waves of the pandemic and found an increase in overall burnout prevalence in the second wave compared to the first wave (83). They also reported that the increased burnout prevalence applied to all frontline specialties except emergency medicine, who displayed reduced burnout results in the second wave compared to the first (Professional Fulfillment Index Burnout Composite Scale score difference: −0.09, 95% CI: −0.53, 0.34), though these differences were not significant. As the pandemic ensued, increased workload, cases, and strain on resources could explain the increase in burnout across the waves in non-emergency specialties as reported by Melnikow et al. Yet, despite this strain, the exercise of various personal resilience and institutional strategies to manage burnout

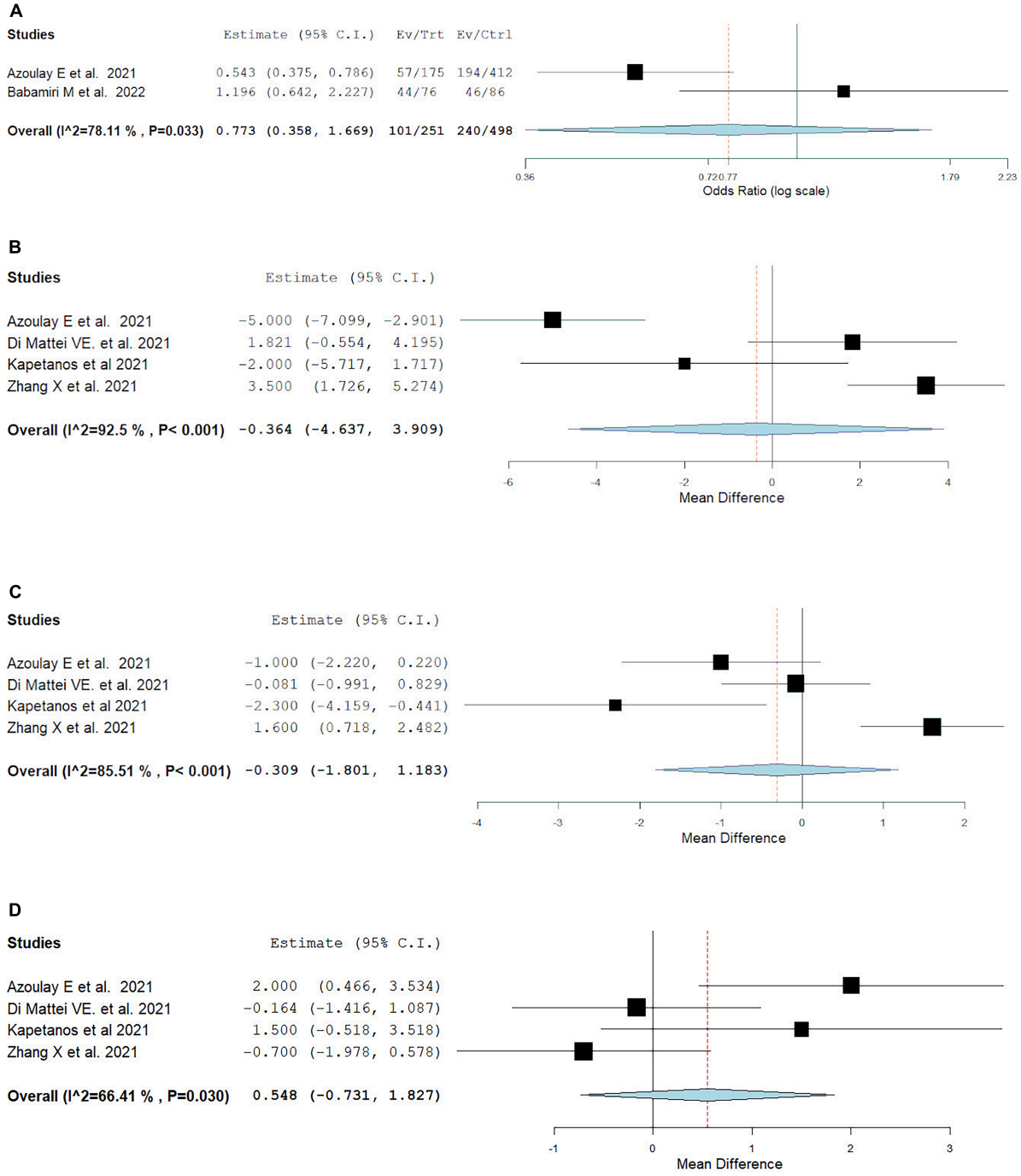

FIGURE 5
Pooled estimate of burnout prevalence in nurses vs physician according to Maslach burnout inventory by **(A)** overall prevalence, **(B)** emotional exhaustion prevalence, **(C)** depersonalization prevalence, **(D)** personal accomplishment prevalence.

would explain the observed prevalence rates of burnout being lower in the second wave when compared to the first. Also, COVID-19 knowledge and preparedness increased over time thus decreasing COVID-19 fear, which has been shown to correlate with higher levels of burnout among healthcare professionals (84). On the other hand, the differences in prevalence could be attributed to several confounding factors given that the early and late pandemic studies were conducted with different populations, with different sample sizes, and in different countries and regions.

Out of the three regions studied, HCW in MENA displayed a higher prevalence of burnout compared to Europe and South America (66.6, 48.8, and 42%). It is important to note that a contributor to this observation is the number of included studies. South America had the least amount of included studies for the subgroup analysis and an overall total of six studies (24, 40, 52, 54, 61, 75) whereas MENA (25, 32, 39, 44, 46, 49, 50, 64, 65, 70) and Europe (8, 26, 42, 48, 53, 57, 60, 62, 66, 69) both had ten included studies each. We could not estimate pooled prevalence from Asian studies due to wide variability in rating scales. MENA countries report a

scarcer number of resources aimed at alleviating burnout compared to European countries (85). Other differences in prevalence can be attributed to cultural differences as well as variation in healthcare systems, as cultural differences may explain the roles physicians play in addition to patient's attitudes toward their healthcare providers (86). The cultural context of healthcare systems is also thought to play a role in physician versus nurses' social acknowledgment, affecting their mental health status (87).

Physicians were found to have a comparable risk of burnout with nurses, as well as comparable mean scores for emotional exhaustion, depersonalization, and personal accomplishment. These results are consistent with the findings of another systematic review by Kunz M., Strasser M., and Hasan A 2019 (88), showing comparable levels of general stress levels and burnout between nurses and physicians. However, that review found that overall mental health outcomes were lower for nurses, with higher levels of depression, posttraumatic stress disorder (PTSD), and anxiety. By virtue of the nature of their job, nurses are more psychologically and physically involved in patient care and for longer hours than physicians are, which could explain these results (88). Some studies in Belgium explored the working conditions of nurses, where they suffer from insufficient teamwork, organizational support, and social recognition (87, 89, 90). On the other hand, it is important to remember that there are several confounding factors to consider, such as gender proportions and mean age (88). Though there have been conflicting results regarding gender susceptibility to burnout in nurses, it has been reported that female nurses displayed higher levels of emotional exhaustion than male nurses (91). Burnout also presents higher incidences amongst young professionals under the age of thirty, possibly due to lack of experience and self-confidence exerting additional stress on their workload (92). The comparable burnout results between nurses and physicians may be understood best by the unique demands of the COVID-19 pandemic on these professionals. The increased workload, medical demand, and overall fear of COVID-19 due to proximity to patients were experienced by both physicians and nurses, explaining comparable burnout results (93).

Aside from understanding the trends of burnout in HCW, it is also important to address the results of this study and put forth solutions to this crisis. Aryankhesal et al. conducted a systematic review on effective interventions for burnout in nurses and physicians. Per their findings, psychosocial training and mindfulness techniques had a positive effect on improving mental health and burnout in nurses, whereas, e-mental health approaches, communication skills training, and online programs had a positive effect for physicians (94). Innovative approaches to encouragement and motivation were also shown to reduce burnout and improve mental health in nurses (95). For HCW in general, a frequent suggestion has been to increase the availability and accessibility of Personal Protective Equipment (PPE), as well training on their usage (96–98).

Other possible solutions to address burnout in HCW include recruitment and training of volunteers to relieve the heavy workload first and second-line workers experience (99). Longitudinal departmental burnout assessment as well as off-duty social gatherings which provide an opportunity to share challenges and boost morale are potential ways to keep track of workers mental health and assess stressors (10). Updating electronic medical record keeping techniques increases efficiency and minimizes the stress of documentation (100, 101). Lastly, providing stress management and resiliency training aid in addressing perceived loss of control and autonomy could prove helpful (10). The implementation of these interventions coupled with the understanding of burnout trends during the COVID-19 pandemic are useful steps in alleviating the healthcare crisis posed by burnout in HCW.

5. Limitations

High heterogeneity was found in the meta-analysis results; however, this was expected since the studies had been conducted in different periods of the pandemic and different countries. The studies included all had different sample sizes, ranging from 40 to 3,203, which also posed a limitation and contributed to the heterogeneity of the meta-analysis results. Additionally, the study outcomes were assessed using self-reported questionnaires in uncontrolled settings, therefore introducing reporting bias. The MBI used to assess burnout in most of the studies was not used in a standardized manner thus leading to differences in results; different Likert scales were used and cut off values for outcome results as well as definition of burnout varied across studies. To address the issue of different Likert scales, meta-analysis was conducted separately between studies that reported mean overall burnout and subscale score results using the same MBI version and Likert scale measure. To resolve the challenge proposed by inconsistent cut-off scores, the cut-off values used in this study were derived from a systematic review of 41 studies that used the MBI questionnaire for burnout evaluation (62). Included studies used different scales for burnout assessment which led to the exclusion of several studies from the meta-analysis. As sampling error is an inherent limitation in meta-analyses, it was not accounted for. Instead, studies were assessed using the Newcastle Ottawa Assessment Scale, which investigates sample selection and representativeness. Furthermore, handsearching of journals and recurrent searches on google scholar during the completion of the study in order to pick up new articles that might not be indexed in the databases selected was not performed, in accordance to Cochrane guidelines (37). At the time of this review, previous study had compared between early and late pandemic burnout or between region burnout, therefore limiting the discussion on the results of said subgroup analyses.

6. Conclusion

The purpose of this study was to explore the burnout prevalence in frontline medical healthcare and second-line workers during the COVID-19 pandemic as well as differences in prevalence according to region, healthcare profession and COVID-19 timeline. Our findings showed that frontline workers were at higher risk of experiencing burnout compared to their second-line workers colleagues, the early pandemic was associated with a higher burnout prevalence compared to late pandemic period and MENA had a higher burnout prevalence than Europe or South America. Burnout prevalence between physicians and nurses were found to be comparable. Though there have been studies on this phenomenon, this study specifically studied burnout in medical healthcare providers that work in a hospital setting. Possible solutions for burnout were also discussed, especially since burnout had significant consequential effects on HCW, patients, and the healthcare system. Further studies comparing burnout according to pandemic waves as well as regional analyses should be conducted so that more concrete evidence can be obtained on timeline and regional effects to better prepare for future pandemics A standardized diagnostic inventory for burnout

assessment, as well as uniform cut-off scores, should be implemented to make measuring and grading of burnout easier.

Data availability statement

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

Author contributions

MM: conceptualization, methodology, investigation, data curation, writing – original draft, writing – review and editing, visualization, and project administration. OS-O: investigation, data curation, writing – original draft, writing – review and editing, and visualization. RM: conceptualization, methodology, software, formal analysis, investigation, writing – review and editing, visualization, and supervision. AB: data curation, validation, and writing – review and editing. HN: conceptualization, validation, writing – review and editing, software, and supervision. CT and OA: conceptualization, project administration, writing – review and editing, and supervision. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.1071397/full#supplementary-material

SUPPLEMENTARY ITEM 1
Search strategy.

SUPPLEMENTARY ITEM 2
Methodological quality assessment.

SUPPLEMENTARY ITEM 3
Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram.

SUPPLEMENTARY ITEM 4
Burnout scales.

References

1. Maslach C, Jackson S, Leiter M. The maslach burnout inventory manual. In: Zalaquett CP, Wood RJ editors. *Evaluating Stress: A Book of Resources*. Lanham, MA: The Scarecrow Press (1997). p. 191–218.

2. Rossi AM, Perrewe PL, Sauter SL. *Stress and Quality of Working Life: Current Perspectives in Occupational Health*. Charlotte, NC: Information Age Publishing (2006).

3. Stamm B. *The Concise Manual for the Professional Quality of Life Scale*. West Harrison, NY: Eastwoods, LLC (2010).

4. Demerouti E, Bakker AB. The oldenburg burnout inventory: a good alternative to measure burnout and engagement. In: Halbesleben JRB editor. *Handbook of Stress and Burnout in Health Care*. New York, NY: Nova Science (2008). p. 65–78.

5. Kristensen TS, Borritz M, Villadsen E, Christensen KB. The copenhagen burnout inventory: a new tool for the assessment of burnout. *Work Stress.* (2005) 19:192–207. doi: 10.1080/02678370500297720

6. Vetter M, Vetter M, Cohn D, Yeager K, Fowler J. Utility of the Stanford Professional Fulfillment Index as a single survey instrument to assess holistic physician wellbeing. *Gynecol Oncol.* (2021) 162:S327–8. doi: 10.1016/S0090-8258(21)01272-5

7. The Institute for Professional Worklife. *Mini Z Survey*. Minneapolis, MN: The Institute for Professional Worklife (2020).

8. Treluyer L, Tourneux P. Burnout among paediatric residents during the COVID-19 outbreak in France. *Eur J Pediatr.* (2021) 180:627–33. doi: 10.1007/s00431-020-03907-x

9. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: contributors, consequences and solutions. *J Internal Med.* (2018) 283:516–29. doi: 10.1111/joim.12752

10. Bhardwaj A. COVID-19 pandemic and physician burnout: ramifications for healthcare workforce in the United States. *J Healthc Leadersh.* (2022) 14:91–7. doi: 10.2147/JHL.S360163

11. De Kock JH, Latham HA, Leslie SJ, Grindle M, Munoz S-A, Ellis L, et al. A rapid review of the impact of COVID-19 on the mental health of healthcare workers: implications for supporting psychological well-being. *BMC Public Health.* (2021) 21:104. doi: 10.1186/s12889-020-10070-3

12. Billings J, Ching BCF, Gkofa V, Greene T, Bloomfield M. Experiences of frontline healthcare workers and their views about support during COVID-19 and previous pandemics: a systematic review and qualitative meta-synthesis. *BMC Health Services Res.* (2021) 21:923. doi: 10.1186/s12913-021-06917-z

13. Patrick K, Lavery JF. Burnout in nursing. *Aust J Adv Nurs.* (2007) 24:43.

14. Ghahramani S, Lankarani KB, Yousefi M, Heydari K, Shahabi S, Azmand SA. Systematic review and meta-analysis of burnout among healthcare workers during COVID-19. *Front Psychiatry.* (2021) 12:758849. doi: 10.3389/fpsyt.2021.758849

15. Preti E, Di Mattei V, Perego G, Ferrari F, Mazzetti M, Taranto P, et al. The psychological impact of epidemic and pandemic outbreaks on healthcare workers: rapid review of the evidence. *Curr Psychiatry Rep.* (2020) 22:43. doi: 10.1007/s11920-020-01166-z

16. Alnazly E, Khraisat OM, Al-Bashaireh AM, Bryant CL. Anxiety, depression, stress, fear and social support during COVID-19 pandemic among Jordanian healthcare workers. *PLoS One.* (2021) 16:e0247679. doi: 10.1371/journal.pone.0247679

17. van den Boogaard M, Zegers M. Mental preparedness for prolonged periods of high workload – What did we learn from the covid-19 pandemic? *Intensive Crit Care Nurs.* (2022) 71:103258. doi: 10.1016/j.iccn.2022.103258

18. West CP, Tan Ad Fau – Habermann TM, Habermann Tm Fau – Sloan JA, Sloan Ja Fau – Shanafelt TD, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. *JAMA.* (2009) 302:1294–300.

19. Dyrbye LN, Shanafelt TD. Physician burnout: a potential threat to successful health care reform. *JAMA* (2011) 305:2009–10. doi: 10.1001/jama.2011.652

20. Shanafelt TD, Mungo M, Schmitgen J, Storz KA, Reeves D, Hayes SN, et al. Longitudinal study evaluating the association between physician burnout and changes

in professional work effort. *Mayo Clin Proc.* (2016) 91:422–31. doi: 10.1016/j.mayocp.2016.02.001

21. Vahey DC, Aiken Lh Fau – Sloane DM, Sloane Dm Fau – Clarke SP, Clarke Sp Fau – Vargas D, Vargas D. Nurse burnout and patient satisfaction. *Med Care.* (2004) 42:II57–66. doi: 10.1097/01.mlr.0000109126.50398.5a

22. Moher D, Liberati A, Fau – Tetzlaff J, Tetzlaff J Fau – Altman DG, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med.* (2009) 6:e1000097. doi: 10.1371/journal.pmed.1000097

23. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. *Eur J Epidemiol.* (2010) 25:603–5. doi: 10.1007/s10654-010-9491-z

24. Fumis RRL, Costa ELV, Dal'Col SVC, Azevedo LCP, Pastore Junior L. Burnout syndrome in intensive care physicians in time of the COVID-19: a cross-sectional study. *BMJ Open.* (2022) 12:e057272. doi: 10.1136/bmjopen-2021-057272

25. Ismail TI, Shehata SF, Mahrous RSS. Occupational stress and burnout among frontline Egyptian anesthesiologists during COVID-19 outbreak in Egypt. *Egypt J Anaesth.* (2021) 37:91–9. doi: 10.1080/11101849.2021.1891704

26. Mosolova E, Sosin D, Mosolov S. Stress, anxiety, depression and burnout in frontline healthcare workers during two peaks of COVID-19 pandemic in Russia. *Psychiatry Res.* (2021) 306:114226. doi: 10.1016/j.psychres.2021.114226

27. Singh V, Young JQ, Malhotra P, McCann-Pineo M, Rasul R, Corley SS, et al. Evaluating burnout during the COVID-19 pandemic among physicians in a large health system in New York. *Arch Environ Occupat Health.* (2022) 77:819–27. doi: 10.1080/19338244.2021.2023084

28. Jiang W, Zhao X, Jiang J, Zhou Q, Yang J, Chen Y, et al. Hospital ethical climate associated with the professional quality of life among nurses during the early stage of COVID-19 pandemic in Wuhan, China: a cross-sectional study. *Int J Nurs Sci.* (2021) 8:310–7. doi: 10.1016/j.ijnss.2021.05.002

29. Tipa RO, Tudose C, Pucarea VL. Measuring burnout among psychiatric residents using the oldenburg burnout inventory (OLBI) instrument. *J Med Life.* (2019) 12:354–60. doi: 10.25122/jml-2019-0089

30. Steil A, Pereira Tokeshi AB, Bernardo LS, da Silva Neto GP, Davi RFJ, Bárbara AFS, et al. Medical residents' mental distress in the COVID-19 pandemic: an urgent need for mental health care. *PLoS One.* (2022) 17:e0266228.

31. Papaefstathiou E, Tsounis A, Malliarou M, Sarafis P. Translation and validation of the Copenhagen Burnout Inventory amongst Greek doctors. *Health Psychol Res.* (2019) 7:7678. doi: 10.4081/hpr.2019.7678

32. Alsulimani LK, Farhat AM, Borah RA, AlKhalifah JA, Alyaseen SM, Alghamdi SM, et al. Health care worker burnout during the COVID-19 pandemic: a cross-sectional survey study in Saudi Arabia. *Saudi Med J.* (2021) 42:306–14. doi: 10.15537/smj.2021.42.3.20200812

33. Trockel M, Bohman B, Lesure E, Hamidi MS, Welle D, Roberts L, et al. A brief instrument to assess both burnout and professional fulfillment in physicians: reliability and validity, including correlation with self-reported medical errors, in a sample of resident and practicing physicians. *Acad Psychiatry.* (2018) 42:11–24. doi: 10.1007/s40596-017-0849-3

34. Shanafelt TD, Makowski MS, Wang H, Bohman B, Leonard M, Harrington RA, et al. Association of burnout, professional fulfillment, and self-care practices of physician leaders with their independently rated leadership effectiveness. *JAMA Netw Open.* (2020) 3:e207961. doi: 10.1001/jamanetworkopen.2020.7961

35. Wu J, Scarabel F, McCarthy Z, Xiao Y, Ogden NH. A window of opportunity for intensifying testing and tracing efforts to prevent new COVID-19 outbreaks due to more transmissible variants. *Can Commun Dis Rep.* (2021) 47:329–38. doi: 10.14745/ccdr.v47i78a06

36. Higgins JP, Thompson Sg Fau – Deeks JJ, Deeks Jj Fau – Altman DG, Altman DG. Measuring inconsistency in meta-analyses. *BMJ.* (2003) 327:557–60. doi: 10.1136/bmj.327.7414.557

37. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al. *Cochrane Handbook for Systematic Reviews of Interventions*. New York, NY: John Wiley & Sons (2019). doi: 10.1002/9781119536604

38. Sterne JA, Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. *J Clin Epidemiol.* (2001) 54:1046–55. doi: 10.1016/S0895-4356(01)00377-8

39. Alwashmi AH, Alkhamees AA. Burnout and the psychological impact among physiatrists in Saudi Arabia during COVID-19. *Int J Environ Res Public Health.* (2021) 18:13. doi: 10.3390/ijerph18189621

40. Appiani FJ, Rodriguez Cairoli F, Sarotto L, Yaryour C, Basile ME, Duarte JM. Prevalence of stress, burnout syndrome, anxiety and depression among physicians of a teaching hospital during the COVID-19 pandemic. *Arch Argent Pediatr.* (2021) 119:317–24. doi: 10.5546/aap.2021.eng.317

41. Asghar MS, Yasmin F, Alvi H, Shah SMI, Malhotra K, Farhan SA, et al. Assessing the mental impact and burnout among physicians during the COVID-19 pandemic: a developing country single-center experience. *Am J Trop Med Hygiene.* (2021) 104:2185–9. doi: 10.4269/ajtmh.21-0141

42. Di Mattei VE, Perego G, Milano F, Mazzetti M, Taranto P, Di Pierro R, et al. The "Healthcare Workers' wellbeing (benessere operatori)" project: a picture of the mental health conditions of italian healthcare workers during the first wave of the COVID-19 Pandemic. *Int J Environ Res Public Health.* (2021) 18:15. doi: 10.3390/ijerph18105267

43. Dobson H, Malpas CB, Burrell AJ, Gurvich C, Chen L, Kulkarni J, et al. Burnout and psychological distress amongst Australian healthcare workers during the COVID-19 pandemic. *Aust Psychiatry.* (2021) 29:26–30. doi: 10.1177/1039856220965045

44. Etesam F, Akhlaghi M, Vahabi Z, Akbarpour S, Sadeghian MH. Comparative study of occupational burnout and job stress of frontline and non-frontline healthcare workers in hospital wards during COVID-19 pandemic. *Iran J Public Health.* (2021) 50:1428–35. doi: 10.18502/ijph.v50i7.6633

45. Gupta MD, Jha MK, Bansal A, Yadav R, Ramakrishanan S, Girish MP, et al. COVID 19-related burnout among healthcare workers in India and ECG based predictive machine learning model: Insights from the BRUCEE- Li study. *Indian Heart J.* (2021) 73:674–81. doi: 10.1016/j.ihj.2021.10.002

46. Haji Seyed Javadi SA, Rezaei B, Shafikhani A, Sarichloo ME. Comparative study of burnout and other aspects of mental health in medical staff working in Covid-19 and Non-Covid-19 Wards. *Iran Red Crescent Med J.* (2021) 23:1293.

47. Kanneganti A, Tan BY, Nik Ab Rahman NH, Leow AS, Denning M, Goh ET, et al. Safety attitudes, burnout and wellbeing among healthcare workers during the COVID-19 pandemic: an Indo-Pacific regional cross-sectional study. *Singapore Med J.* (2022) 10:10. doi: 10.11622/smedj.2022014

48. Kashtanov A, Molotok E, Yavorovskiy A, Boyarkov A, Vasil'ev Y, Alsaegh A, et al. A comparative cross-sectional study assessing the psycho-emotional state of intensive care units' physicians and nurses of COVID-19 hospitals of a Russian Metropolis. *Int J Environ Res Public Health.* (2022) 19:06. doi: 10.3390/ijerph19031828

49. Sarikhani Y, Khatami K, Salehi-Marzijarani M, Sivandzadeh GR, Kouhi P, Shahabi S, et al. Burnout assessment among physicians and medical students: comparing time-periods of coronavirus disease outbreak in Shiraz. *Shiraz E Med J.* (2022) 23:e116275. doi: 10.5812/semj.116275

50. Khoodoruth MAS, Al-Nuaimi SK, Al-Salihy Z, Ghaffar A, Khoodoruth WNCK, Ouanes S. Factors associated with mental health outcomes among medical residents exposed to COVID-19. *BJPsych Open.* (2021) 7:e52. doi: 10.1192/bjo.2021.12

51. Kim C, Park KH, Eo EK, Kim Y-M, Eo SK, Han J. Burnout and resilience among emergency physicians at Korean University Hospitals during the COVID-19 pandemic: a cross-sectional analysis. *Yonsei Med J.* (2022) 63:372–9. doi: 10.3349/ymj.2022.63.4.372

52. Steil A, Tokeshi ABP, Bernardo LS, da Silva Neto GP, Davi RF, Barbara AFS, et al. Medical residents' mental distress in the COVID-19 pandemic: an urgent need for mental health care. *PLoS One.* (2022) 17:e0266228.

53. Naldi A, Vallelonga F, Di Liberto A, Cavallo R, Agnesone M, Gonella M, et al. COVID-19 pandemic-related anxiety, distress and burnout: prevalence and associated factors in healthcare workers of North-West Italy. *BJPsych Open.* (2021) 7:e27. doi: 10.1192/bjo.2020.161

54. Faria AR, Coelho HFC, Silva AB, Damascena LCL, Carneiro RR, Lopes MT, et al. Impact of the COVID-19 pandemic on the development of burnout syndrome in frontline physicians: prevalence and associated factors. *Rev Assoc Med Bras.* (2021) 67:942–9. doi: 10.1590/1806-9282.20210244

55. Shiu C, Chen W-T, Hung C-C, Huang EP-C, Lee TS-H. COVID-19 stigma associates with burnout among healthcare providers: evidence from Taiwanese physicians and nurses. *J Formosan Med Assoc.* (2021) 09:09. doi: 10.1016/j.jfma.2021.09.022

56. Teo I, Sung SC, Cheung YB, Wong WHM, Abu Bakar Aloweni F, Ang HG, et al. Burnout, anxiety and depression in healthcare workers during the early COVID-19 period in Singapore. *Singapore Med J.* (2021) 10:07. doi: 10.11622/smedj.2021156

57. Torrente M, Sousa PAC, Sanchez-Ramos A, Pimentao J, Royuela A, Franco F, et al. To burn-out or not to burn-out: a cross-sectional study in healthcare professionals in Spain during COVID-19 pandemic. *BMJ Open.* (2021) 11:e044945. doi: 10.1136/bmjopen-2020-044945

58. Tuna T, Ozdin S. Levels and predictors of anxiety, depression, and burnout syndrome in physicians during the COVID-19 Pandemic. *Int J Mental Health Addict.* (2021) 19:2470–83. doi: 10.1007/s11469-021-00505-2

59. Turan C, Acar T, Acar BA, Unlubas Y, Erdogan R, Guzey Aras Y, et al. Specialist physicians battle against the COVID-19 pandemic: the relationship between specialist physicians working conditions and levels of burnout during the COVID-19 pandemic. *Eur Rev Med Pharmacol Sci.* (2022) 26:1403–13.

60. Enea V, Candel OS, Zancu SA, Scrumeda A, Barbuselu M, Largu AM, et al. Death anxiety and burnout in intensive care unit specialists facing the COVID-19 outbreak: the mediating role of obsession with COVID-19 and coronaphobia. *Death Stud.* (2021) 46:2306–15. doi: 10.1080/07481187.2021.1928331

61. Ibar C, Fortuna F, Gonzalez D, Jamardo J, Jacobsen D, Pugliese L, et al. Evaluation of stress, burnout and hair cortisol levels in health workers at a University Hospital during COVID-19 pandemic. *Psychoneuroendocrinology.* (2021) 128:105213. doi: 10.1016/j.psyneuen.2021.105213

62. Kapetanos K, Mazeri S, Constantinou D, Vavlitou A, Karaiskakis M, Kourouzidou D, et al. Exploring the factors associated with the mental health of frontline healthcare workers during the COVID-19 pandemic in Cyprus. *PLoS One.* (2021) 16:e0258475. doi: 10.1371/journal.pone.0258475

63. Karacan FA, Yilmaz S, Kirpinar I. Psychosocial adjustment of healthcare professionals during the COVID-19 pandemic: resident doctors, nurses, and caregivers need extra attention. *Med J Bakirkoy.* (2021) 17:375–85. doi: 10.4274/BMJ.galenos.2021.46338

64. Mousavi-Asl B, Firouzifar M, Noury L, Khamushian P, Mousavi-Asl D, Heidari F. Burnout among health care providers during covid-19 outbreak. *Acta Med Iran.* (2021) 59:108–12. doi: 10.18502/acta.v59i2.5577

65. Mutleq A, Alghazo M, Al-Faouri I, Alarsan S. Burnout among jordanian frontline physicians and nurses during covid-19 outbreak. *N Armenian Med J.* (2021) 15:64–8.

66. Stocchetti N, Segre G, Zanier ER, Zanetti M, Campi R, Scarpellini F, et al. Burnout in intensive care unit workers during the second wave of the covid-19 pandemic: a single center cross-sectional Italian study. *Int J Environ Res Public Health.* (2021) 18:6102. doi: 10.3390/ijerph18116102

67. Zakaria MI, Remeli R, Ahmad Shahamir MF, Md Yusuf MH, Azizah Ariffin MA, Noor Azhar AM. Assessment of burnout among emergency medicine healthcare workers in a teaching hospital in Malaysia during COVID-19 pandemic. *Hong Kong J Emerg Med.* (2021) 28:254–9. doi: 10.1177/1024907921989499

68. Zhang X, Wang J, Hao Y, Wu K, Jiao M, Liang L, et al. Prevalence and factors associated with burnout of frontline healthcare workers in fighting against the COVID-19 pandemic: evidence from China. *Front Psychol.* (2021) 12:680614. doi: 10.3389/fpsyg.2021.680614

69. Azoulay E, Pochard F, Reignier J, Argaud L, Bruneel F, Courbon P, et al. Symptoms of mental health disorders in critical care physicians facing the second COVID-19 wave: a cross-sectional study. *Chest.* (2021) 160:944–55. doi: 10.1016/j.chest.2021.05.023

70. Babamiri M, Bashirian S, Khazaei S, Sohrabi MS, Heidarimoghadam R, Mortezapoor A, et al. Burnout and mental health of COVID-19 frontline healthcare workers: results from an online survey. *Iran J Psychiatry.* (2022) 17:136–43. doi: 10.18502/ijps.v17i2.8903

71. Yilmaz Y, Erdogan A, Bahadir E. Fear, anxiety, burnout, and insomnia levels of healthcare workers during COVID-19 pandemic in Turkey. *Psychiatr Danubina.* (2021) 33(Suppl 13):350–6. doi: 10.22541/au.164864621.11164274/v1

72. Zhou T, Xu C, Wang C, Sha S, Wang Z, Zhou Y, et al. Burnout and well-being of healthcare workers in the post-pandemic period of COVID-19: a perspective from the job demands-resources model. *BMC Health Serv Res.* (2022) 22:284. doi: 10.1186/s12913-022-07608-z

73. Ruiz-Fernández MD, Ramos-Pichardo JD, Ibáñez-Masero O, Cabrera-Troya J, Carmona-Rega MI, Ortega-Galán ÁM. Compassion fatigue, burnout, compassion satisfaction and perceived stress in healthcare professionals during the COVID-19 health crisis in Spain. *J Clin Nurs.* (2020) 29:4321–30. doi: 10.1111/jocn.15469

74. Akova I, Kilic E, Ozdemir ME. Prevalence of burnout, depression, anxiety, stress, and hopelessness among healthcare workers in COVID-19 Pandemic in Turkey. *Inquiry.* (2022) 59:469580221079684. doi: 10.1177/00469580221079684

75. Mendonca VS, Steil A, Teixeira de Gois AF. COVID-19 pandemic in Sao Paulo: a quantitative study on clinical practice and mental health among medical residency specialties. *Sao Paulo Med J.* (2021) 139:489–95. doi: 10.1590/1516-3180.2021.0109.r1.27042021

76. Khan N, Palepu A, Dodek P, Salmon A, Leitch H, Ruzycki S, et al. Cross-sectional survey on physician burnout during the COVID-19 pandemic in Vancouver, Canada: the role of gender, ethnicity and sexual orientation. *BMJ Open.* (2021) 11:e050380. doi: 10.1136/bmjopen-2021-050380

77. Doulougeri K, Georganta K, Montgomery A. "Diagnosing" burnout among healthcare professionals: can we find consensus? *Cogent Med.* (2016) 3:1. doi: 10.1080/2331205X.2016.1237605

78. Vagni M, Giostra V, Maiorano T, Santaniello G, Pajardi D. Personal accomplishment and hardiness in reducing emergency stress and burnout among COVID-19 emergency workers. *Sustainability.* (2020) 12:9071. doi: 10.3390/su12219071

79. Buselli R, Corsi M, Veltri A, Baldanzi S, Chiumiento M, Lupo ED, et al. Mental health of Health Care Workers (HCWs): a review of organizational interventions put in place by local institutions to cope with new psychosocial challenges resulting from COVID-19. *Psychiatry Res.* (2021) 299:113847. doi: 10.1016/j.psychres.2021.113847

80. Khoo EA-O, Lantos JA-O. Lessons learned from the COVID-19 pandemic. *Acta Paediatr.* (2020) 109:1323–5. doi: 10.1111/apa.15307

81. Taylor S, Landry CA, Rachor GS, Paluszek MM, Asmundson GJG. Fear and avoidance of healthcare workers: an important, under-recognized form of stigmatization during the COVID-19 pandemic. *J Anxiety Disord.* (2020) 75:102289. doi: 10.1016/j.janxdis.2020.102289

82. Al-Otaibi T, Abbas A, Nagib AM, Gheith OA, Nair P, Farid MM, et al. COVID-somnia: anxiety, insomnia, and poor sleep among second-line healthcare workers during COVID-19 pandemic. *Egypt J Bronchol.* (2022) 16:47. doi: 10.1186/s43168-022-00143-9

83. Melnikow J, Padovani A, Miller M. Frontline physician burnout during the COVID-19 pandemic: national survey findings. *BMC Health Serv Res.* (2022) 22:365. doi: 10.1186/s12913-022-07728-6

84. Karagöl A, Törenli Kaya Z. Healthcare workers' burn-out, hopelessness, fear of COVID-19 and perceived social support levels. *Eur J Psychiatry.* (2022) 36:200–6. doi: 10.1016/j.ejpsy.2022.01.001

85. Chemali ZA-O, Ezzeddine FL, Gelaye B, Dossett ML, Salameh J, Bizri M, et al. Burnout among healthcare providers in the complex environment of the Middle East: a systematic review. *BMC Public Health.* (2019) 19:1337. doi: 10.1186/s12889-019-7713-1

86. Abdo SAM, El-Sallamy RM, Elsherbini A, Kabbash I. Burnout among physicians and nursing staff working in the emergency hospital of Tanta University, Egypt. *Eastern Mediterran Health J.* (2016) 21:906–15. doi: 10.26719/2015.21.12.906

87. Siebens K, Casterlé BD, Abraham I, Dierckx K, Braes T, Darras E, et al. The professional self-image of nurses in Belgian hospitals: a cross-sectional questionnaire survey. *Int J Nurs Stud.* (2006) 43:71–82. doi: 10.1016/j.ijnurstu.2005.04.004

88. Kunz M, Strasser M, Hasan A. Impact of the coronavirus disease 2019 pandemic on healthcare workers: systematic comparison between nurses and medical doctors. *Curr Opin Psychiatry.* (2021) 34:413–9. doi: 10.1097/YCO.0000000000000721

89. Vandenbroeck S, Van Gerven E, De Witte H, Vanhaecht K, Godderis L. Burnout in Belgian physicians and nurses. *Occupat Med.* (2017) 67:546–54. doi: 10.1093/occmed/kqx126

90. Boumans NPG, De Jong AHJ, Vanderlinden L. Determinants of early retirement intentions among Belgian nurses. *J Adv Nurs.* (2008) 63:64–74. doi: 10.1111/j.1365-2648.2008.04651.x

91. Vitale E, Galatola V, Mea R. Exploring within and between gender differences in burnout levels in Italian nurses engaged in the Covid-19 health emergency: a cohort observational study. *Mine Psichiatr.* (2020) 61:162–70. doi: 10.23736/S0391-1772.20.02090-7

92. França SPDS, De Martino MMF, Aniceto EVDS, Silva LL. Predictors of burnout syndrome in nurses in the prehospital emergency services. *Acta Paul Enfermagem.* (2012) 25:68–73. doi: 10.1590/S0103-21002012000100012

93. Corlade-Andrei M, Măirean C, Nedelea P, Grigoraşi G, Cimpoeşu D. Burnout syndrome among staff at an emergency department during the COVID-19 Pandemic. *Healthcare.* (2022) 10:258. doi: 10.3390/healthcare10020258

94. Aryankhesal A, Mohammadibakhsh R, Hamidi Y, Alidoost S, Behzadifar M, Sohrabi R, et al. Interventions on reducing burnout in physicians and nurses: a systematic review. *Med J Islam Repub Iran.* (2019) 33:77. doi: 10.47176/mjiri.33.77

95. Ziaei M, Yarmohammadi H, Karamimatin B, Yarmohammadi S, Nazari Z, Gharagozlou F. Prevalence and risk factors of occupational burnout among nurses of a hospital in Kermanshah in 2013. *Iran-J-Ergon.* (2014) 2:67–74.

96. Chaka EE, Mekuria M, Melesie G. Access to essential personal safety, availability of personal protective equipment and perception of healthcare workers during the COVID-19 in Public Hospital in West Shoa. *Infect Drug Resist.* (2022) 15:2315. doi: 10.2147/IDR.S344763

97. El-Sokkary RH, Khater WS, El-Kholy A, Mohy Eldin S, Gad DM, Bahgat S, et al. Compliance of healthcare workers to the proper use of personal protective equipment during the first wave of COVID-19 pandemic. *J Infect Public Health.* (2021) 14:1404–10. doi: 10.1016/j.jiph.2021.07.017

98. Murthy VH. Confronting health worker burnout and well-being. *N Engl J Med.* (2022) 387:577–9. doi: 10.1056/NEJMp2207252

99. Bazan D, Nowicki M, Rzymski P. Medical students as the volunteer workforce during the COVID-19 pandemic: polish experience. *Int J Disaster Risk Reduct.* (2021) 55:102109. doi: 10.1016/j.ijdrr.2021.102109

100. Almulhem JA, Aldekhyyel RN, Binkheder SA-OX, Temsah MA-O, Jamal AA-O. Stress and burnout related to electronic health record use among healthcare providers during the COVID-19 Pandemic in Saudi Arabia: a Preliminary National Randomized Survey. *Healthcare.* (2021) 9:1367. doi: 10.3390/healthcare9101367

101. Esmaeilzadeh PA-O, Mirzaei TA-O. Using electronic health records to mitigate workplace burnout among clinicians during the COVID-19 Pandemic: field study in Iran. *JMIR Med Inform.* (2021) 9:e28497. doi: 10.2196/28497

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COVID-19 vaccine confidence project for perinatal women (CCPP)—Development of a stepped-care model to address COVID-19 vaccine hesitancy in low and middle-income countries

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Background: COVID-19 vaccine hesitancy (CVH) is common among perinatal women in low and middle-income countries (LMICs), but it is often unaddressed. This could be due to a lack of feasible, scalable, and acceptable interventions and models for CVH in LMICs. Our study aimed to develop a CVH intervention model that can be implemented in LMICs using existing human healthcare resources.

Methods: A literature review was conducted on aspects of vaccine hesitancy, pre-existing interventions, and models for addressing vaccine hesitancy (COVID-19 and non-COVID-19). The lead authors (RR and PKuk) formed a team consisting of vaccinators, experts, and stakeholders. Members shared their perspectives and proposals for various models and interventions that could be implemented in LMICs. A CVH intervention model was developed using a logic model, a WHO implementation toolkit, experts' feedback, and consensus.

Results: A consensus was reached to develop a COVID-19 Vaccine Confidence Project for Perinatal Women (CCPP), which is a primary health care worker (HCWs)-based stepped-care model. The CCPP model includes HCW training, integration into ongoing COVID-19 vaccination programs, CVH screening, CVH intervention, and referral services suitable for implementation in LMICs.

Conclusion: The CCPP project/model provides a practical approach that can help in the early detection and management of CVH. The model can be tailored to different healthcare settings to improve COVID-19 vaccine uptake among perinatal women in LMICs.

KEYWORDS

pregnancy, COVID-19, children, vaccine, barriers

1. Introduction

The Government of India (GOI) and the World Health Organization (WHO) have recommended several Coronavirus Disease 2019 (COVID-19) vaccines for perinatal women (1, 2). Unvaccinated perinatal women are at a greater risk of COVID-19-related mortality and morbidity, pre-term labor, and fetal death than vaccinated women (2, 3). Still, a substantial proportion of perinatal women are not vaccinated against COVID-19 in low and middle-income countries (LMICs) including India (4).

Vaccination of perinatal women has been regarded as a major strategic weapon against COVID-19. However, COVID-19 vaccine hesitancy (CVH) poses a significant barrier to successful vaccine uptake (4). Vaccine hesitancy is a delay in accepting or refusing vaccination despite its availability (5). Associated factors include lack of information/ misinformation regarding vaccines (related to efficacy, safety, accessibility), low perception of COVID-19 infection, and affordability of vaccines (6, 7).

Addressing CVH requires multi-level interventions: policy and community-based (e.g., reducing the cost of vaccines), organizational (e.g., home visits, reminders, feedback), inter-personal (e.g., recommendations by clinicians to their patients), and individual (e.g., addressing the personal concerns) (8). Presently, the majority of the interventions are policy and community-based, with a primary focus on raising awareness through media. In a few places, vaccination certificates were made mandatory for any travel or employment, but such measures were perceived as an enforced measure (9). Such methods, however, are unethical and likely to increase fear and misconceptions despite the fact that COVID-19 vaccination is effective and beneficial. One reason for implementing such practices could be a lack of individual-level interventions and models to address CVH determinants. Furthermore, capacity building and public health service strengthening for CVH screening and intervention may be insufficient in LMICs, including India.

In this context, we aimed to develop a model of care for addressing CVH in perinatal women which could be feasible, cost-effective, scalable, replicable, applicable, and acceptable and strengthen ongoing efforts of LMIC governments.

2. Material and methods

To develop the CVH intervention model/project, first author (RR) invited psychiatrists [$N = 6$: private 3 and government 3)], public health experts [$N = 4$, private 1 and government 3), psychologists [$N = 2$, one each from private and government facilities), obstetricians ($N = 2$, one each from private and government facilities), pediatricians ($N = 2$, one each from private and government facilities), medical officers (government, $N = 2$)], primary health care workers (HCWs) ($N = 2$, one each from private and government facilities), and stakeholders ($N = 2$, one each from private and government facilities), who were actively involved in COVID-19 vaccination drives in hospital or community settings. Group discussions were held through virtual conferencing platforms as the pandemic was active at that time (mainly email, WhatsApp) for 12 weeks (15th August to 15th November 2021). Thereafter an initial plan for the model/project was developed in the following phases.

2.1. Phase 1

This phase was directed toward assessing the current scenario of COVID-19 vaccinations and approaches adopted in authors' respective States (Delhi, Maharashtra, and Karnataka) from 15th August to 15th November 2021. The team members discussed about their state specific COVID-19 vaccinations, preparedness plans, and current or future measures implemented or proposed by the Government. They also discussed about the pre-existing infrastructure, ongoing training, and human resources in perinatal health care and COVID-19 vaccinations in the three study sites.

2.2. Phase 2

Simultaneously, a literature review was carried out to identify relevant existing information related to CVH, epidemiology, interventions, and recommendations. We appraised: (a) existing systematic reviews on the clinical and psychosocial aspects of vaccine hesitancy (COVID-19 and non-COVID-19) among the general population and perinatal women globally and in India; (ii) epidemiological research on a CVH; (iii) existing interventions and models in India or other countries for CVH. Then, a distillation and matching model was used to facilitate understanding of similarities and differences among interventions or models, to guide intervention/model development, to address gaps in the literature, and to point to possibilities for new interventions/models for CVH for perinatal women in LMICs (10).

2.3. Phase 3

The lead authors (RR and PKuk) then created a preliminary conceptual framework based on the existing literature, responses from team members, and challenges in the implementations of strategies using the WHO implementation toolkit and the logic model for the public health (11, 12).

2.4. Phase 4

A Priori Conceptual Framework was then shared with the team members for feedback, which was then iteratively modified. During the modification phase, team members were asked to provide feedback or comments on the priori conceptual framework and logic model. Using a modified Delphi method (consensus decision making->70 percent representative agreeable), the conceptual frameworks and logic model were revised and approved. The preliminary consensus draft was further discussed with experts (identified by RR and PKuk with predefined criteria) outside the first group (i.e., team members) over 1 month (16th November to 15th December 2021). The Experts ($n = 4$) included a senior professor/consultant with more than 10 years of experience in fields of national immunization program and/or public health/advocacy program for perinatal women, and a background qualification in nursing ($n = 1$), psychiatry ($n = 2$), and public health ($n = 1$). After extensive discussions with experts, a draft of COVID-19 Vaccine Confidence Project for Perinatal Women (CCPP) was prepared and circulated among the team members for final inclusion and approval. The final version of the conceptual framework and logic model (Figures 1, 2) were approved using a modified Delphi method.

2.5. Ethics

Approvals from the Institutional Ethics Committees of all the three centers where the model is being implemented and tested: (i) BKL Walawalkar Rural Medical College, Sawarde Maharashtra (BKLWRMC/IEC/589/2021); (ii) Lady Hardinge Medical College, New Delhi (IEC/KMC/MLR 10/2021/309); and (iii) Kasturba Medical College, Mangalore, Karnataka (LHMC/IEC/2021/03/113) were obtained.

3. Results

The CCPP model was developed after considering the existing human resources, national priorities for COVID-19 vaccinations, and the possibility of future integration into the national programs. It is a HCWs -based, stepped-care model. It includes screening and delivery of a brief psychosocial intervention for CVH in various health care settings (e.g., community or hospital). The model consists of four components: resources, activities, outputs, and outcomes (Figure 1) which briefly described below.

3.1. Resources

3.1.1. Infrastructure

To establish the model in a center, it is important to have attached COVID-19 vaccination services. The infrastructure required includes telephone and internet. This is to ensure that the intervention may be delivered by phone or video calls in rural or remote regions and during public health measures (e.g., lockdowns). Furthermore, phones may be used to send reminders and address queries.

3.1.2. Human resources

The CCPP focuses on developing and implementing the primary HCWs -based care for CVH. Primary HCW-based models have been found to be effective in many LMIC countries for several other health conditions related service delivery, including COVID-19 pandemic times (13–15). Primary HCWs (e.g., Accredited Social Health Activist) are pillars of several national programs, service delivery by them is more acceptable and is better integrated with general healthcare infrastructure. They are more accessible for providing a trusted and reliable source of information to perinatal women and the general public (16). Thus, the CCPP model may be flexible and adaptable across all health care levels.

3.1.3. Tools

Developed CCPP model consist of a screening tool and a CVH intervention. The screening tool consists of two questions:

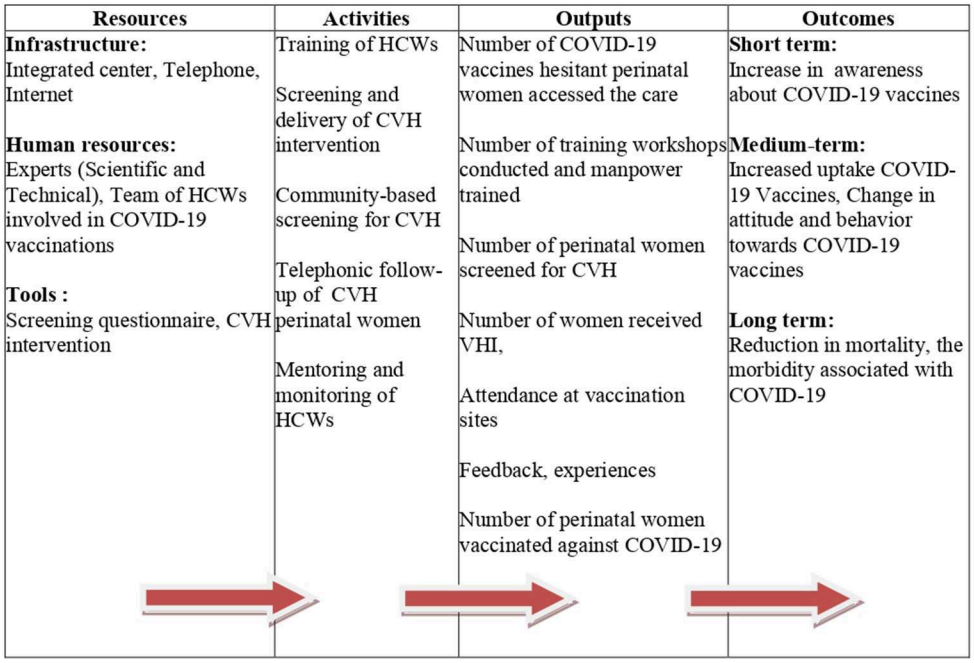

FIGURE 1
Logic model for the COVID-19 vaccine project confidence project for perinatal women (CCPP model).

(1) whether you have received any dose of COVID-19 vaccine i.e., current vaccination status and (2) whether you are willing to take COVID-19 vaccine in the next 2 months, if available i.e., willingness to take a second dose of vaccine. Perinatal women who answer "no" to both questions, or "yes" to the first question and "no" to the second, are assessed further for determinants of CVH using standardized self-reported scales (Oxford COVID-19 Vaccine Hesitancy Scale, Oxford COVID-19 Vaccine Confidence & Complacency Scale) in local languages (Marathi, Hindi, and Kannada) (4).

3.1.4. CVH intervention

A brief, individual-level psycho-social intervention was developed using principles of MET (motivational enhancement therapy). A brief outline of our intervention has been published elsewhere (4). Based on stages pf motivation, every perinatal women is classified for CVH into four categories (i.e., pre-contemplation, contemplation, decision, and preparation). The specific determinants of CVH (e.g., confidence, complacency, constraints, calculation, and collective responsibility) are explored using motivational interviewing skills (e.g., asking open-ended questions, using reflective listening, and affirming and reiterating statements) (17) (Figure 2). At present, the CVH intervention is being delivered in different study sites and its outcomes will be reviewed by experts from diverse backgrounds.

3.2. Activities

Various activities (Figure 1) that need to be performed for effective implementation are listed.

3.2.1. CCPP training and mentoring

The model was also prepared to train HCWs working in COVID-19 vaccination services for screening and delivery of CVH intervention. This involves didactic lectures, video presentations, self–assessment, group work, and suggested readings, conducted for 4 to 6 hours with fortnightly follow-ups. Also, clinical psychologists and medical officers will provide support as and when required and once weekly for around 15–20 minutes. The training manual is structured and includes details of each session, illustrative case histories, questions and assessment, active listening, and communication skills.

3.2.2. Screening and assessment for CVH

The trained primary HCWs will ask two questions (as mentioned above) to perinatal women at their first contact with maternal and child services [e.g., antenatal (ANC), postnatal (PNC), immunization clinic] or during home visits (Figure 2). Based on results of screening tools and self-reported scales, determinants of CVH will be divided into five categories: confidence, complacency, constraints, calculation, and collective responsibility for delivery of a CVH intervention.

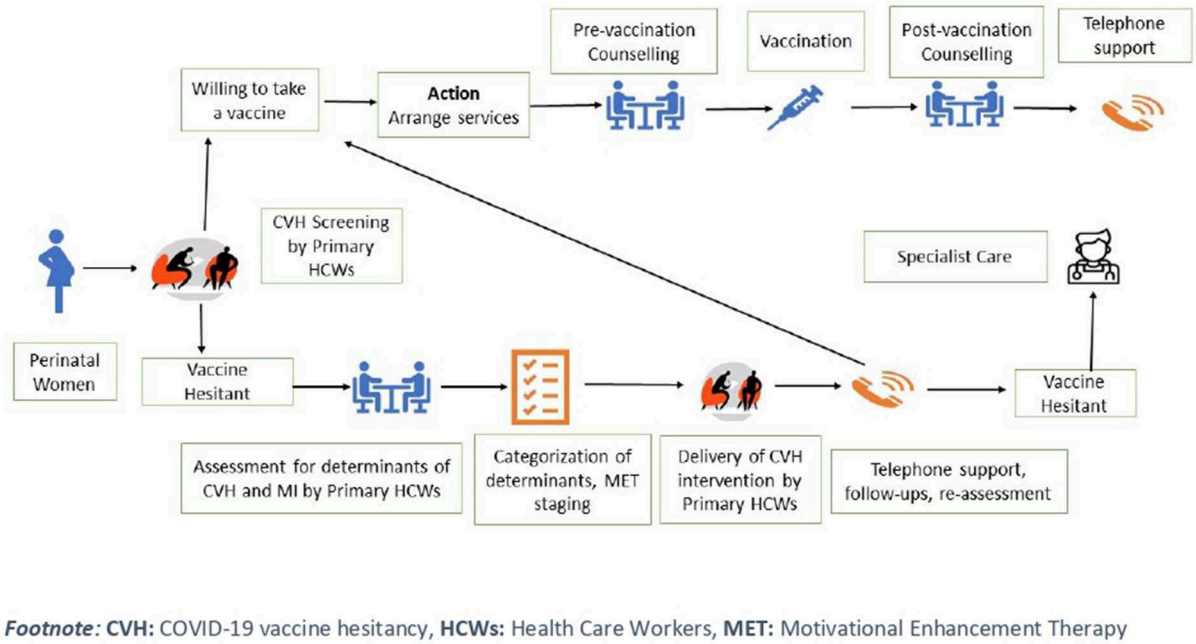

FIGURE 2
Algorithm for CVH screening and intervention.

3.2.3. Delivery of CVH intervention

Primary HCWs will deliver the intervention over 25 to 30 minutes *via* telephone (audio or video calls), or in-person. The session is split into two parts of 10–15 minutes each. In the first part, HCWs introduce themselves, establish rapport, and interpret the result of self-reported scales. The HCWs will then educate the perinatal women about the available COVID-19 vaccines and post-vaccination care. A step-wise approach will be adopted to address the CVH determinants using MET techniques. Some of these determinants may be difficult to address due to rapidly evolving evidence about COVID-19 vaccines. In case of any discrepancy, the primary HCWs can refer the perinatal women to specialists such as Psychologist/ Psychiatric Social Worker (Figure 2).

3.2.4. Reminders

Two follow-ups (telephonic, in-person, home visits) are to be carried out at a periodic interval of 3 and 6 weeks. During this, the HCW will assess whether the COVID-19 vaccine-hesitant woman has received the vaccine or if there are any additional concerns or myths, they can be addressed. This can serve as a reminder and will help in answering any additional query of perinatal women.

3.2.5. Monitoring

Certain quantitative (e.g., number of perinatal women screened and receiving intervention, mode of delivery of intervention, duration of intervention) or qualitative (e.g., experiences or feedback from both perinatal women and HCWs) performance indicators will be used to monitor intervention delivery.

3.3. Outputs and outcomes

Figure 1 depicts the broad categories of outputs and outcomes that would be expected following the implementation of the CCPP model. The expected direct outcomes are (i) increased awareness about COVID-19 vaccination (ii) referrals for CVH intervention with (iii) increase in COVID-19 vaccination coverage for perinatal women. The expected indirect outcomes are (i) adoption of preventive measures, and (ii) reduction of COVID-19 mortality and morbidity.

4. Discussion

The CCPP has been developed as a stepped-care model based on primary HCWs and it has five core components: theoretical background, CVH intervention content, intervention delivery, monitoring, as well as training and

mentoring model. Published literature suggests that stepped-care model have been proven effective, feasible, acceptable, scalable, and replicable in many LMICs for several medical conditions, including during the COVID-19 pandemic (14, 15, 18).

4.1. Integrated center for COVID-19 vaccination and CVH intervention services

Our experts noticed that none of the COVID-19 vaccination centers offer individual-level CVH intervention. Ideally, CVH intervention services should be available at these centers and we intend to provide these services through our model. At these centers, primary HCWs or trained volunteers can screen the perinatal women for CVH. This strategy may result in tangible results and strengthen community participation for COVID-19 vaccination. A recent survey of 44,260 participants in LMICs found that HCWs are the most trusted by service users for COVID-19 vaccine-related information (19). India has a strong workforce of primary HCWs like Junior Health Assistants (JHAs) and Accredited Social Health Activists (ASHAs) who can be utilized effectively in improving the CVH screening and intervention.

At the moment, there is no effective CVH intervention in any of the LMICs. Rather, most perinatal women neither screened for CVH nor do they receive any intervention. In such scenarios, the use of two screening questions in conjunction with CVH scales (e.g., Oxford Covid-19 Vaccine Hesitancy Scale, Oxford COVID-19 Vaccine Confidence & Complacency Scale) has a higher scale-up potential to strengthen the ongoing COVID-19 vaccination drives (4, 20).

The Indian Government started a mass vaccination drive to increase access to COVID-19 vaccines (21, 22). However, due to non-availability of an individual-level interventions for CVH, COVID-19 vaccine-related myths and misconceptions are not adequately addressed. Therefore, a brief psycho-social intervention (e.g., CVH intervention) may help to align the ongoing efforts to improve access to COVID-19 vaccinations. The CVH intervention in our model is based on MET techniques (4). Evidence suggests that MET techniques are useful to reduce vaccine hesitancy (8). This intervention is flexible enough to allow for additional techniques to be added in the future making it more comprehensive and transdiagnostic. Due to ongoing public health measures (e.g., lockdown, isolation), just single face-to-face sessions has been kept.

In India, research on CVH in perinatal women is limited. COVID-19 vaccination experiences, beliefs, and circumstances differ from those of the general population (e.g., apprehension regarding vaccine safety in fetuses, infants). CVH among perinatal women is likely to result in non-vaccination of their children with COVID-19 as well as non-COVID-19 vaccines (23). Moreover, the interventions focused on generating awareness or based on social media are ineffective in addressing individual level determinants of CVH. Feasible and effective individual-level interventions may help in addressing CVH among perinatal women and motivate them to develop positive attitudes toward vaccinations.

Some studies reported that text-based reminders were ineffective to improve the COVID-19 vaccination rates (24). Therefore, we coupled our intervention with telephonic reminders. Experts noticed that HCWs are not advocating the COVID-19 vaccine to perinatal women actively, primarily because the government had not recommended the COVID-19 vaccine to pregnant women during the first phase of COVID-19 vaccinations (25). Moreover, HCWs are not trained to provide any individual-level CVH intervention.

The skills needed to screen for and detect CVH can be learned using our proposed model. This may help primary HCWs to understand the importance of screening for CVH and referring to the nearest COVID-19 vaccination center. Integrated center should maintain a list of HCWs in the region who provide CVH detection and intervention services. This will ensure that the services are provided to the perinatal women in the community. As the COVID-19 situation is dynamic, it is necessary to update the knowledge of HCWs through training. CVH intervention is a living document that can be edited and updated to address the emerging determinants of CVH. Furthermore, trained HCWs can screen and deliver the intervention to other populations (e.g., children and adolescents) and contribute to lowering the overall burden of CVH in the community.

4.2. Challenges in the implementation of the CCPP model

Certain challenges expected during the implementation of intervention can be a lack of readiness of the system, limited resources, lower relative priority, lack of incentives, and poor motivation of HCWs. Though providing incentives to HCWs has the potential to increase vaccination coverage, such approaches are unlikely to be sustainable in LMICs. Considering these factors, we developed a brief psycho-social intervention that can be delivered in 25–30 minutes *via* phone or in-person.

4.3. Potential benefits of CCPP model

Our model was developed specifically to address CVH through individual-level interventions. During the pandemic,

among the various preventive models like public health measures and contact tracing, primary HCWs-based models were successful. Once HCWs with "preventive" focus align with the CCPP concept, this can lead to the launch of new services and improve access to CVH intervention.

Training would strengthen the skills and knowledge of HCWs. Being grass root workers, delivering the intervention would further enhance their presence in the community. It would also increase their professional satisfaction. Further, this model may raise public awareness about COVID-19 vaccinations and, as a result, help to reduce CVH. Moreover, suggested approach is simpler, more cost-effective, sustainable, and easier to integrate into existing programs.

4.4. Adapting and using the CCPP model of care in other countries and settings

We attempted to address several key questions related to the implementation with involving primary HCWs, using video conferencing and phone calls. As a result, this model is likely to be more cost-effective, feasible, accessible, scalable, sustainable, replicable, and acceptable for low-resource settings, to be implemented in national programs, and even in pandemic settings. Also, the model is flexible for implementation in government as well as private settings. However, qualitative and quantitative research is needed before local adaptation. Intervention characteristics (single session, transdiagnostic nature, strength of evidence of the content) and implementation processes (e.g., engaging diverse stakeholders) may influence the implementation positively. Thus, the CCPP model may be adapted to other Indian states or LMICs.

4.5. Current status of CCPP model in India and future directions

The CCPP model is currently being implemented in India. We have begun training the HCWs at each center. Trained HCWs have reported a considerable increase in knowledge, skill, and confidence in addressing CVH. In upcoming trials, both the model and CVH intervention will be tested for feasibility and effectiveness across three centers. Once the effectiveness has been demonstrated, it can then be further researched or implemented in different ways. To make this more acceptable, applicable, culturally appropriate, and evidence-based, there is a strong need to conduct targeted research efforts such as systematic identification of multi-level factors associated with CVH and delivery of VHI in different settings (e.g., hospital, rural). Lessons learned from our model and intervention can assist in implementation, adoption of intervention, allowing policymakers, researchers, and stakeholders to consider the strengths and challenges of our model to implement a CVH intervention in their countries and other parts of India.

4.6. Strengths and limitations

To the best of our knowledge, our model is the first of its kind to address CVH among perinatal women in LMICs. The model provides a better perspective in terms of medical ethics, informed decision, appropriateness, and acceptability. The model has been developed considering the stakeholders' perspectives and using the WHO implementation toolkit (11). This model helps to understand the individual level determinants of CVH and can be instrumental in bringing positive changes in vaccination uptake within the different framework of the Indian Health care systems (private and government, urban and rural, primary, secondary, and tertiary). The content of CVH intervention was developed with the goal of compatibility across implementation and delivery systems, which helped to improve their scalability potential. The CVH Intervention and telephonic reminders will improve adherence and outcomes. In terms of limitations, it is worth noting that the consensus method can be prone to subjectivity and opinion bias.

5. Conclusion

The CCPP model is a suggested new stepped-care model centered on primary HCWs that can be useful in addressing CVH among perinatal women comprehensively and effectively in LMICs. Implementing this model in the existing COVID-19 vaccination centers, antenatal clinics, postnatal clinics, and immunization clinics may be a more feasible, sustainable, and acceptable approach to increasing capacity for CVH screening and intervention. Future research should look into the barriers and enablers affecting the implementation of the CCPP model in real-world settings.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Ethics Committee, BKL Walawalkar Rural Medical College, Kasturba Medical College, Manglore, Lady Hardinge Medical College, New Delhi. The patients/participants provided their written informed consent to participate in this study.

Author contributions

RR, PR, and PKuk conceived the project and collected the data. RR wrote the first draft of the manuscript. RR, PR, MP, KP, SP, and PKuk wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

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

The handling editor RF declared a past collaboration with one of the authors RR.

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References

1. Sharma NC. Centre approves covid-19 vaccination for pregnant women. (2021). Available online at: https://www.livemint.com/news/india/centre-approves-covid-19-vaccination-for-pregnant-women-11624635010798.html (accessed January 27, 2022).

2. Magnus MC, Gjessing HK, Eide HN, Wilcox AJ, Fell DB, Håberg SE. Covid-19 vaccination during pregnancy and first-trimester miscarriage. *N Engl J Med.* (2021) 385:2008–10. doi: 10.1056/NEJMc2114466

3. Walter K. COVID-19 and pregnancy. *JAMA.* (2021) 42:22679. doi: 10.1001/jama.2021.22679

4. Ransing R, Kukreti P, Raghuveer P, Puri M, Paranjape AD, Patil S, et al. A brief psycho-social intervention for COVID-19 vaccine hesitancy among perinatal women in low-and middle-income countries: need of the hour. *Asian J Psychiatr.* (2021) 3:102929. doi: 10.1016/j.ajp.2021.102929

5. MacDonald NE. Vaccine hesitancy: definition, scope and determinants. *Vaccine.* (2015) 33:4161–4. doi: 10.1016/j.vaccine.2015.04.036

6. Truong J, Bakshi S, Wasim A, Ahmad, M, Majid U. What factors promote vaccine hesitancy or acceptance during pandemics? A systematic review and thematic analysis. *Health Promot Int.* (2021) 5:105. doi: 10.1093/heapro/daab105

7. Ransing R, Dashi E, Rehman S, Chepure A, Mehta V, Kundadak GK. COVID-19 anti-vaccine movement and mental health: challenges and the way forward. *Asian J Psychiatr.* (2021) 58:102614. doi: 10.1016/j.ajp.2021.102614

8. Rutten LJ, Zhu X, Leppin AL, Ridgeway JL, Swift MD, Griffin JM, et al. Evidence-based strategies for clinical organizations to address COVID-19 vaccine hesitancy. *Mayo Clin Proc.* (2021) 96:699–707. doi: 10.1016/j.mayocp.2020.12.024

9. Outlook. Maharashtra District Makes Covid-19 Vaccine Mandatory For Getting Ration, Petrol. (2021). Available online at: https://www.outlookindia.com/website/story/india-news-maharashtra-district-makes-covid-19-vaccine-mandatory-for-getting-ration-petrol/400423 (accessed January 27, 2022).

10. Chorpita BF, Daleiden EL, Weisz J, R. Identifying and selecting the common elements of evidence based interventions: a distillation and matching model. *Ment Health Serv Res.* (2005) 7:5–20. doi: 10.1007/s11020-005-1962-6

11. WHO. Implementation Research Toolkit. (2014). Available online at: https://www.who.int/tdr/publications/year/2014/9789241506960_workbook_eng.pdf (accessed January 27, 2022).

12. Mills T, Lawton R, Sheard, L. Advancing complexity science in healthcare research: the logic of logic models. *BMC Med Res Methodol.* (2019) 19:55. doi: 10.1186/s12874-019-0701-4

13. Lund C, Schneider M, Garman EC, Davies T, Munodawafa M, Honikman S, et al. Task-sharing of psychological treatment for antenatal depression in Khayelitsha, South Africa: Effects on antenatal and postnatal outcomes in an individual randomized controlled trial. *Behav Res Ther.* (2020) 130:103466. doi: 10.1016/j.brat.2019.103466

14. Ransing R, Kukreti P, Mahadevaiah M, Raghuveer P, Karkal R, Rana S, et al. COVID-19 pandemic and stepped care model for perinatal depression in rural India: lessons learned and the way forward. *Indian J Psychol Med.* (2021) 43:246–51. doi: 10.1177/02537176211005017

15. Ransing R, Kukreti P, Raghuveer P, Mahadevaiah M, Puri M, Pemde H, et al. Development of a brief psychological intervention for perinatal depression (BIND-P). *Asia-Pacific Psychiatry.* (2021) 13:e12436. doi: 10.1111/appy.12436

16. Mavalankar D. *The Changing Role of Auxiliary Nurse Midwife (ANM) in India: Implications for Maternal and Child Health (MCH) esocialsciencescom*. New Delhi: Outlook India News. (2010).

17. Betsch C, Schmid P, Heinemeier D, Korn L, Holtmann C, Böhm R. Beyond confidence: Development of a measure assessing the 5C psychological antecedents of vaccination. *PLoS One.* (2018) 13:e0208601. doi: 10.1371/journal.pone.0208601

18. World Health Organization. *Mental Health Gap Action Programme. mhGAP: Mental Health Gap Action Programme: Scaling Up Care for Mental, Neurological and Substance Use Disorders*. Geneva: World Health Organization (2008).

19. Solís Arce JS, Warren SS, Meriggi NF, Scacco A, McMurry N, Voors M, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med.* (2021) 25:1454. doi: 10.1038/s41591-021-01454-y

20. Freeman D, Loe BS, Chadwick A, Vaccari C, Waite F, Rosebrock L, et al. COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus

explanations, attitudes, and narratives survey (Oceans) II. *Psychol Med.* (2020) 3:1–15. doi: 10.1017/S0033291720005188

21. Choudhary OP, Choudhary P, Singh I. India's COVID-19 vaccination drive: key challenges and resolutions. *Lancet Infect Dis.* (2021) 21:1483–4. doi: 10.1016/S1473-3099(21)00567-3

22. Ransing R, Kar S, Menon V. Potential barriers to handle the second wave of COVID-19 in India. *J Geriatric Care Res.* (2021) 8:36–8. Available online at: https://www.researchgate.net/publication/352173154_Potential_barriers_to_handle_the_second_wave_of_COVID-19_in_India

23. Gencer H, Özkan S, Vardar O, Serçekuş P. The effects of the COVID 19 pandemic on vaccine decisions in pregnant women. *Women Birth.* (2021) 5:3. doi: 10.1016/j.wombi.2021.05.003

24. Kozlov MA. simple text has the power to increase COVID vaccinations. *Nature.* (2021) 2:2108. doi: 10.1038/d41586-021-02108-2

25. COVID-19 Vaccine FAQs. (2021). Available online at: https://www.mohfw.gov.in/covid_vaccination/vaccination/faqs.html (accessed January 27, 2022).

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Positive and negative experiences with the COVID-19 pandemic among lonely and non-lonely populations in Germany

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The COVID-19 pandemic is causing an epidemic of loneliness. Previous studies have shown the differences in positive and negative experiences of lonely and non-lonely people in a non-pandemic setting. However, it is unclear how the drastic alteration of the COVID-19 pandemic may influence peoples' reactions and beliefs, especially among those who feel lonely. Our study aims to examine the positive and negative experiences among lonely and non-lonely people. We undertook a cross-sectional online survey of the general population in Germany ($N = 1{,}758$) from May 2020 to May 2022. We assessed their feelings of loneliness with the short eight-item UCLA Loneliness Scale (ULS-8), their positive and negative experience of living in the COVID-19 pandemic as well as their psychological distress regarding the pandemic with the COVID-19 Peritraumatic Distress Index (CPDI). We found lonely individuals (ULS-8 score $\geq$ 16) reported fewer positive experiences of living in the COVID-19 pandemic, for example, less time with loved ones [$z_{(1,756)} = -2.5$, $p = 0.012$] and less sense of togetherness [$z_{(1,756)} = -2.39$, $p = 0.017$] as compared to non-lonely individuals. Meanwhile, they experienced more negative experiences, for example, worry and fear [$z_{(1,756)} = 6.31$, $p < 0.001$] compared with non-lonely individuals. Interestingly, lonely people were less likely to view the pandemic as a conspiracy than non-lonely people were [$z_{(1,756)} = -3.35$, $p < 0.001$]. Our results may give insight into attribution bias and the negative affect of lonely people during the COVID-19 pandemic as well as highlight the experience of non-lonely people and raise the question of differences in conspiracy beliefs. For pandemic preparedness and response, decision-makers may focus on interventions to foster social cohesion, empower people, build resilience, and most importantly provide timely social care.

KEYWORDS

social isolation, epidemic, environmentally friendly, perception, positive psychology, attribution bias, conspiracy beliefs

1. Introduction

With the start of lockdown during the beginning of COVID-19, it was uncertain how long the significant changes that governments made would last. Those changes brought grand challenges to life, such as preventing the virus from spreading around the world (e.g., wearing a mask) (1), staying at home to protect children and vulnerable adults (2–4), and staying connected when physically apart (5–7). The World Health Organization reported that the global prevalence of anxiety and depression increased by a massive 25% in the first year of COVID-19 (8). Beyond health challenges, COVID-19 has also exacerbated social challenges (9–14), including attitudes toward social roles (e.g., gender roles) (15). However, dealing with this adversity is a chance to bring forward positive aspects as well. Wong's Existential Positive Psychology theory states that the great adversity that exists in life is a chance to bring forward positive experiences, indicating that suffering can promote strength and wellbeing (16). Wong et al. proposed that faith, courage, creativity, and the meaning of life are essential to transform suffering into flourishing (17). Existential positive psychology seeks to integrate various ways that help people experience positive states in times of suffering (17). To prepare for and respond to future pandemics, it is crucial to reflect on both positive and negative experiences that we had during the ongoing COVID-19 pandemic. When looking back, the COVID-19 movement restrictions did have a positive impact on the living environment (i.e., reduction in air pollution and emission of greenhouse gases) (7). In addition to making life more environmentally friendly compared to before COVID-19, the adaption to the new way of living (e.g., spending more time at home) provided opportunities for introspection (18). For example, people can for once rethink what is really important in their life, how they truly want to spend their time, and what they value most (18). This is a unique opportunity to generate ideas as well as to evaluate one's life. Moreover, staying at home during the lockdown enabled people to spend more time with loved ones (i.e., family members that live together in lockdown) (19). Another positive outcome of the unexpected COVID-19 lockdown was more time for hobbies (20). People chose hobbies that can be done in solidarity like spending time in nature and engaging in creative activities (20). Finally, working from home has advantages, such as greater work control and an improved work–life balance (21), which may lead to less work-related stress.

Despite the potential positive experiences of COVID-19, it is important to understand perceived negative experiences as well (22). Existential positive psychology suggests that negative experiences can add meaning to life by striving to overcome them (23). Considerable studies across countries reported negative effects of COVID-19 on mental health, including feeling worried, anxious, restricted, lonely, angry, depressed, and having sleep problems (24–29). People experience negative cognitive states, such as COVID-19-related worry, which can be an indicator of negative mood (26, 30). Moreover, such negative feelings or experiences are most common among vulnerable populations (e.g., the elderly, pregnant women and their children, people with disabilities, and chronic long-term health conditions) (2, 31). In addition, perceiving COVID-19 as more dangerous than seasonal influenza (32) was associated with a heightened perception of worry and fear (33). Interestingly, many people even believed the whole pandemic was a hoax and made up of secret organizations, possibly to change the "world order," which is a narrative deeply rooted in antisemitism (34).

Strikingly, loneliness played a key role in triggering stress-related behaviors and cognition during lockdown (35). Even before COVID-19, loneliness was described as a "behavioral epidemic" in the population (36). During COVID-19, physical distancing can worsen this situation, as positive social contact is a key factor in battling loneliness (37). Other factors that can increase feelings of loneliness and may have been intensified under COVID-19 are living alone, infrequent contact with family or friends, dissatisfaction with living circumstances, chronic work and/or social stress, small social network as well as a poor quality social network, and marital or family conflict (38). A representative study from Germany showed that the prevalence of loneliness increased from 11% before COVID-19 to 27% during COVID-19 (37). Our recent study showed that up to 66% of people in Germany sometimes or always felt lonely amid COVID-19 (39). Furthermore, loneliness increased with a small effect size in the population that reinforces a "loneliness epidemic" (40). Similar results have been reported in the association between increased prevalence of loneliness, depression, and anxiety (41, 42).

The Evolutionary Theory of Loneliness (ETLs) conceptualizes that loneliness has an adaptive and non-conscious function of a person perceiving the world as more threatening (43). Furthermore, if people feel no sense of solidarity, it leads to them operating in a "selfish" mode, which can help them protect themselves in a potentially dangerous situation (43). This state is extremely aversive and thus is conceptualized to bring people to renew their social connections (38) and to protect themselves from being alone in a hostile environment (43). Considering these points, it highlights that lonely individuals may perceive an objectively neutral situation as more hostile than non-lonely individuals may. That raises an interesting question of whether lonely and non-lonely people react differently in the ongoing COVID-19 pandemic. Spithoven et al. highlighted that lonely people process information differently from non-lonely individuals (44). Lonely individuals interpret information with more negative expectations and have a hostile attribution bias and negative evaluation of self and others (44). They also tend to have a higher sensibility for socially threatening and socially negative stimuli (44). These cognitive biases tend to reinforce and strengthen

counterproductive social behaviors (44, 45). These findings undermine the fact that in a socially shifting situation like a lockdown, lonely people may perceive the world differently from non-lonely people. One of the popular beliefs amid COVID-19 was conspiracy theories. There were mixed results on loneliness relating to belief in conspiracy theories. On the one hand, the induction of loneliness increases paranoid ideation (46) that correlated with COVID-19 conspiracy beliefs (47). On the other hand, instead of loneliness, people who endorse conspiracy theories are influenced by their personal willingness to conspire (48) and by social contagion through conventional and social media (49). The inconsistent results are encouraging a better understanding of the role of loneliness in conspiracy endorsement.

While there is a surfeit of studies measuring the negative experiences among lonely people amid COVID-19 (2, 8–14, 26, 31, 35), there is a lack of studies on positive outcomes. To better prepare for and respond to the future pandemic, it is crucial to understand both positive and negative lessons we have learned during the COVID-19 pandemic. In this study, we aim to examine the positive and negative experiences during COVID-19 among lonely and non-lonely individuals in Germany. We expect that there will be different positive and negative experiences of living in COVID-19 among lonely and non-lonely people. Specifically, we hypothesize that lonely individuals will report less positive and more negative experiences than non-lonely individuals will. Finally, we assume the belief in conspiracy theories will be independent of individuals' feelings of loneliness.

2. Methods

2.1. Participants and procedure

We conducted an anonymous online survey using the Siuvo platform (https://www.siuvo.com) for psychological assessments in healthcare settings between May 2020 and May 2022 in Germany. The survey was distributed using a QR code shared primarily through social media, advertisements, and newsletters. We recruited participants who were aged 18 years and above and gave informed consent. We collected our data conveniently by recruiting populations who had access to the Internet. We used G*Power Version 3.1.9.6 to determine sample size. According to a previous study in Germany (50), 32% of people reported being lonely in Germany under the first nationwide lockdown in March 2020. We calculated a sample size of 1,434, which gives an α error rate of 5%, power of 90%, a "small" effect size ($d = 0.2$), and an allocation ratio of 0.32. Considering a 20% dropout rate, 1,721 participants were set as the target sample size. We collected socio-demographic data (i.e., sex, age, and years of education), used a short form of the UCLA Loneliness Scale (ULS-8) to assess feelings of loneliness, as well as the COVID-19 Peritraumatic Distress Instrument (CPDI) and asked individuals' positive and negative experiences of living in the COVID-19 pandemic. We also asked our participants if they have less contact with their family amid COVID-19 and if they have been diagnosed with a mental illness in the past 3 months. The Ethics Committee of Charité—Universitätsmedizin Berlin (EA2/143/20) approved the study.

2.2. Measurement of loneliness and perceived positive and negative experiences amid COVID-19 and COVID-19-related distress

Loneliness was assessed by using the well-established short eight-item UCLA Loneliness Scale (ULS-8) in a validated German version (39, 51, 52). Each item was answered on a 4-point Likert scale with total scores ranging from 8 to 32, with higher scores suggesting a higher degree of loneliness. Participants who reported at least sometimes (a cut-off score $\geq$16) to always feeling lonely were considered "lonely people" (53). We used the 24-item COVID-19 Peritraumatic Distress Index (CPDI) questionnaire to capture peritraumatic psychological distress in the general population amid COVID-19 (54). Each item was answered on a 5-point Likert scale, with higher scores suggesting a higher psychological distress level (a score between 28 and 51 indicates mild-to-moderate distress). Perceived positive experiences during COVID-19 were assessed with a nominal scale by asking, "Do you perceive any positive experiences of the COVID-19 pandemic?" Participants had to choose one of the nine following categorical statements compared to before COVID-19: (1) "No positive effects at all," (2) "A more environmentally friendly world," (3) "Time to think about life," (4) "More time for loved ones," (5) "More time for hobbies," (6) "Less work-related stress," (7) "Less social pressure," (8) "An increased sense of togetherness," and (9) "Other positive experiences." Perceived negative experiences during the pandemic were assessed with a nominal scale by asking, "Did you perceive any negative experiences of the COVID-19 pandemic?" Participants had to choose one of the five following categorical statements that made them feel the most psychological distressed in times of COVID-19: (1) "Corona *per se* is a dangerous infectious disease," (2) "The epidemic was deliberately manufactured to serve the interest of powerful forces," (3) "A feeling of imminent threat," (4) "An edge and worries in general," and (5) "Other negative experiences." The items on positive and negative experiences were based on

previous studies on life-changing experiences before COVID-19 (e.g., the outbreak of Ebola virus disease, the 2003 SARS epidemic) (55–57) and public views about COVID-19 in Germany (58–61).

2.3. Data analysis

We performed statistical analysis by using R Statistical Software (version 4.1.2; R Foundation for Statistical Computing, Vienna, Austria). Differences were considered statistically significant at $p < 0.05$ and highly statistically significant at $p < 0.01$. To check the influences of socio-demographic factors (i.e., sex, age, and years of education) on the loneliness scores, we conducted a multiple linear regression analysis. We used the chi-square test to evaluate if there are differences between non-lonely and lonely people in reporting their contact with families and having been diagnosed with a mental illness in the past 3 months. We used independent sample *t*-tests to examine differences in CPDI scores in non-lonely and lonely people as well as in men and women. We used logistic regression analysis to examine whether there was a significant difference between non-lonely and lonely people in choosing each category of positive and negative experiences. We used the chi-square test to compare men and women and investigate the effects of gender. Finally, we performed logistical regression analyses to understand whether gender, age, and loneliness played a role in conspiracy beliefs.

3. Results

3.1. Group description

A total of 4,226 participants got access to our survey, 2,466 participants responded to it, 1,858 participants completed it, and 100 participants did not meet the data quality control. Our final sample consists of 1,758 participants (1,304 women (74.2%), age range: 18–75, M = 33.37, SD = 12.24), as shown in Table 1. Each participant completed the survey only once. Of note, 1,354 (77.02%) participants were categorized as "lonely," as they reported feeling lonely at least sometimes. Our regression analysis revealed that people with less years of education [$t_{(3,1,754)} = -2.16$, $p = 0.03$] reported higher loneliness scores. Younger age [$t_{(3,1,754)} = -1.73$, $p = 0.08$] and gender did not play a role in the feeling of loneliness [$t_{(3,1,754)} = 1.63$, $p = 0.1$]. The the chi-square tests showed that lonely people responded to having less family contact amid COVID-19 as compared to non-lonely people [$\chi^2_{(4)} = 177.9$, $p = < 0.001$], and there was no significantly higher proportion of lonely people who were diagnosed with a mental illness as compared to non-lonely people [$\chi^2_{(1)} = 3.84$, $p = 0.0501$]. There were gender differences in reporting psychological distress: CPDI scores were significantly higher in women than men ($p < 0.001$), indicating that women had higher COVID-19-related distress than men.

3.2. Less positive experiences of living in COVID-19 among lonely individuals

We found that lonely people were more likely to report no positive experience of living during the COVID-19 pandemic as compared to non-lonely people [$z_{(1,756)} = 2.92$, $p = 0.004$], as shown in Figure 1. In our sample, due to a higher proportion of women, we also conducted additional analyses of men and women separately. In general, we did not find a significant difference between men and women in perceiving no positive experiences during the pandemic [$\chi^2_{(1)} = 1.4$, $p = 0.24$]. However, we found lonely women were more likely to report no positive experience of living during the COVID-19 pandemic as compared to non-lonely women ($p = 0.007$). In lonely men, we did not find that they were more likely to report no positive experience of living during the COVID-19 pandemic as compared to non-lonely men ($p = 0.85$). Furthermore, lonely people experienced significantly less time with loved ones [$z_{(1,756)} = -2.5$, $p = 0.012$] and less sense of togetherness [$z_{(1,756)} = -2.39$, $p = 0.017$] than non-lonely people. There was no significant difference between lonely and non-lonely individuals in experiencing a more "eco-friendly world" [$z_{(1,756)} = -0.009$, $p = 0.99$], "more time to think about life" [$z_{(1,756)} = 1.12$, $p = 0.295$], "more time for hobbies" [$z_{(1,756)} = -1.44$, $p = 0.15$], "less work-related stress" [$z_{(1,756)} = 0.181$, $p = 0.857$], and "less social pressure" [$z_{(1,756)} = 0.846$, $p = 0.398$] as positive outcomes of COVID-19.

3.3. More negative experiences of living in COVID-19 among lonely individuals

Lonely participants reported "worry" significantly more often than non-lonely participants [$z_{(1,756)} = 6.31$, $p < 0.001$], as shown in Figure 2. There was no significant difference between lonely and non-lonely individuals in experiencing "danger" [$z_{(1,756)} = -0.19$, $p = 0.85$], as well as "threat" [$z_{(1,756)} = 1.51$, $p = 0.13$]. Non-lonely participants experienced "other" negative outcomes of COVID-19 [$z_{(1,756)} = -8.54$, $p < 0.001$] significantly more often than lonely participants. The detailed logistical regression results are reported in Table 2. When comparing men with women, we found that women reported worry as a negative experience more often [$\chi^2_{(1)} = 7.29$, $p = 0.007$] than men. Conversely, men reported perceiving the pandemic as dangerous more often as a negative outcome [$\chi^2_{(1)} = 5.29$, $p = 0.007$] than women. We did not find a significant difference between men and women in having conspiracy beliefs [$\chi^2_{(1)} = 3.68$, $p = 0.055$] and perceiving the pandemic

TABLE 1 Descriptive differences between non-lonely and lonely individuals.

	All	Non-lonely	Lonely	*p*
	N = 1,758	*N* = 404	*N* = 1,354	
Gender, *n* (%)				
Women	1,304 (74.2)	282 (69.8)	1,022 (75.5)	0.026
Men	454 (25.8)	122 (30.2)	332 (24.5)	
Age, mean (SD)	33.4 (12.2)	35.3 (12.9)	32.8 (12.0)	0.001
Years of education, mean (SD)	15.8 (3.68)	16.0 (3.84)	15.8 (3.64)	0.439
Less family contact, *n* (%)				
No	893 (50.8)	321 (79.5)	572 (42.2)	<0.001
Prior diagnosis, *n* (%)				
Yes	251 (14.3)	46 (11.4)	205 (15.1)	0.0501
CPDI score, mean (SD)	35.9 (18.7)	19.1 (13.2)	40.9 (17.1)	<0.001
ULS-8 score, mean (SD)	20.0 (5.83)	12.0 (2.34)	22.4 (4.16)	0.000

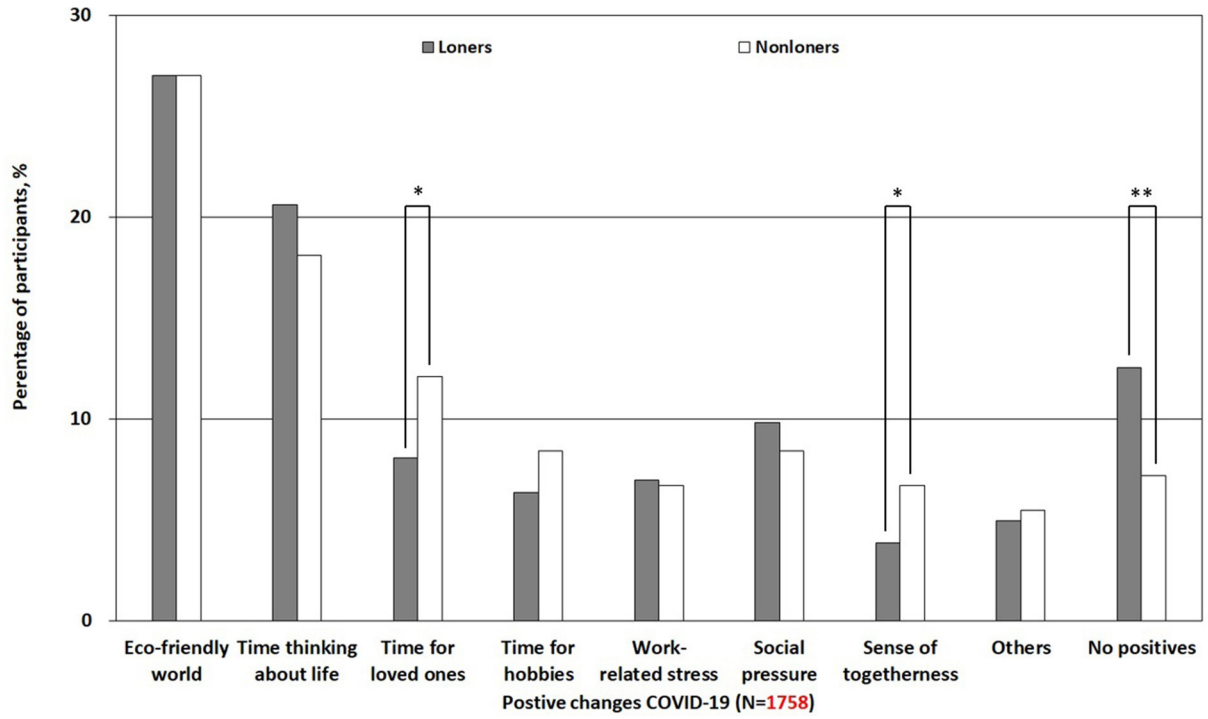

FIGURE 1
Differences in positive experiences of living in the COVID-19 pandemic among lonely and non-lonely individuals. $^{*}p < 0.05$; $^{**}p < 0.01$.

as threatening [$\chi^2_{(1)} = 0.11$, $p = 0.74$]. Overall, our logistic regression showed that age [$z_{(1,756)} = 0.15, p = 0.88$] and gender [$z_{(1,756)} = -1.9, p = 0.057$] were not associated with conspiracy belief, whereas loneliness score was associated with conspiracy belief [$z_{(1,756)} = -3.35, p < 0.001$].

4. Discussion

We conducted a cross-sectional study from May 2020 to May 2022 to discover whether there are different positive and negative experiences of living during the COVID-19 pandemic

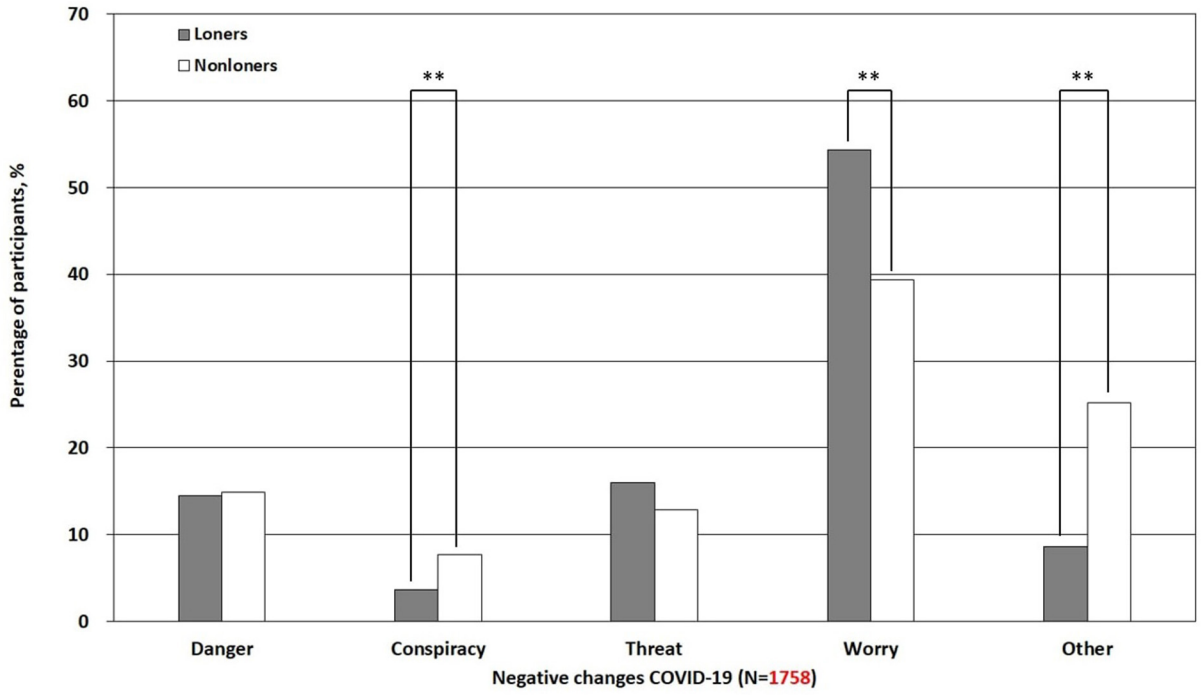

FIGURE 2
Differences in negative experiences of living in the COVID-19 pandemic among lonely and non-lonely individuals. $^{**}p < 0.01$.

among lonely and non-lonely people. We found less positive and more negative experiences among lonely people as compared with non-lonely people.

Regarding positive experiences, lonely people reported perceiving no positive experiences of living during the pandemic more than non-lonely people. In line with previous studies, lonely people tend to have negative feelings more often (62). Negative feelings and thinking can hint at a generally depressed mood in lonely people, as loneliness can be a sign of depression (63). The negative effect of a depressed state can lead people to withdraw from social life even more (64, 65), which can be an alarming situation during an already-implemented lockdown. In line with Wong's Existential Positive Psychology theory (17), positives cannot exist apart from negatives. Wong conceptualizes wellbeing not only as pursuing positive goals but also as overcoming and mastering negative experiences (17). The absence of positive experiences being especially prominent in lonely people may reflect that they desire ways to deal with negativity and savor positive experiences. In addition to the positive experiences among non-lonely and lonely people, we found that lonely women were more likely to report no positive experience of living during the COVID-19 pandemic as compared to non-lonely women. There was no such a significant difference between non-lonely and lonely men. Further research is needed to examine different positive and negative experiences among non-lonely and lonely men and women.

Furthermore, we found that lonely people perceived "spending more time with loved ones" significantly less than non-lonely people did. It is unclear whether such a perception plays a role in developing and maintaining a desired social relationship that is associated with defying loneliness: Did people not spend enough time with their loved ones and then became lonely, or were they lonely and withdrew themselves even more from social contacts? Another interesting aspect would be to exhibit if lonely people actually spend less time with loved ones than non-lonely people or if they just perceive it as such, as lonely people tend to have more negative and less satisfying social interactions, which contribute to negative moods and interactions (66). In this context, we found that lonely people reported less sense of togetherness than non-lonely people. A sense of togetherness reflects solidarity that comes hand in hand with achieving a common goal (67). Interestingly, loneliness as "selfish" mode can inhibit our sense of solidarity (43, 68, 69). The ETL suggests this "selfish" mode as a response to avoid a dangerous situation (43). However, people may be at risk of developing chronic loneliness, if they continue with this mode over time (70). Loss of sense of togetherness may reinforce this vicious circle. Laitinen and Pessi suggested that chaos and conflict in societies can oppose solidarity, along with the maximization of self-interest (71). Furthermore, our findings uncovered various aspects of what it feels like to be lonely amid COVID-19. Although closer friendships seem to remain intact

TABLE 2 Differences in positive and negative experiences of living in the COVID-19 pandemic among lonely and non-lonely individuals.

	All	Non-lonely	Lonely	*p*
	N = 1,758	*N* = 404	*N* = 1,354	
No positives				0.004
Not chosen	1,560 (88.7%)	375 (92.8%)	1,185 (87.5%)	
Chosen	198 (11.3%)	29 (7.18%)	169 (12.5%)	
Eco-friendly world				1.000
Not chosen	1,284 (73.0%)	295 (73.0%)	989 (73.0%)	
Chosen	474 (27.0%)	109 (27.0%)	365 (27.0%)	
Thinking about life				0.295
Not chosen	1,406 (80.0%)	331 (81.9%)	1,075 (79.4%)	
Chosen	352 (20.0%)	73 (18.1%)	279 (20.6%)	
Time loved ones				0.016
Not chosen	1,600 (91.0%)	355 (87.9%)	1,245 (91.9%)	
Chosen	158 (8.99%)	49 (12.1%)	109 (8.05%)	
Time hobbies				0.183
Not chosen	1,638 (93.2%)	370 (91.6%)	1,268 (93.6%)	
Chosen	120 (6.83%)	34 (8.42%)	86 (6.35%)	
Less work-stress				0.945
Not chosen	1,637 (93.1%)	377 (93.3%)	1,260 (93.1%)	
Chosen	121 (6.88%)	27 (6.68%)	94 (6.94%)	
Less social pressure				0.453
Not chosen	1,591 (90.5%)	370 (91.6%)	1,221 (90.2%)	
Chosen	167 (9.50%)	34 (8.42%)	133 (9.82%)	
Sense of togetherness				0.022
Not chosen	1,679 (95.5%)	377 (93.3%)	1,302 (96.2%)	
Chosen	79 (4.49%)	27 (6.68%)	52 (3.84%)	
Other positives				0.787
Not chosen	1,669 (94.9%)	382 (94.6%)	1,287 (95.1%)	
Chosen	89 (5.06%)	22 (5.45%)	67 (4.95%)	
Danger				0.914
Not chosen	1,502 (85.4%)	344 (85.1%)	1,158 (85.5%)	
Chosen	256 (14.6%)	60 (14.9%)	196 (14.5%)	
Conspiracy				0.001
Not chosen	1,678 (95.4%)	373 (92.3%)	1,305 (96.4%)	
Chosen	80 (4.55%)	31 (7.67%)	49 (3.62%)	
Threat				0.152
Not chosen	1,490 (84.8%)	352 (87.1%)	1,138 (84.0%)	
Chosen	268 (15.2%)	52 (12.9%)	216 (16.0%)	
Worry				<0.001
Not chosen	822 (46.8%)	245 (60.6%)	577 (42.6%)	
Chosen	936 (53.2%)	159 (39.4%)	777 (57.4%)	
Other negatives				<0.001
Not chosen	1,540 (87.6%)	302 (74.8%)	1,238 (91.4%)	
Chosen	218 (12.4%)	102 (25.2%)	116 (8.57%)	

in the pandemic (72), it is associated with less general peer-to-peer contact (73) and worse recognition of one's own and others' emotions (74), which can lead to more distress and loneliness (73). When looking back at the possible evolutionary functions of loneliness, solidarity and spending time with a peer group help increase social skills for battling loneliness, which in turn lessens their risk for mortality (43). The absence of those social experiences and their effects on the mind and body can be a particular danger for lonely people.

Regarding the negative experiences of living during the pandemic, our results were consistent with the previous studies showing an association between loneliness and worry (75). In our study, lonely people worried significantly more than non-lonely people did. Strikingly, nearly two times as many of the non-lonely individuals believed that the whole pandemic was a hoax and made up of secret powers compared to lonely people. Recent research explains what draws people to conspiracy beliefs. Reasons to believe in conspiracy theories are that they give self-contained explanations for insecure situations, make people feel special, and give them a positive self-image for knowing information that nobody else knows and/or satisfy people's needs for safety and security (76). Other important socio-demographic data related to conspiracy beliefs are socio-economic status, education and political positions (76). Finally, our results showed that non-lonely individuals experienced more "other" negative outcomes of COVID-19 than lonely participants did. Negative experiences that were not mentioned before may include, among other factors, prolonged grievances for loved ones who died (77–79), financial hardships (80, 81), and family problems (82, 83).

Generalizability and representativeness are limited in our study populations (e.g., people 18 ± 75 years old), although our socio-demographic characteristics are consistent with other published surveys during COVID-19 (84, 85). To reduce sampling bias, respondents were from Germany's 16 federal states and worked in various fields, such as office administration, healthcare, education, civil service, sales, agriculture, arts, sports, and media. Moreover, our sample consists of a high rate of women, which is consistent with other published surveys during COVID-19 (84, 85). Our findings cannot establish a cause-and-effect relationship or analyze momentary experiences and daily behavior over a period. We cannot rule out the varying influences of COVID-19 and its related measures (e.g., lockdowns, public health, social, and economic measures) on our observed results. Future studies may also consider different socio-demographic factors (e.g., marital status, migration background, and household) that may have influences on the observed effects. A depth quality assessment is needed to uncover other potential positive and negative experiences with the COVID-19 pandemic.

5. Conclusion

The COVID-19 crisis may be a chance to reconsider personal and social priorities. Our study showed that lonely people reported more negative and less positive experiences during the COVID-19 pandemic than non-lonely people. To prepare for and respond to future pandemics, decision-makers may seek to spread positive energy among vulnerable populations (e.g., people who feel lonely), build trust and confidence in dealing with negative experiences (e.g., worry and fear), and improve communication. Future studies may focus on effective, adaptive, and scalable interventions to foster social cohesion, empower people helps build resilience, and, most importantly, provide timely social care.

Data availability statement

The datasets are available, with restrictions, due to confidentiality in line with Berlin Data Protection Act (Berliner Datenschutzgesetz - BlnDSG). Interested individuals can contact stresshealth@charite.de.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of Charité – Universitätsmedizin Berlin. The participants provided their written informed consent to participate in this study.

Author contributions

Conceptualization, writing—review and editing, and supervision: SL. Methodology, data collection, and data curation: LW and SL. Data analysis and writing—original draft preparation: LW. Both authors have read and agreed to the published version of the manuscript.

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Conflict of interest

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

Publisher's note

References

1. Kerekes S, Badea AG-E, Paun D. Analyzing lockdown policies and their effectiveness in Romania and Hungary. *Challenges*. (2021) 12:20. doi: 10.3390/challe12020020

2. Amerio A, Aguglia A, Odone A, Gianfredi V, Serafini G, Signorelli C, et al. Covid-19 pandemic impact on mental health of vulnerable populations. *Acta Biomed*. (2020) 91:95–6. doi: 10.23750/abm.v91i9-S.10112

3. Siegel RM, Mallow PJ. The impact of COVID-19 on vulnerable populations and implications for children and health care policy. *Clin Pediatr*. (2021) 60:93–8. doi: 10.1177/0009922820973018

4. Webber-Ritchey KJ, Simonovich SD, Spurlark RS. COVID-19: qualitative research with vulnerable populations. *Nurs Sci Quart*. (2021) 34:13–9. doi: 10.1177/0894318420965225

5. Brown G, Greenfield PM. Staying connected during stay-at-home: communication with family and friends and its association with well-being. *Hum Behav Emerg Technol*. (2021) 3:147–56. doi: 10.1002/hbe2.246

6. Nguyen MH, Gruber J, Marler W, Hunsaker A, Fuchs J, Hargittai E. Staying connected while physically apart: digital communication when face-to-face interactions are limited. *N Media Soc*. (2022) 24:2046–67. doi: 10.1177/1461444820985442

7. Khan I, Shah D, Shah SS. COVID-19 pandemic and its positive impacts on environment: an updated review. *Int J Environ Sci Technol*. (2021) 18:521–30. doi: 10.1007/s13762-020-03021-3

8. World Health Organization. *COVID-19 Pandemic Triggers 25% Increase in Prevalence of Anxiety and Depression Worldwide*. World Health Organization. Available online at: https://www.who.int/news/item/02--03-2022-covid-19-pandemic-triggers-25-increase-in-prevalence-of-anxiety-and-depression-worldwide (accessed December 06, 2022).

9. Uddin M. Addressing work-life balance challenges of working women during COVID-19 in Bangladesh. *Int Soc Sci J*. (2021) 71:7–20. doi: 10.1111/issj.12267

10. Sarrasanti N, Donkor FK, Santos C, Tsagkari M, Wannous C. Its about time we care about an equitable world: women's unpaid care work and COVID-19. *IEEE Eng Manag Rev*. (2020) 48:37–45. doi: 10.1109/EMR.2020.3031313

11. Kalabikhina IE. Demographic and social issues of the pandemic. *Popul Econ*. (2020) 4:103–22. doi: 10.3897/popecon.4.e53891

12. Agostinelli F, Doepke M, Sorrenti G, Zilibotti F. When the great equalizer shuts down: schools, peers, and parents in pandemic times. *J Public Econ*. (2022) 206:104574. doi: 10.1016/j.jpubeco.2021.104574

13. Bettinger-Lopez C, Bro A. A double pandemic: domestic violence in the age of COVID-19. *Council Foreign Relat*. (2020) 13.

14. Navarro V. The consequences of neoliberalism in the current pandemic. *Int J Health Serv*. (2020) 50:271–5. doi: 10.1177/0020731420925449

15. Rosenfeld DL, Tomiyama AJ. Can a pandemic make people more socially conservative? Political ideology, gender roles, and the case of COVID-19. *J Appl Soc Psychol*. (2021) 51:425–33. doi: 10.1111/jasp.12745

16. Wong P. *Courage, Faith, Meaning, and Mature Happiness in Dangerous Times*. (2017). Available online at: http://www.drpaulwong.com/inpm-presidents-report-may-2017/ (accessed December 06, 2022).

17. Wong PT, Mayer C-H, Arslan G. COVID-19 and existential positive psychology (PP2. 0): the new science of self-transcendence. *Front Psychol*. (2021) 12:800308. doi: 10.3389/fpsyg.2021.800308

18. Novaković IZ, Lueger-Schuster B, Verginer L, Bakić H, Ajduković D, Borges C, et al. You can't do anything about it, but you can make the best of it: a qualitative analysis of pandemic-related experiences in six European countries. *Eur J Psychotraumatol*. (2022) 13:2065431. doi: 10.1080/20008198.2022.2065431

19. Bates CR, Nicholson LM, Rea EM, Hagy HA, Bohnert AM. Life interrupted: family routines buffer stress during the COVID-19 pandemic. *J Child Fam Stud*. (2021) 30:2641–51. doi: 10.1007/s10826-021-02063-6

20. Wright L, Fluharty M, Steptoe A, Fancourt D. How did people cope during the COVID-19 pandemic? A structural topic modelling analysis of free-text data From 11,000 United Kingdom adults. *Front Psychol*. (2022) 13:810655. doi: 10.3389/fpsyg.2022.810655

21. Ipsen C, van Veldhoven M, Kirchner K, Hansen JP. Six key advantages and disadvantages of working from home in Europe during COVID-19. *Int J Environ Res Public Health*. (2021) 18:1826. doi: 10.3390/ijerph18041826

22. Büssing A, Rodrigues Recchia D, Hein R, Dienberg T. Perceived changes of specific attitudes, perceptions and behaviors during the corona pandemic and their relation to wellbeing. *Health Qual Life Outcomes*. (2020) 18:1–17. doi: 10.1186/s12955-020-01623-6

23. Wong PT, Arslan G, Bowers VL, Peacock EJ, Kjell ONE, Ivtzan I, et al. Self-transcendence as a buffer against COVID-19 suffering: the development and validation of the self-transcendence measure-B. *Front Psychol*. (2021) 12:648549. doi: 10.3389/fpsyg.2021.648549

24. Cénat JM, Farahi SMMM, Dalexis RD, Darius WP, Bekarkhanechi FM, Poisson H, et al. The global evolution of mental health problems during the COVID-19 pandemic: A systematic review and meta-analysis of longitudinal studies. *J Affect Disord*. (2022) 315:70–95. doi: 10.1016/j.jad.2022.07.011

25. 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

26. Haucke M, Liu S, Heinzel S. The persistence of the impact of COVID-19–related distress, mood inertia, and loneliness on mental health during a post-lockdown period in Germany: an ecological momentary assessment study. *JMIR Mental Health*. (2021) 8:e29419. doi: 10.2196/29419

27. Zhang SX, Batra K, Xu W, Liu T, Dong RK, Yin A, et al. Mental disorder symptoms during the COVID-19 pandemic in Latin America–a systematic review and meta-analysis. *Epidemiol Psychiatr Sci*. (2022) 31:e23 doi: 10.1017/S2045796021000767

28. Zhang SX, Chen J. Scientific evidence on mental health in key regions under the COVID-19 pandemic–meta-analytical evidence from Africa, Asia, China, Eastern Europe, Latin America, South Asia, Southeast Asia, and Spain. *Eur J Psychotraumatol*. (2021) 12:2001192. doi: 10.1080/20008198.2021.2001192

29. Islam MR, Quaiyum S, Pakhe SA, Repon MAU, Bhuiyan MA. Dataset concerning the mental health of healthcare professionals during COVID-19 pandemic in Bangladesh. *Data Brief*. (2021) 39:107506. doi: 10.1016/j.dib.2021.107506

30. Zysberg L, Zisberg A. Days of worry: emotional intelligence and social support mediate worry in the COVID-19 pandemic. *J Health Psychol*. (2022) 27:268–77. doi: 10.1177/1359105320949935

31. Nam S-H, Nam J-H, Kwon C-Y. Comparison of the mental health impact of COVID-19 on vulnerable and non-vulnerable groups: a systematic review and meta-analysis of observational studies. *Int J Environ Res Public Health*. (2021) 18:10830. doi: 10.3390/ijerph182010830

32. Attema AE, L'haridon O, Raude J, Seror V, Group C. Beliefs and risk perceptions about COVID-19: evidence from two successive French representative surveys during lockdown. *Front Psychol*. (2021) 12:619145. doi: 10.3389/fpsyg.2021.619145

33. Akbari M, Spada MM, Nikčević AV, Zamani E. The relationship between fear of COVID-19 and health anxiety among families with COVID-19 infected: the mediating role of metacognitions, intolerance of uncertainty and emotion regulation. *Clin Psychol Psychother*. (2021) 28:1354–66. doi: 10.1002/cpp.2628

34. Schuller S. World conspiracy literature and antisemitism. *Transit*. (2021) 13:195–204. doi: 10.5070/T713153441

35. Haucke M, Heinz A, Liu S, Heinzel S. The impact of COVID-19 lockdown on daily activities, cognitions, and stress in a lonely and distressed population: temporal dynamic network analysis. *J Med Internet Res*. (2022) 24:e32598. doi: 10.2196/32598

36. Jeste DV, Lee EE, Cacioppo S. Battling the modern behavioral epidemic of loneliness: suggestions for research and interventions. *JAMA Psychiatry*. (2020) 77:553–4. doi: 10.1001/jamapsychiatry.2020.0027

37. Krieger T, Seewer N. *Einsamkeit / Tobias Krieger, Noëmi Seewer*. Göttingen: Hogrefe (2022). doi: 10.1026/03172-000

38. Cacioppo JT, Cacioppo S, Boomsma DI. Evolutionary mechanisms for loneliness. *Cogn Emot*. (2014) 28:3–21. doi: 10.1080/02699931.2013.837379

39. Liu S, Haucke MN, Heinzel S, Heinz A. Long-term impact of economic downturn and loneliness on psychological distress: triple crises of COVID-19 pandemic. *J Clin Med*. (2021) 10:4596. doi: 10.3390/jcm10194596

40. Ernst M, Niederer D, Werner AM, Czaja SJ, Mikton C, Ong AD, et al. Loneliness before and during the COVID-19 pandemic: a systematic review with meta-analysis. *Am Psychol*. (2022) 77: 660–77. doi: 10.1037/amp0001005

41. Bello UM, Kannan P, Chutiyami M, Salihu D, Cheong AM, Miller T, et al. Prevalence of anxiety and depression among the general population in Africa during the COVID-19 pandemic: a systematic review and meta-Analysis. *Front Public Health*. (2022) 10:814981. doi: 10.3389/fpubh.2022.814981

42. Johns G, Samuel V, Freemantle L, Lewis J, Waddington L. The global prevalence of depression and anxiety among doctors during the covid-19 pandemic: systematic review and meta-analysis. *J Affect Disord*. (2022) 298:431–41. doi: 10.1016/j.jad.2021.11.026

43. Cacioppo JT, Cacioppo S. Loneliness in the modern age: an evolutionary theory of loneliness (ETL). *Adv Exp Soc Psychol*. (2018) 58: 27–97. doi: 10.1016/bs.aesp.2018.03.003

44. Spithoven AW, Bijttebier P, Goossens L. It is all in their mind: a review on information processing bias in lonely individuals. *Clin Psychol Rev*. (2017) 58:97–114. doi: 10.1016/j.cpr.2017.10.003

45. Bellucci G. Positive attitudes and negative expectations in lonely individuals. Scientific Reports. (2020) 10:1–9. doi: 10.1038/s41598-020-75712-3

46. Lamster F, Nittel C, Rief W, Mehl S, Lincoln T. The impact of loneliness on paranoia: an experimental approach. *J Behav Ther Exp Psychiatry*. (2017) 54:51–7. doi: 10.1016/j.jbtep.2016.06.005

47. Suthaharan P, Reed EJ, Leptourgos P, Kenney JG, Uddenberg S, Mathys CD, et al. Paranoia and belief updating during the COVID-19 crisis. *Nat Hum Behav*. (2021) 5:1190–202. doi: 10.1038/s41562-021-01176-8

48. Douglas KM, Sutton RM. Does it take one to know one? Endorsement of conspiracy theories Is influenced by personal willingness to conspire. *Br J Soc Psychol*. (2011) 50:544–52. doi: 10.1111/j.2044-8309.2010.02018.x

49. Dow BJ, Johnson AL, Wang CS, Whitson J, Menon T. The COVID-19 pandemic and the search for structure: social media and conspiracy theories. *Soc Pers Psychol Compass*. (2021) 15:e12636. doi: 10.1111/spc3.12636

50. Berger K, Riedel-Heller S, Pabst A, Rietschel M, Richter D. [Loneliness during the first wave of the SARS-CoV-2 pandemic-results of the German National Cohort (NAKO)]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz*. (2021) 64:1157–64. doi: 10.1007/s00103-021-03393-y

51. Döring N, Bortz J. Psychometrische Einsamkeitsforschung: Deutsche Neukonstruktion der UCLA Loneliness Scale [Psychometric research on loneliness: A new German version of the University of California at Los Angeles (UCLA) Loneliness Scale]. *Diagnostica*. (1993) 39:224–39.

52. Liu S, Heinzel S, Haucke MN, Heinz A. Increased psychological distress, loneliness, and unemployment in the spread of COVID-19 over 6 months in Germany. *Medicina*. (2021) 57:53. doi: 10.3390/medicina 57010053

53. Hays RD, DiMatteo MR. A short-form measure of loneliness. *J Pers Assess*. (1987) 51:69–81. doi: 10.1207/s15327752jpa5101_6

54. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen Psychiatry*. (2020) 33:e100213. doi: 10.1136/gpsych-2020-100213

55. Thompson RR, Garfin DR, Holman EA, Silver RC. Distress, worry, and functioning following a global health crisis: a national study of Americans' responses to Ebola. *Clin Psychol Sci*. (2017) 5:513–21. doi: 10.1177/2167702617692030

56. Fredrickson BL, Tugade MM, Waugh CE, Larkin GR. What good are positive emotions in crisis? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *J Pers Soc Psychol*. (2003) 84:365. doi: 10.1037/0022-3514.84.2.365

57. Lau JT, Yang X, Pang E, Tsui H, Wong E, Wing YK. SARS-related perceptions in Hong Kong. *Emerg Infect Dis*. (2005) 11:417. doi: 10.3201/eid1103.040675

58. Freudental R. *Die positiven Folgen der Corona-Krise: Mehrheit glaubt, Pandemie bringt Familie und Freunde näher zusammen*. Available online at: https://www.ipsos.com/de-de/die-positiven-folgen-der-corona-krise-mehrheit-glaubt-pandemie-bringt-familie-und-freunde-naher (accessed December 06, 2022).

59. Der Spiegel. *Coronakrise führt zu historischem CO2-Rückgang*. Avaialble online at: https://www.spiegel.de/wirtschaft/unternehmen/corona-krise-fuehrt-zu-historischem-co2-rueckgang-a-66efc1a4-b572-4013-88a0-38b5510a0a73 (accessed December 06, 2022).

60. Drosner R. *Homeoffice in Corona-Zeiten - ≪Viele vermissen die Wertschätzung der Vorgesetzten≫*. Available online at: https://www.srf.ch/wissen/corona/homeoffice-in-corona-zeiten-viele-vermissen-die-wertschaetzung-der-vorgesetzten (accessed December 06, 2022).

61. Naumann E, Mata J, Reifenscheid M, Möhring K, Wenz A, Rettig T, et al. *Die Mannheimer Corona-Studie: Schwerpunktbericht zum Angstempfinden in der Bevölkerung. Survey Results*. University of Mannheim (2020). Available online at: https://www.unimannheim.de/media/Einrichtungen/gip/Corona_Studie/Schwerpunktbericht_Angstempfinden_Mannheimer_Corona_Studie.pdf

62. Coşan D. An evaluation of loneliness. *Eur Proc Soc Behav Sci*. (2014) 1:103–10. doi: 10.15405/epsbs.2014.05.13

63. Erzen E, Çikrikci Ö. The effect of loneliness on depression: a meta-analysis. International *J Soc Psychiatry*. (2018) 64:427–35. doi: 10.1177/0020764018776349

64. Derntl B, Seidel E-M, Eickhoff SB, Kellermann T, Gur RC, Schneider F, et al. Neural correlates of social approach and withdrawal in patients with major depression. *Soc Neurosci*. (2011) 6:482–501. doi: 10.1080/17470919.2011.579800

65. Lee JI, Parhar IS, Soga T. Hikikomori: social withdrawal a risk factor for depression. *Psychiatry Clin Neurosci*. (2022) 76:340–8. doi: 10.1111/pcn.13354

66. Hawkley LC, Preacher KJ, Cacioppo JT. Multilevel modeling of social interactions and mood in lonely and socially connected individuals: the MacArthur social neuroscience studies. In: Ong AD, van Dulmen MHM, editors. *Oxford Handbook of Methods in Positive Psychology*. Oxford University Press (2007). p. 559–75.

67. Bayertz K. Four uses of "solidarity". In: Bayertz, K, editor. *Solidarity*. Dordrecht: Kluwer (1999). p. 3–28. doi: 10.1007/978-94-015-9245-1_1

68. Swann WB Jr, Gómez Á, Dovidio JF, Hart S, Jetten J. Dying and killing for one's group: identity fusion moderates responses to intergroup versions of the trolley problem. *Psychol Sci*. (2010) 21:1176–83. doi: 10.1177/0956797610376656

69. Kramer RM, Brewer MB. Effects of group identity on resource use in a simulated commons dilemma. *J Pers Soc Psychol*. (1984) 46:1044. doi: 10.1037/0022-3514.46.5.1044

70. Krieger T, Seewer N, Skoko A. chronische einsamkeit–mehr als ein symptom einer depression. *PiD-Psychotherapie im Dialog*. (2021) 22:59–63. doi: 10.1055/a-1215-1677

71. Laitinen A, Pessi AB. "Solidarity: Theory and practice. An introduction," in Laitinen A, Pessi AB, editors. *Solidarity: Theory and Practice*. Lanham, MD: Lexington Books (2015), pp. 1–29.

72. Cook EC. Perceived changes in peer relationships and behavioral health among college students during COVID-19. *J Am Coll Health*. (2022) 1–8. doi: 10.1080/07448481.2022.2106787

73. Song Q, Vicman JM, Doan SN. Changes in attachment to parents and peers and relations with mental health during the COVID-19 pandemic. *Emerg Adulth*. (2022) 10:1048–60. doi: 10.1177/21676968221097167

74. Tambelli R, Cimino S, Marzilli E, Ballarotto G, Cerniglia L. Late adolescents' attachment to parents and peers and psychological distress resulting from COVID-19. A study on the mediation role of alexithymia. *Int J Environ Res Public Health*. (2021) 18:10649. doi: 10.3390/ijerph182010649

75. Theeke LA, Mallow J, Gianni C, Legg K, Glass C. The experience of older women living with loneliness and chronic conditions in Appalachia. *J Rural Mental Health*. (2015) 39:61. doi: 10.1037/rmh0000029

76. Douglas KM, Uscinski JE, Sutton RM, Cichocka A, Nefes T, Ang CS, et al. Understanding conspiracy theories. *Polit Psychol*. (2019) 40:3–35. doi: 10.1111/pops.12568

77. Eisma MC, Tamminga A, Smid GE, Boelen PA. Acute grief after deaths due to COVID-19, natural causes and unnatural causes: an empirical comparison. *J Affect Disord*. (2021) 278:54–6. doi: 10.1016/j.jad.2020.09.049

78. Gang J, Falzarano F, She WJ, Winoker H, Prigerson HG. Are deaths from COVID-19 associated with higher rates of prolonged grief disorder (PGD) than deaths from other causes? *Death Stud*. (2022) 46:1287–96. doi: 10.1080/07481187.2022.2039326

79. Khoury B, Barbarin O, Gutiérrez G, Klicperova M, Padakannaya P, Thompson A. (2022). Complicated grief during COVID-19: An international perspective. *Int Perspect Psychol*. 11:214–221. doi: 10.1027/2157-3891/a000055

80. Cleaveland CL, Frankenfeld CL. Household financial hardship factors are strongly associated with poorer Latino mental health during COVID-19. *J Racial Ethnic Health Disparit*. (2022) 1–14. doi: 10.1007/s40615-022-01366-8

81. Goins RT, Anderson E, Minick H, Daniels H. Older adults in the United States and COVID-19: a qualitative study of perceptions, finances, coping, and emotions. *Front Public Health*. (2021) 9:660536. doi: 10.3389/fpubh.2021.660536

82. Athapathu A, Navaratnam D, Doluweera M, Liyanage G. Child emotional and behavioral difficulties and parent stress during COVID-19 lockdown in Sri Lankan families. *PLoS ONE*. (2022) 17:e0271757. doi: 10.1371/journal.pone.0271757

83. Kamoshida S, Nihonmatsu N, Takagi G, Wakashima K. The relationship between family variables and family social problems during the COVID-19 pandemic. *PLoS ONE*. (2022) 17:e0270210. doi: 10.1371/journal.pone.0270210

84. Öksüz EE, Kalkan B, Can N, Haktanir A. Adult mental health and loneliness during the COVID-19 pandemic in late 2020. *Eur J Psychol Open*. (2021) 80:1–13. doi: 10.1024/2673-8627/a000001

85. McQuaid RJ, Cox SM, Ogunlana A, Jaworska N. The burden of loneliness: implications of the social determinants of health during COVID-19. *Psychiatry Res*. (2021) 296:113648. doi: 10.1016/j.psychres.2020.113648

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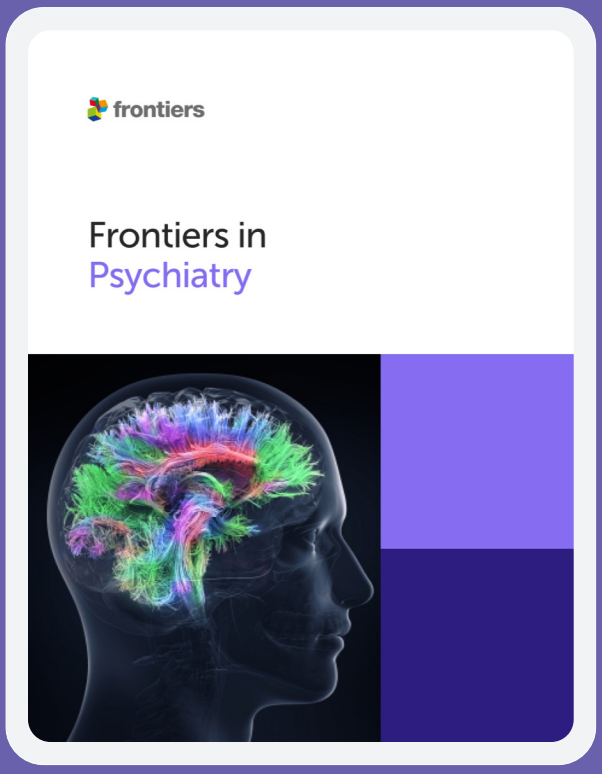

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