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Disaster-related psychiatric disorders: assessment, recovery, intervention

Edited by
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Published in
Frontiers in Psychiatry
Frontiers in Public Health

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ISSN 1664-8714
ISBN 978-2-8325-6214-7
DOI 10.3389/978-2-8325-6214-7

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Disaster-related psychiatric disorders: assessment, recovery, intervention

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Citation

Fu, W., Wang, C., Law, S., Gan, Y., eds. (2025). *Disaster-related psychiatric disorders: assessment, recovery, intervention*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-6214-7

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frontiers | Frontiers in Psychiatry

TYPE Editorial
PUBLISHED 25 March 2025
DOI 10.3389/fpsyt.2025.1586458

Check for updates

OPEN ACCESS

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RECEIVED 02 March 2025
ACCEPTED 04 March 2025
PUBLISHED 25 March 2025

CITATION
Law SF (2025) Editorial: Disaster-related psychiatric disorders: assessment, recovery, intervention.
Front. Psychiatry 16:1586458.
doi: 10.3389/fpsyt.2025.1586458

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Editorial: Disaster-related psychiatric disorders: assessment, recovery, intervention

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KEYWORDS

PTSD, resilience, disaster, trauma, public health

Editorial on the Research Topic
Disaster-related psychiatric disorders: assessment, recovery, intervention

Studies of the 9/11 attack in the US have led to new critical understanding and insights into disaster psychiatry, highlighting screening, trauma responses, long-term mental health impacts, and intervention strategies. Related research have paved the way to increased public awareness of Post-Traumatic Distress Disorder (PTSD) and their impact on survivors, first responders, and families (1). There have also been renewed focus on early intervention efforts, and mindfulness that PTSD often exacerbate previous vulnerabilities and typically coexists with other mental illness such as depression, anxiety, and substance use disorders (2), calling for integrated treatment approaches (3). It has also pointed to long-term effects of PTSD, affecting some survivors with persistent mental health challenges, and how symptoms sometimes worsen over time (4). The field has learned to shift towards more community-based interventions, resilience training, and development of more mental health programs tailored to trauma care (5).

In this Research Topic: *Disaster-Related Psychiatric Disorders: Assessment, Recovery, Intervention*, researchers have continued to expand our knowledge in disaster and trauma related effects, studying numerous man-made and natural disasters, with Covid-19 being a global threat as another important backdrop. While the current understanding is that disasters and their impacts are highly heterogeneous (6), these studies contribute nuanced new knowledge that are informative to the field at large.

In Lee et al. studies of bereaved families from a fairy disaster in Korea, they showed long-term prevalence of PTSD symptoms in family members who lost loved ones, and highlighted how psychological state of optimism are protective against PTSD, but being avoidant and isolative worsened such. The presence of these factors likely reflect both personal and cultural attributes, providing potential area of foci in treatment and support. Addressing another disaster, studies by Berthail et al. on the Paris attack in 2015 drew newer attention to the fact that physical reactions to the traumatic event and tendency to engage in intrusive thoughts suppression are associated with elevated development of PTSD. These findings call for attention to both psychological and biological underpinnings

for PTSD, and could contribute to early screening success for those who will be vulnerable in developing PTSD. To focus on protective factors, First's study focused on disaster resilience, conceptualized as how various internal and external factors interact to influence an individual's ability to adapt and recover following exposure to a disaster. The knowledge that such factors related to resilience can modify development of PTSD and depression give rise to areas of interest for both population and clinical levels of intervention. The study also found that more exposure to disaster losses was associated with more resilience, so exposure to disaster is related to development of resilience itself, as intuitive as it may sound; however, there is some critical doses of such loss that can overwhelm an individual's resilience when the exposure levels are cumulative and ongoing (7), with an implication that timely and targeted support is critical in fostering resilience. Moving the field more upstream and using a preventative framework, Rizzi et al. have studied earthquake survivors in Morocco, particularly in a highly vulnerable population of pediatric cancer patients and caregivers, and advocated a focus on the communication, education, and having well defined disaster preparedness plans as a way to increase population health and resilience.

In a parallel world to the local and single event disasters, the Covid pandemic with its protracted and global impact at social, economical, and population health levels has trained a spotlight on the importance of disaster preparation and management. Out of this global disaster, a number of authors have contributed work to further our understanding on the manifested impact the pandemic has had. Yuan et al. have reported how the pandemic disaster could exacerbate a previously vulnerable and disadvantaged population living with HIV in a large Chinese sample of participants. Medved et al. remarked on increase in substance use and addictive behaviors in those with severe mental illness, occurring during the pandemic and compounded by the disaster of an earthquake in Croatia. The double-disaster predicted the acute need for special attention for those who are already vulnerable. Combined, these authors point to an importance of a more progressive, selective approach in protecting the most vulnerable during challenging times (8).

In other fronts, Teckchandani et al. examined those who were not known yet to be vulnerable, but found those with higher potential to have mental health concerns tend to be less likely to engage in some forms of proactive mental health training in a police cadet population that is known to face higher incidences of mental health challenge, including PTSD as part of their professional hazard. Their study is noteworthy for how to identify and engage in an upstream approach for health promotion and illness prevention. Another vulnerable group, by choice or by external factors is people with a history of migration. Renner et al. reviewed the relationship between migratory grief –defined as related to interpersonal, material and abstract losses - and psychopathology. Not surprisingly, migratory grief predicted depression and psychological distress, but their public health and social policy implications are ever more relevant in today's global political climate regarding immigration and resettlement issues. Lastly, taking on actual studies of refugee youth, Schumacher et al. examined PTSD and beyond in refugee minors in Germany, and found a large proportion over (40%) of the participants met diagnostic criteria for depression and many of whom showed comorbid PTSD diagnosis. They stressed the importance of recognizing latent depressive symptoms that develop from the original PTSD symptoms associated with the flight and stress as part of the refugee experience for many.

In summary, the Research Topic in disaster related psychiatric disorders expanded knowledge in assessment, understanding, and paved new paths towards more effective and tailored intervention, with aim to promote fuller recovery, particularly mindful of those who are already or known to be vulnerable. Studying these populations from the margins could ultimately help us to understand more on how to address disaster related mental health challenges for the general population at large.

Author contributions

SL: Conceptualization, Project administration, Writing – original draft, Writing – review & editing.

Conflict of interest

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

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 15 December 2023
DOI 10.3389/fpsyt.2023.1264875

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OPEN ACCESS

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RECEIVED 21 July 2023
ACCEPTED 06 November 2023
PUBLISHED 15 December 2023

CITATION
Medved S, Palavra IR, Gerlach J, Levaj S, Shields-Zeeman L, Bolinski F, Bradaš Z, Madžarac Z, Filipčić I and Rojnić Kuzman M (2023) Changes in substance use and engagement in gaming/gambling in persons with severe mental illness during the COVID-19 pandemic and earthquakes: a community study in two points.
Front. Psychiatry 14:1264875.
doi: 10.3389/fpsyt.2023.1264875

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Changes in substance use and engagement in gaming/gambling in persons with severe mental illness during the COVID-19 pandemic and earthquakes: a community study in two points

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Introduction: External stressors, such as COVID-19 pandemic and earthquake, can cause an increase in substance use and addictive behavior in persons with severe mental illnesses (SMI). We analyzed the changes and predictors of substance use and addictive behavior in SMI during these double disasters in Croatia.

Methods: Questionnaires exploring the presence of substance or behavior addiction disorder, mental ill health [Depression Anxiety Stress Scales-21 (DASS-21), Insomnia Severity Index (ISI), Perceived Stress Scale (PSS), Obsessive-Compulsive Inventory-Revised], coping mechanisms, and perceived social support [Multidimensional Scale of Perceived Social Support (MSPSS)] were administered among 90 participants with SMI included in the RECOVER-E study in May/June 2020 (first COVID-19 wave, Zagreb earthquake) and in December 2020/January 2021 (second COVID-19 wave, Petrinja earthquake).

Results: In both time points, a major increase was observed in tobacco smoking (25.0%; 28.6%, respectively) predicted by discontinuation of antidepressants and higher DASS-21 score. Increased sedative use was observed (24.4%; 23.8%, respectively) predicted by higher PSS and ISI scores, lower MSPSS scores, antipsychotic discontinuation and not receiving community mental health team (CMHT) service.

Discussion: In persons with SMI during a double disaster special attention needs to be given to reducing mental-ill health and stress, providing social support and continuity of psychiatric care, through medications and CMHTs.

KEYWORDS

addiction, COVID-19 pandemic, severe mental illness, earthquake, community mental health team (CMHT)

1 Introduction

The COVID-19 pandemic has necessitated the implementation of preventive measures, which have had a detrimental impact on mental health (1–3). Additionally, psychiatric services have faced significant reductions (4). Persons with severe mental illnesses (SMI) have shown to be highly sensitive to the changes brought by the COVID-19 pandemic (5).

Unfortunately, Croatia experienced two major earthquakes during the pandemic. On March 22nd, 2020, the capital of Croatia, Zagreb was struck by an earthquake measuring 5.5 on the Richter scale, causing extensive damage to numerous healthcare facilities (6). On December 29th, another earthquake measuring 6.4 on the Richter scale occurred near Zagreb, specifically in Petrinja, which is approximately 40 kilometers away (7). The impact of earthquake can exacerbate addictive behavior and influence the factors related to mental ill-health and the utilization of mental health services (8–10). Double disasters, such as the pandemic and earthquakes in this case, pose a unique challenge to the mental health of populations (11, 12). Globally, changing conditions directly affect the complexity of current and future disaster management issues (11). Previous research has underscored the necessity for special attention and long-term support in addressing the psychological impacts of double disasters (12, 13). Higher incidence of posttraumatic stress disorder, depression, and anxiety have been reported following such disasters (12, 13). Certain pre-existing psychiatric conditions, such as obsessive-compulsive disorder, may exhibit significant clinical worsening (14). Experiencing loss, displacement from one's place of residence, socio-economic challenges, lack of social support, and negative coping mechanisms, such as substance abuse, can induce psychological stress (13). Moreover, persons with SMI are particularly prone to experiencing higher levels of stress compared to the general population (15). They also inherently express a higher rate of certain psychoactive substances and behavioral addictive disorders (16). Discontinuation of pharmacological therapy may further exacerbate their condition (13). Therefore, the occurrence of a double disaster can potentially place persons with mental illnesses in an extremely vulnerable position.

The primary aim of this research is to examine changes in substance use and addictive behavior in persons with SMI during the first and second double disasters—the COVID-19 waves and the co-occurring earthquakes. Furthermore, we seek to explore mental ill-health, coping mechanisms, psychiatric treatment, and perceived social support as predictors of changes in substance use and addictive behavior.

2 Materials and methods

2.1 Study design

This research was conducted at the Department of Psychiatry and Psychological Medicine, University Hospital Centre (UHC) Zagreb, as part of the RECOVER-E project (Large-scale implementation of community based mental health care for people with severe and enduring mental ill health in Europe) (17, 18). The primary aim of the RECOVER-E study is to implement and evaluate a model of a community-based mental health service, community mental health teams (CMHTs), to people with SMI and compare it to the treatment as usual (TAU) at five different sites, including UHC Zagreb. The participants for RECOVER-E were consecutively recruited from 2018 at the UHC Zagreb if they were adults diagnosed with SMI (schizophrenia and other psychotic disorders, bipolar-affective disorder, or major depressive disorder) according to ICD-10 (International Classification of Diseases 10th Revision) and randomized in the group receiving CMHT or TAU. More details of the RECOVER-E study aims and design can be found elsewhere (17). RECOVER-E and this extension of the research were approved by the Ethics Committee of UHC Zagreb (class: 8.1-18/149-2, number: 02/21 AG).

The first measurement in this particular extension of the study was conducted from May to June 2020; in the midst of the first pandemic wave (19), and shortly after the Zagreb earthquake, during which a very stringent set of restrictions was introduced (20, 21). Inpatient treatment was provided only for emergency conditions (22, 23), and other services were transferred to telepsychiatry.

The second measurement in this extension was conducted during the second pandemic wave from December 2020 to January 2021 (19), and shortly after the Petrinja earthquake. At that point, mass vaccination program had started, and a soft lockdown was introduced (21). However, the overall health system was under much higher pressure compared to the first wave (20, 21). The acute psychiatric inpatient unit at UHC Zagreb was repurposed to COVID-19 ward, so all patients requiring hospitalization were transferred to another inpatient facility. Day hospitals resumed their work, whereas outpatient care continued with telepsychiatry and reduced in-person visits.

2.2 Participants

In May 2020, all RECOVER-E project participants in CMHT and TAU group were contacted and asked to engage in this additional research. Upon signing the informed consent, survey and questionnaires were administered by telephone. Participants could withdraw from the study at any time without any consequences on their participation in the main project. From March 2020 until the end of the project (February 2021), CMHT home visits were transformed to continuous telepsychiatry (online and telephone services) with occasional in-person interventions.

2.3 Materials

Survey and questionnaires were used for the assessment, which took up to 45 min for the completion. All the materials, except for the coping mechanism evaluation were applied in both time points. The materials were collected over the telephone by independent investigators (SM, JG, and SL) not involved in providing either CMHT or TAU. The investigators have been trained in applying questionnaires and collecting the data via telephone. During the study, the investigators were having regular meetings and consensually agreed on all questionnaires applied in the research.

2.3.1 Survey measures

The survey collected socio-demographics and medical information. Socio-demographic component collected the data on

age, sex, marital status, employment, education, and household. Information about psychiatric diagnosis, received service (TAU or CMHT), and psychiatric medication was obtained. Self-reported changes in substance use and addictive behavior was assessed with response categories "no consumption," "no changes in use," "increased use" or "decreased use" for use of alcohol, tobacco smoking, cannabis use, sedative use, and other drugs. Gaming and gambling use was assessed with response categories "never," "no changes in use," "more often use" or "less often."

2.3.1.1 Questionnaires

Questionnaires were used to assess the presence of addiction disorders, mental ill-health, coping mechanisms and perceived social support. All questionnaires were applied in Croatian language, using the validated versions of the questionnaires in Croatian population, apart from OCI-R and DASS-21, which were not previously validated. These two questionnaires were translated and back-translated into Croatian language by an English and Croatian native speaker.

The presence of alcohol, drug and gambling addiction disorders were assessed using standardized scales:

1. Alcohol Use Disorders Identification Test (AUDIT) is a 10-item questionnaire providing data on alcohol consumption, drinking behavior, and alcohol-related problems. A range from 1 to 7 suggests low-risk consumption; from 8 to 14 hazardous or harmful alcohol consumption and a score from 15 or more indicates the likelihood of alcohol dependence (24).
2. Drug Use Disorders Identification Test (DUDIT) is an 11-item self-administered screening instrument for substance abuse/harmful use and dependence according. If a male patient shows a score of 6 or more, or a female patients a score of 2 or more, he or she probably has drug related problems – either substance abuse/harmful use or dependence. If a patient (both genders) shows a score of 25 points or more, it is highly probable that he or she is dependent on one or more drugs (25).
3. The South Oaks Gambling Screen (SOGS) is a 20-item multiple-choice instrument that was introduced for identifying individuals with pathological gambling. Positive responses to 5 or more items indicate a "probable pathological gambler" (26).

Mental ill-health was assessed using questionnaires for exploring symptoms of depression, anxiety, stress, insomnia, and exacerbation of compulsive obsessive symptoms:

1. Depression Anxiety Stress Scales-21 (DASS-21) rates symptoms of depression, anxiety, and stress through 21 items rated from 0 (did not apply to me at all) to 3 (applied to me almost completely or most of the time). The depression subscale contains items related to hopelessness, depressed mood, feeling worthlessness of life, lack of interest and involvement in daily activities, anhedonia, and ideas of guilt. Anxiety is assessed by items about physical changes in the body, anxiety related to different life situations and subjective experience of fear. Stress is assessed by items about tension, irritability, and overreaction. The final score for each subscale provides four severity ranges: mild, moderate, severe, and extremely severe (27).
2. Insomnia Severity Index (ISI) is a seven-item questionnaire that assesses the quality of sleep in the past 2 weeks using a 5-point Likert scale (0–4). The following dimensions are evaluated: difficulties falling asleep, sleep maintenance, early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning and quality of life and distress caused by the sleep difficulties. The total score ranges from 0 to 28, and higher scores indicate greater sleep difficulties (28).
3. Perceived Stress Scale (PSS) is used to measure the degree to which situations in one's life are appraised as stressful. It consists of 10 items, using Likert's s Scale for scoring. The total score ranges from 0 to 40 with higher scores indicating higher perceived stress (29).
4. Obsessive-Compulsive Inventory – Revised (OCI-R) which is an 18-item instrument that uses the Likert scale (0–5) to assess experiences in everyday life that belong to spectrum of obsessive-compulsive disorder. The score range is between 0 and 72 (30).
5. Coping mechanisms were assessed using Brief Resilient Coping Scale (BRCS). BRCS quantifies the ability to recover from a stressful situation with respect to behavior and activities of the individual using a Likert scale (1–5). The total score ranges from 4 to 20 with higher score indicating high resilient coping (31).
6. Finally, the Multidimensional Scale of Perceived Social Support (MSPSS), a 12-item scale was used to measure perceived social support from three sources: family, friends, and a significant other on a scale from 1 (I do not agree at all) to 7 (I completely agree). The mean score for each subscale is calculated by summing across items from that subscale and then dividing by 4, with the score range from 1 to 7 (32).

All questionnaires were selected based on their good validity and reliability. We used the Croatian versions of AUDIT, DUDIT, SOGS, DASS-21, ISI, OCI-R, MSPSS and the English versions of PSS and BRCS.

2.3.2 Study outcomes

The primary outcome was the evaluation of changes in substance use and addictive behavior in persons with SMI in the first and second study point. The secondary outcome was the analysis of predictors of increased substance use and addictive behavior. The outcomes in the first and second time point were not compared directly, due to different circumstances that could have impacted outcomes of this study.

2.3.3 Statistical analysis

We calculated the required sample size for secondary outcomes with a targeted statistical power of 0.80, a significance level of $p < 0.05$, two tailed, for logistic regression, using the means and SD of quantitative variables (DASS) and the minimum odds ratio of 1.1. Under these conditions we needed up to 80 respondents. Anticipating around 10% of the data would be incorrectly collected, we estimated the initially required sample size to 90 participants. We calculated the required sample size using the G*Power version 3.1.9.4 (33). Descriptive analysis was used for sample description. For the primary outcome analysis, variables describing the changes in the use of substances and addictive behavior were recoded into binary variables "increased use" and "other" that combined those stable or with

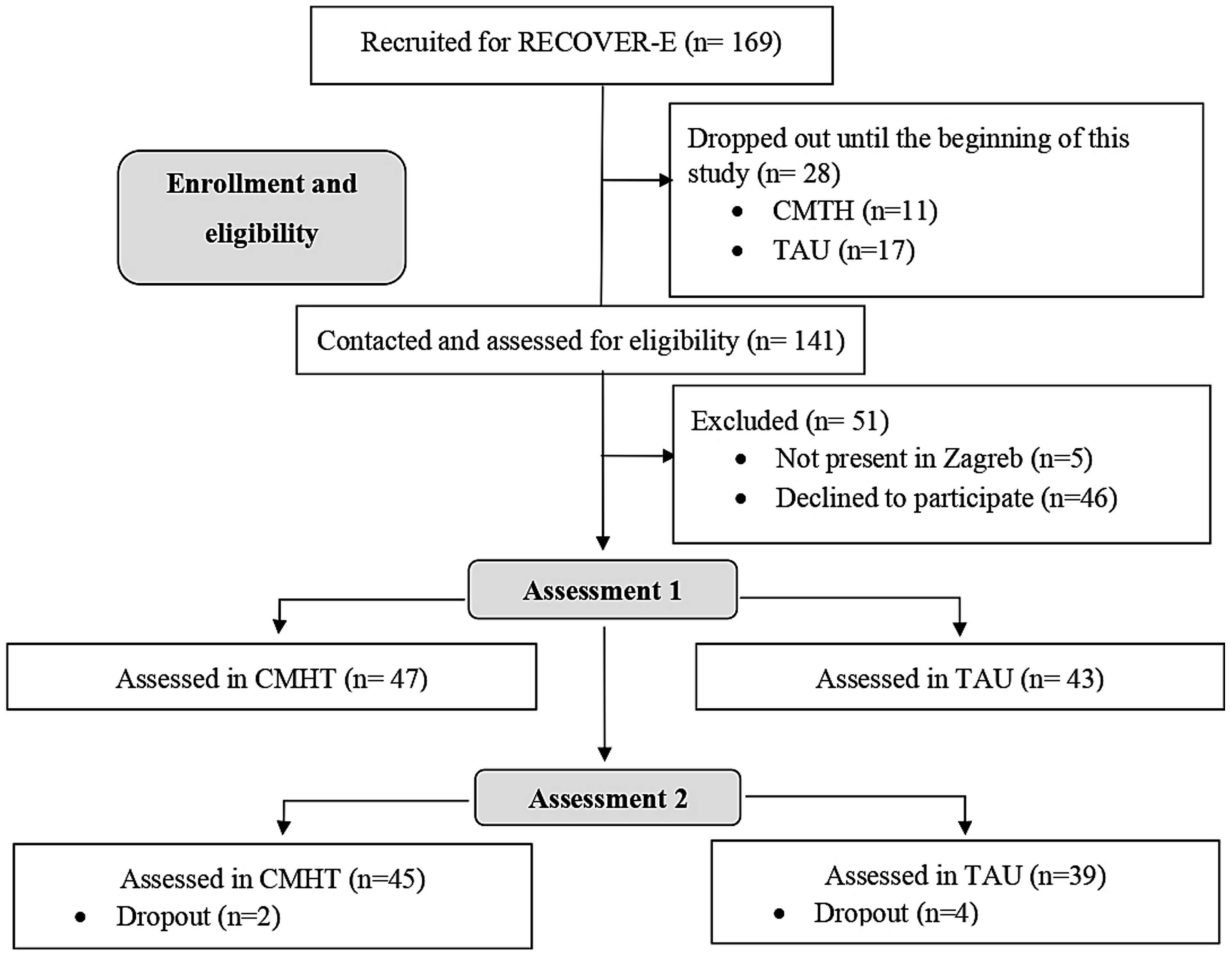
decreased use or addictive behavior due to the small sample size in one of the groups. Odds ratios were estimated through binary logistic regression to predict the increased use of these dependent variables by sex, age and variables indicating mental ill-health (PSP, OCI-R, ISI, DASS-21), coping styles (BRCS), support system (MSPSS), received psychiatric service (TAU or CMHT group), and psychiatric medications. The results were interpreted at the 5% significance level ($\alpha = 0.05$). The statistical program STATA/IC 15.1 Stata Corp LLC was used for statistical analysis. We used the False discovery rate (FDR) set at 5% to control the effect of multiple testing considering the primary and secondary outcomes testing (34).

3 Results

The sampling is shown in Figure 1. From overall 169 RECOVER-E participants, 90 participants engaged in the first measurement of this study. The assessment included 47 participants included in the CMHT group and 43 in TAU group. Altogether six participants dropped out in the second measurement: two in the CHMT group and 4 in the TAU group. There was no statistically significant difference between the control and intervention group (TAU vs. CMHT group) in socio-demographic and medical data, except in the use of long acting injectables (LAI) (CMHT group received LAIs more than TAU group). We refer the reader to another publication with more details about the population (35).

Table 1 shows baseline socio-demographic and medical data of the population and scores of questionnaires exploring the presence of substance or behavior addiction disorder, mental ill-health, coping mechanisms, and perceived social support in the first and second study point.

Within the sample, approximately 2.4% of participants ($N = 2$) were identified with harmful alcohol consumption and 3.4% ($N = 3$) with alcohol dependence using AUDIT, 1.2% ($N = 1$) with probable drug abuse using DUDIT and 5.8% ($N = 5$) with probable gambling problem using SOGS in the first assessment. In the second assessment, approximately 2.4% ($N = 2$) were showing harmful use of alcohol and 1.2% ($N = 1$) of participants were identified as alcohol dependent, 1.2%



Abbreviations: RECOVER-E study: Large-scale implementation of community based mental health care for people with severe and enduring mental ill health in Europe, CMHT: community mental health team, TAU: treatment as usual.

FIGURE 1
Flow chart of analysis sample.

TABLE 1 Baseline sociodemographic and medical data of participants ($N = 90$)*.

Variable	*N* (%)*
Socio-demographic characteristics	
Male	39 (43.3)
Age (years), mean (SD)*	41.9 (14.6)
Single/divorced	62 (68.9)
Employed	20 (22.7)
Finished high school	79 (90.8)
Living alone	12 (13.3)
Mean number of persons in household (SD)	2.7 (1.3)
Mean number of children in household (SD)	0.3 (0.7)
Psychiatric diagnosis	
Schizophrenia and other psychotic disorders	63 (70.0)
Major depressive disorder	19 (21.1)
Bipolar-affective disorder	8 (8.9)
Provided treatment	
CMHT	47 (52.2)
TAU	43 (47.8)
Psychiatric medication	
Oral antipsychotics	79 (88.8)
LAIs	23 (27.4)
Mood stabilizers	26 (29.2)
Antidepressants	33 (37.1)
Sedatives	56 (62.9)

Questionnaires overall scores		
Mean score (SD)*	1st assessment	2nd assessment ($N = 84$)
DASS-21	37.4 (32.8)	35.6 (30.6)
ISI	7.8 (6.4)	9.7 (6.2)
PSS	20.0 (6.0)	20.6 (5.2)
OCI-R	9.1 (10.3)	9.6 (10.1)
BRCS	12.6 (3.6)	–
Low coping (*N* (%))	43 (48.9)	–
Moderate coping (*N* (%))	39 (44.3)	–
High coping (*N* (%))	6 (6.7)	–
MSPSS significant others	5.1 (2.2)	5.4 (2.2)
MSPSS friends	4.8 (2.1)	4.9 (2.2)
MSPSS family	5.8 (1.6)	5.9 (1.6)
MSPSS		
High social support (*N* (%))	49 (56.9)	57 (69.5)
Moderate social support (*N* (%))	32 (37.2)	22 (26.8)
Limited social support (*N* (%))	5 (5.8)	3 (3.7)

*Unless otherwise specified. SD, standard deviation; CMHT, community mental health team; TAU, treatment as usual; LAI, long acting injectables; DASS-21, Depression Anxiety Stress Scales-21; ISI, Insomnia Severity Index; PSS, Perceived Stress Scale; OCI-R, Obsessive-Compulsive Inventory - Revised; BRCS, Brief Resilient Coping Scale; MSPSS, Multidimensional Scale of Perceived Social Support.

($N = 1$) were having probable drug abuse, while nobody identified as a pathological gambler. Since increased alcohol consumption, psychoactive substance use, gaming, and gambling measured by AUDIT, DUDIT and SOGS were reported by less than 5 persons, we did not include it in the further analyses.

The major increase was observed in the use of tobacco smoking and sedatives (Table 2). All data about self-reported changes in substance use and addictive behavior are presented in Table 2.

A higher DASS-21 score was a positive predictor of increased tobacco use in the second assessment ($p = 0.021$, OR 1.102, 95% CI 1.015–1.197). In the first assessment, increased sedative use was predicted in participants not receiving CMTH service, i.e., those in TAU group ($p = 0.031$, OR 8.225, 95% CI 1.208–56.015), by discontinuation in antipsychotic medications ($p = 0.010$, OR 0.020, 95% CI 0.001–0.386) and by higher PSS score ($p = 0.011$, OR 1.216, 95% CI 1.046–1.413). Higher ISI and MSPSS family subscale scores predicted higher sedative use in the second assessment ($p = 0.007$, OR 1.222, 95% CI 1.057–1.413; $p = 0.034$, OR 0.576, 95% 0.346–0.959, respectively). All results remained statistically significant even after adjustment with the FDR set at 5%. Details are shown in Table 3.

4 Discussion

The results of our study revealed a noteworthy increase in tobacco smoking and the use of sedatives among individuals with SMI during both instances of the double disaster. It is important to note that the frequency of psychoactive substance use in this sample was notably lower than what has been reported in previous literature (36). This disparity can be attributed to several factors, including the implementation of anti-COVID-19 measures, such as the "stay-at-home" national policy, which disrupted conventional sources of drugs and led to an observed increase in pricing (37). Drug availability is one of the important risk factors for addiction (38). Additionally, specific cultural standards regarding addiction within the socio-cultural model may have biased self-reporting (39).

Despite the relatively small number of individuals exhibiting harmful use and behavior in our sample, a significant increase in smoking and sedative use was evident at both study points, mirroring trends in the general population (40). Notably, a higher prevalence of tobacco smoking was already documented among individuals with SMI in the pre-pandemic time (41), amplifying their health burden (42). The increase in sedative use is also a cause for concern, given its association with a higher risk of mortality (43).

The use of tobacco was predicted by depression and anxiety symptoms and discontinuation of antidepressant use, whereas increased use of sedatives was predicted by insomnia, not- receiving CMHT treatment, discontinuation of antipsychotics, and perceived levels of stress and social support. High environmentally – induced stress contributes to mental-ill health and elicits different, sometimes maladaptive coping responses, including the use of substances (44). It is worth noting that environmental stressors, which can contribute to mental ill-health and maladaptive coping responses, including substance use, played a significant role in the context of the COVID-19 pandemic and earthquakes (44, 45). The documented increase in

TABLE 2 Assessment of self-reported changes of substance use and addictive behavior.

Self-reported substance use and addictive behavior	1st assessment (*N* = 90), *N* (%)	2nd assessment (*N* = 84), *N* (%)
Alcohol		
Do not use	75 (89.3)	76 (90.5)
No change	3 (3.6)	2 (2.4)
Increased	2 (2.4)	3 (3.6)
Decreased	4 (4.8)	3 (3.6)
Tobacco smoking		
Do not smoke	42 (50.0)	43 (51.2)
No change	13 (15.5)	9 (10.7)
Increased	21 (25.0)	24 (28.6)
Decreased	8 (9.5)	8 (9.5)
Cannabis		
Do not use	83 (92.2)	84 (100.0)
No change	6 (6.7)	0 (0.0)
Increased	0 (0.0)	0 (0.0)
Decreased	1 (1.1)	0 (0.0)
Drugs		
Do not use	83 (92.2)	83 (98.8)
No change	7 (7.8)	1 (1.2)
Increased	0 (0.0)	0 (0.0)
Decreased	0 (0.0)	0 (0.0)
Sedatives		
Do not use	34 (41.5)	50 (59.5)
No change	24 (29.3)	7 (8.3)
Increased	20 (24.4)	20 (23.8)
Decreased	4 (4.9)	7 (8.3)
Gaming		
Never	71 (78.9)	75 (89.3)
No change	9 (10.0)	2 (2.4)
More	7 (7.8)	7 (8.3)
Less	3 (3.3)	0 (0.0)
Gambling		
Never	81 (90.0)	75 (89.3)
No change	8 (8.9)	3 (3.6)
More	0 (0.0)	5 (5.9)
Less	1 (1.1)	1 (1.2)

depression, anxiety, and stress symptoms during these challenging times aligns with findings from other studies (46–48). Importantly, depression and anxiety symptoms have known associations with addictive behavior (46), while stress is independently associated with SMI (49). This heightened stress level not only exacerbates the risk of substance use and addictive behavior but also underscores the importance of effective mental health interventions, particularly in times of crisis.

Our study found that participants who reported receiving greater social support were at a lower risk of engaging in substance use. This finding aligns with previous research that has shown a significant relationship between the lack of social support and an increased risk of addiction during the pandemic (36). Social support plays a crucial role in promoting recovery (50) and can act as a protective factor against the negative impact of stigma and shame. This, in turn, has a positive effect on an individual's quality of life and mental health (51).

Psychiatric treatment has been shown to have a significant effect on tobacco and sedative use. Participants receiving CMHT treatment had a lower risk for substance use. CMHTs as an outreach service have been recognized as a valuable resource for persons with SMI and addictive disorders for many years (52). The availability of mental health services, such as CMHTs, has been shown to have multiple benefits. It can enhance treatment adherence, alleviate anxiety associated with the loss of service support, and provide essential medical advice (53). Notably, in some situations, CMHTs were the only accessible psychiatric service for individuals with SMI during the pandemic and earthquakes in Croatia (10). This highlights their pivotal role in ensuring continued care for the most severely affected patients, presenting a novel approach to healthcare during crises (54, 55). Furthermore, it is recommended that CMHTs should not be limited to pandemic times but should be sustained and expanded beyond such emergencies (56, 57). This model of care should be developed and implemented in countries where it does not currently exist (56, 57). There is a scarcity of studies examining the impact of the organization of psychiatric services, including CMHT services, on individuals with SMI during a pandemic or natural catastrophe. While a few examples exist (11, 12, 35, 58), further research in this area is warranted to better understand their role and effectiveness in crisis situations.

The discontinuation of antidepressant medications emerged as a predictor of increased tobacco use in our study. This finding is noteworthy considering that effective treatments for smoking cessation are currently available (59), and efforts to raise awareness about cessation strategies during the pandemic have been initiated (60). These results may indicate a potential gap in healthcare. Similarly, the increase in sedative use was predicted by the discontinuation of antipsychotic treatment. This could be explained by the shortfall of sleep induction (61). The discontinuation of psychiatric treatment is attributable to the lock-down measures and the disruption of the standard care in the assessment (35).

These results highlight the profound impact of external stressors on the unhealthy lifestyles of individuals with SMI. As mentioned earlier, individuals with SMI are inherently vulnerable, and additional burdens can significantly compromise their well-being (42, 43). Unfortunately, the anticipated rise in the frequency of natural disasters in the coming years (62) necessitates proactive measures.

During and after a natural disaster, the mental and physical health of marginalized populations, including those with SMI, is particularly at risk (63). Clinicians must be well-prepared and equipped with the skills and knowledge required to deliver continuous psychiatric care to individuals with SMI, especially in cases of double disasters. This includes the capacity to provide mental health services in the community, tailored to the specific needs of the SMI population, and in coordination with other essential public services, such as social services, labor services, and housing. Additionally, policymakers must prioritize emergency preparedness and response strategies tailored to

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TABLE 3 Predictors of the increase smoking and sedative use in participants.

Variable	Increased tobacco smoking					
	1st assessment ($N = 85$)			2nd assessment ($N = 79$)		
	p	OR	95% CI	*p*	OR	95% CI
Sex (female)	0.462	1.619	0.449–5.843	0.675	1.436	0.265–7.792
Age	0.573	1.013	0.968–1.060	0.700	0.989	0.935–1.046
No CMHT	0.225	0.451	0.124–1.633	0.236	0.372	0.073–1.906
Antipsychotics	0.978	1.027	0.151–7.006	0.342	0.380	0.051–2.802
LAI	0.459	0.597	0.153–2.335	0.222	0.329	0.055–1.960
Mood stabilizers	0.669	1.309	0.380–4.513	0.114	4.182	0.708–24.712
Antidepressants	0.964	0.971	0.274–3.442	**0.046**	**0.152**	**0.024–0.966**
Benzodiazepines	0.755	0.816	0.227–2.938	0.428	0.514	0.099–2.662
ISI	0.824	0.979	0.812–1.180	0.684	1.029	0.898–1.178
PSS	0.342	1.054	0.946–1.173	0.451	1.082	0.881–1.329
OCI	0.437	1.057	0.919–1.215	0.847	0.992	0.918–1.073
MSPSS others	0.538	1.019	0.959–1.083	0.283	0.750	0.443–1.269
MSPSS friends	0.812	1.008	0.942–1.080	0.270	1.398	0.770–2.537
MSPSS family	0.462	1.148	0.795–1.658	0.311	1.317	0.773–2.246
DASS-21	0.436	1.167	0.791–1.723	**0.021**	**1.102**	**1.015–1.197**
BRCS	0.787	1.063	0.684–1.651	0.323	0.890	0.706–1.122

Variable	Increased sedatives use					
	1st assessment			2nd assessment		
	p	OR	95% CI	*p*	OR	95% CI
Sex (female)	0.344	0.409	0.064–2.608	0.837	0.828	0.137–5.005
Age	0.323	0.971	0.915–1.030	0.543	1.018	0.961–1.079
No CMHT	**0.031**	**8.225**	**1.208–56.015**	0.137	4.170	0.634–27.444
Antipsychotics	**0.010**	**0.020**	**0.001–0.386**	0.601	2.489	0.081–76.194
LAI	0.066	6.227	0.887–43.696	0.692	0.669	0.092–4.879
Mood stabilizers	0.255	0.304	0.039–2.368	0.712	1.396	0.238–8.206
Antidepressants	0.839	0.839	0.154–4.568	0.903	1.109	0.211–5.835
Benzodiazepines	0.878	1.167	0.163–8.371	0.971	0.966	0.150–6.215
ISI	0.844	1.029	0.777–1.362	**0.007**	**1.222**	**1.057–1.413**
PSS	**0.011**	**1.216**	**1.046–1.413**	0.814	0.979	0.819–1.170
OCI	0.704	0.963	0.792–1.171	0.865	1.007	0.927–1.094
MSPSS others	0.119	1.076	0.981–1.181	0.076	1.940	0.933–4.032
MSPSS friends	0.222	0.940	0.851–1.038	0.145	0.646	0.359–1.163
MSPSS family	0.426	1.215	0.753–1.960	**0.034**	**0.576**	**0.346–0.959**
DASS-21	0.416	1.242	0.737–2.091	0.831	1.008	0.936–1.086
BRCS	0.833	1.062	0.609–1.850	0.215	0.870	0.698–1.084

OR, odds ratio; CI, confidence interval; CMHT, community mental health team; LAI, long acting injectables; DASS-21, Depression Anxiety Stress Scales-21; ISI, Insomnia Severity Index; PSS, Perceived Stress Scale; OCI-R, Obsessive-Compulsive Inventory - Revised; BRCS, Brief Resilient Coping Scale; MSPSS, Multidimensional Scale of Perceived Social Support. Bold values indicate statistically significant value ($p < 0.05$).

the needs of vulnerable populations during crises (63). Given the far-reaching impacts of natural disasters, cross-national responses may be necessary. This was especially evident during the pandemic, underlining the crucial role played by international associations and informal organizations in alleviating the effects of traumatic events. They have the potential to develop scientifically universal guidelines and algorithms specifically designed for persons with SMI, applicable to various domestic circumstances at every level. With well-structured

preventive measures in place for persons with SMI, the risks to their well-being can be significantly mitigated.

4.1 Limitations

First, many of the measures used in this study are based on self-report, as there is a lack of more objective measures for assessing the true consumption of substances. Secondly, the absence of research data collected before the outbreak of the pandemic and earthquakes, using the same standardized scales, prevents us from confirming that the observed results are a direct consequence of the COVID-19 pandemic and/or earthquakes. Other unmeasured factors may have influenced the outcomes. Furthermore, the cross-sectional design of the study limits our ability to establish causality between the pandemic, earthquakes, and substance abuse/addictive behavior. The study also does not address the longer-term effects of the COVID-19 pandemic. Some effects of the disruption of mental health care and the impact of stressors may become more apparent after a more extended period. Lastly, the sample size of participants in this study was relatively small, which may limit the ability to perform advanced statistical analyses or draw generalizable conclusions. Future research with larger sample sizes would be beneficial in confirming and extending these findings.

5 Conclusion

In conclusion, in a case of a double disaster, additional health burden due to tobacco smoking and sedative use in persons with SMI needs to be foreseen. To counteract the effect, special attention needs to be given to reducing mental-ill health and stress, providing social support and continuity of psychiatric care, through both medications and CMHTs.

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 humans were approved by the Ethics Committee of University Hospital Centre Zagreb. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – review & editing, Writing – original draft. IRP: Supervision, Writing – review & editing. JG: Investigation, Writing – original draft, Project administration, Writing – review & editing. SL: Conceptualization, Data curation, Investigation, Methodology, Project administration, Writing – review & editing. LS-Z: Funding acquisition, Resources, Supervision, Writing – review & editing. FB: Software, Writing – review & editing. ZB: Investigation, Writing – review & editing. ZM: Investigation, Project administration, Writing – review & editing. IF: Writing - review and editing, Supervision. MR: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This work was supported by the European Union's Horizon 2020 research and innovation programme under grant agreement no. 779362, RECOVER-E "Large-scale implementation of community based mental health care for people with severe and enduring mental ill health in Europe."

Acknowledgments

We are grateful to all participants in the RECOVER-E project, for their time and devotion to participate in this research.

Conflict of interest

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

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frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 05 January 2024
DOI 10.3389/fpubh.2023.1306414

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RECEIVED 03 October 2023
ACCEPTED 18 December 2023
PUBLISHED 05 January 2024

CITATION
Yuan GF, Qiao S and Li X (2024) Bridging internalized HIV stigma and depressive symptoms among people living with HIV in China during the COVID-19 pandemic: a network analysis.
Front. Public Health 11:1306414.
doi: 10.3389/fpubh.2023.1306414

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Bridging internalized HIV stigma and depressive symptoms among people living with HIV in China during the COVID-19 pandemic: a network analysis

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Previous research has documented that HIV-related stigma may be a significant trigger of mental health problems among people living with HIV (PLWH). However, less is known about how internalized HIV stigma is linked to depressive symptoms among PLWH during the COVID-19 pandemic. The current study sought to explore the network structure of internalized HIV stigma and depressive symptoms, along with bridge nodes, to elucidate how they co-exist. Participants were 1,197 Chinese PLWH (64.3% male, M_{age} = 41.52, SD = 9.20) who completed the measurements of internalized HIV stigma and depressive symptoms during the early phase of the COVID-19 outbreak (May 2020). Results revealed that "ashamed of having HIV" was identified as the most central nodes in the internalized HIV stigma network, whereas "mind wandered during tasks" ranked highest on centrality in the depressive symptoms network. Two bridge connections were exhibited within the combined internalized HIV stigma and depressive symptoms network model: "inferiority due to HIV" and "gloomy feelings" from internalized HIV stigma and depressive symptoms communities, respectively. This study is one of the first to examine the co-occurrence of internalized HIV stigma and depressive symptoms in the context of the COVID-19 pandemic using a network approach. These findings have potential clinical implications for mitigating depressive symptoms in populations facing socioeconomic disadvantage and vulnerability.

KEYWORDS

internalized HIV stigma, depressive symptoms, PLWH, COVID-19, network analysis

1 Introduction

The COVID-19 pandemic has underscored the intersection of public health crises and mental health challenges, particularly among disadvantaged and vulnerable populations such as people living with HIV (PLWH) (1). The added strain of the pandemic has exacerbated mental health problems, particularly depressive symptoms, among this group (2). Depressive symptoms, including persistent sadness, lack of interest in daily activities, cognitive difficulties, and physical malaise, are prevalent in PLWH due to the chronic nature of their condition (3–5). These symptoms may be exacerbated by the stressors and uncertainties of the COVID-19 pandemic, such as increased social isolation, fear of increased vulnerability to the virus, and disruptions in health care services (6, 7). A recent systematic review and

meta-analysis study found that the pooled prevalence rate of (moderate-to-severe) depressive symptoms among PLWH during the COVID-19 was 16.9% [95% confidence interval (CI): 3.8–30.0%] (6). Winters and colleagues compared the prevalence of depression among PLWH in Shinyanga region, Tanzania before and during COVID-19 and found substantially higher prevalence of depression (prevalence differences: 38; CI: 34, 42) (8). Given the existing health complications and increased risk of mental health issues, understanding the interplay between predictive factors and depressive symptoms among PLWH during COVID-19 is of paramount importance to enable more tailored and effective interventions for this population.

Internalized HIV stigma has been found to be one of the most significant risk factors of depressive symptoms among PLWH (9, 10). This stigma involves the incorporation of negative societal attitudes about HIV, resulting in self-disparagement, feelings of rejection and guilt (11). The harmful self-perceptions that individuals hold may serve as a direct antecedent to depressive symptoms. This occurs as individuals cultivate a negative self-concept and engage in harmful self-evaluations (12). In support of Meyer's minority stress theory, which emphasizes the consequential role of stigma in generating psychological distress, individuals who belong to disadvantaged minority groups, such as PLWH, exhibit greater susceptibility to both external and internal stressors (13). These stressors are inextricably intertwined with instances of stigma and discrimination, making PLWH more vulnerable to depressive symptoms than their non-HIV peers (13).

Simultaneously, the COVID-19 pandemic may exacerbate internalized HIV stigma in addition to depressive symptoms (14). The additional stigma associated with the pandemic may intersect with and reinforce existing HIV-related stigma, exacerbating depressive symptoms (2). Because of their interrelated nature, understanding the complex relationship between internalized HIV stigma and depressive symptoms in PLWH during the COVID-19 pandemic is critical. Internalized stigma may exacerbate depressive symptoms through feelings of isolation, self-blame, and anticipated rejection. Conversely, the presence of depressive symptoms may increase the experience of internalized stigma, as individuals may further blame themselves for their condition (15). Additionally, existing evidence suggests that several underlying problems experienced by PLWH during COVID-19 may exacerbate the incidence of internalized stigma and depressive symptoms. For example, a scoping review of 45 articles found that several factors were related to increased psychological distress during the pandemic, including substance use, social support, financial hardship, antiretroviral adherence, and economic vulnerability (16). A recent qualitative study revealed that medical mistrust among PLWH might be associated with HIV stigma during the COVID-19 pandemic (17). It is therefore important for HIV researchers to explore the potential relationship between internalized HIV stigma and depressive symptoms during the pandemic in this population.

Although numerous empirical studies have documented the strong association between internalized HIV stigma and depressive symptoms, there is still a research gap regarding the network analysis model between internalized HIV stigma and depressive symptoms among PLWH during the COVID-19 pandemic. In this study, we attempted to use a novel analytical method—psychometric network analysis—to explore the relationship between these two variables in the context of the COVID-19 pandemic.

In contrast to traditional approaches that treat internalized HIV stigma and depressive symptoms as latent variables that are independent of each other, network analysis offers an alternative methodology capable of visualizing and quantifying the complexity inherent in such a system of interrelated variables (18–21). It provides a detailed understanding of these complex interactions and sheds light on the interplay between internalized HIV stigma and depressive symptoms within a larger context of psychosocial factors (22, 23). Using network analysis, elements of internalized HIV stigma and depressive symptoms are conceptualized as "nodes," while the relationships between these elements are referred to as "edges" (24). When these nodes coexist within a population, they are considered to be directly connected. These critical links that serve as conduits between internalized HIV stigma and depressive symptoms are referred to as "bridges" in the network model (25).

Applied to the context of PLWH, this methodology can highlight specific attributes of internalized HIV stigma or specific depressive symptoms that exert a significant influence within the network. This identification is important for intervention development, as strategies can be tailored to address these key nodes, potentially leading to a more profound system-wide impact. In addition, network analysis helps to demystify the potential pathways linking internalized HIV stigma and depressive symptoms. Understanding these pathways is useful in creating predictive models, allowing clinicians and researchers to anticipate the progression of these symptoms based on network models (26). Such insights could provide timely indications for intervention, potentially averting further psychological distress. Therefore, network analysis can serve as a valuable tool for understanding and addressing the intertwined relationship between internalized HIV stigma and depressive symptoms among PLWH. By providing a nuanced and targeted understanding of this relationship, it can inform more effective strategies to alleviate psychological distress during challenging public health crisis in the future.

1.1 The current study

In the present study, we utilized network analysis to construct three different models: a network for internalized HIV stigma, a network for depressive symptoms, and a combined network model that includes both internalized HIV stigma and depressive symptoms. The objective was to identify critical "bridging nodes" that is the fundamental elements providing connections between internalized HIV stigma and depressive symptoms. Because network analysis is fundamentally a method for revealing key relationships within and across groups of nodes, we did not hypothesize about the particular nodes or edges that might emerge as central in these network models.

2 Materials and methods

Data were drawn from a large cohort research project that attempted to explore the behavioral and mental health problems of PLWH in Guangxi, China (15, 27). The data were collected from May 2020 to October 2020. In collaboration with the Guangxi Center for Disease Control and Prevention (CDC), a strategic selection of study sites was made to conduct the research. We identified six hospitals and clinics in five cities based on their high numbers of HIV patients under care. This selection allowed us to focus on the sites with the largest HIV patient populations, thereby increasing the scope and

relevance of our study. All participants were recruited from these local HIV clinics according to their medical records. This study was designed with precise inclusion criteria for participants: individuals who are aged between 18 and 60, diagnosed with HIV/AIDS, and have no plans to relocate from Guangxi for subsequent follow-up investigations lasting more than 12 months. Excluded from participation were those with language, mental, or physical impairments that might affect their ability to respond to assessment questions; those currently detained or institutionalized for drug use or involvement in commercial sex; or those intending to leave the province within the next year. In total, the study included 1,197 PLWH who successfully completed the survey. Sample demographics are shown in Table 1.

Ethical approval to conduct this study was granted by the Institutional Review Boards of University of South Carolina. The study procedures were fully disclosed to all participants, who were informed of the purpose of the study, the confidentiality of their responses, and their rights as participants. This information included their freedom to withdraw from the study at any time. After providing informed consent, participants were asked to complete a questionnaire administered by an interviewer. The interview-style questionnaires were administered by nurses trained by experts with more than 10 years of research experience with PLWH. In recognition of their contribution to the study, participants were offered an incentive of US$5.00 (equivalent to approximately 35 RMB, the Chinese currency).

TABLE 1 Sample characteristics (n = 1,197).

Variables	*M* (SD) or *n* (%)
Age	41.52 (9.20)
Sex	
Female	427 (35.7%)
Male	770 (64.3%)
Ethnic group	
Han	779 (65.1%)
Other	418 (34.9%)
Residence	
Urban	535 (44.7%)
County	111 (9.3%)
Township	120 (10.0%)
Rural	428 (35.8%)
Marital status	
Never married	323 (27.0%)
Unmarried—living with partner	25 (2.1%)
Married	641 (53.6%)
Married—separated	36 (3.0%)
Divorced	93 (7.8%)
Widowed	67 (5.6%)
Education	
Primary school	217 (18.1%)
Middle school	467 (39.0%)
High school	238 (19.9%)
College	228 (19.0%)
Other	47 (3.9%)
Employment status	
Unemployed	221 (18.5%)
Part-time	235 (19.6%)
Full-time	732 (61.2%)
Monthly household income (CNY)	
0–999	122 (10.2%)
1,000–1,999	247 (20.6%)
2,000–2,999	350 (29.2%)
3,000–3,999	234 (19.5%)
4,000–4,999	93 (7.8%)
5,000 or more	148 (12.4%)

The number of participants for some variables does not add up to the total sample size due to missing data.

2.1 Measures

2.1.1 Depressive symptoms

Depressive symptoms were assessed by a Chinese version of the Center of Epidemiological Studies Depression Scale (CESD-10) (28). The questionnaire contains 10 items, each rated on a four-point scale from 1 (rarely or none of the time) to 4 (all the time). Sample items include "I had trouble keeping my mind on what I was doing" and "My sleep was restless." This questionnaire has shown good reliability and construct validity in Chinese samples (29, 30). A higher total score indicates a higher level of depressive symptoms. Cronbach's alpha reliability for the CESD-10 in this study was 0.81.

2.1.2 Internalized HIV stigma

The assessment of internalized HIV stigma was conducted using an adapted Chinese version of eight items from the Negative Self Image Scale (31). Previous research with Chinese PLWH has demonstrated satisfactory validity and reliability for the Chinese version of this questionnaire (32, 33). Examples of the items include, "Having HIV makes me feel like I'm a bad person" and "I feel guilty because I have HIV." This instruction consists of eight items, each rated on a four-point scale from 1 (strongly disagree) to 4 (strongly agree). A higher total score indicates a higher level of internalized HIV stigma. In the current study, the scale demonstrated excellent internal consistency, Cronbach's alpha reliability was 0.94.

To ensure relevance to the COVID-19 context, we supplemented these with some COVID-19-specific instructions. This approach allowed us to capture the nuanced ways in which the pandemic has affected depressive symptoms and internalized stigma, despite the generic nature of these instruments.

2.2 Data analysis

Data management, univariate statistics, and network analyses were performed using SPSS 23.0 and R software version 4.2.2. Analyses of the distributions of internalized HIV stigma and depressive symptoms indicated that they did not deviate significantly from normality. Specifically, assessments of skewness and kurtosis-measures were used to describe the shape and distribution of the

data-indicated nominal deviations. The absolute values for skewness ranged from 0.01 to 2.19, while those for kurtosis ranged from 0.05 to 5.66. These results suggest that the data for internalized HIV stigma and depressive symptoms were reasonably well distributed, allowing for the subsequent use of parametric statistical methods (34).

We implemented the graphical Least Absolute Shrinkage and Selection Operator (LASSO) method to establish regularized partial correlation networks (24). These networks were then visualized using the *qgraph* package (35). We assessed the centrality of each node within these networks by calculating the Expected Influence (EI), an effective centrality index. This step allowed us to identify the most influential nodes within each network model (36). In our approach, we created separate regularized partial correlation networks for internalized HIV stigma and depressive symptoms. We then merged these into a combined network model to examine their potential coexistence (20, 37). To understand the interplay between internalized HIV stigma and depressive symptoms within the combined network model, we used the *networktools* package. This tool facilitated the calculation of the Bridge Expected Influence (BEI), which allowed us to identify which nodes served as "bridges" between these two phenomena (38). Nodes with the highest BEI values were designated as bridge nodes in this model (38). To ensure the reliability of our network models, we used the *bootnet* package. We performed 1,000 case-dropping bootstraps to calculate the correlation stability coefficient (CS-coefficient), which measures the stability of each network model (39). Following previous researchers' suggestions (24, 40), we used a CS-coefficient cutoff of 0.25 and set the default value for the bootstrapping procedure at $r = 0.7$.

3 Results

Descriptive statistics for this study, including means, standard deviations, and intercorrelations of the variables of interest, are detailed in Table 2. In addition, Table 3 describes the names of the nodes used in the network analysis for internalized HIV stigma and depressive symptoms, and presents univariate statistics for each node.

3.1 Internalized HIV stigma network model

Figure 1 provides a visualization of the network structure of internalized HIV stigma, including the EI value for each node. The stability of the internalized HIV stigma network model is confirmed by acceptable CS-coefficients for edge weights [CS (cor = 0.7) = 0.75] and EI values [CS (cor = 0.7) = 0.74], according to the stability criteria (24). Within this model, the symptom "Ashamed of having HIV" (IHS2) emerged as the most influential node, followed by "Self-degradation due to HIV" (IHS5). The symptom with the least centrality was "HIV stigma worsens self-perception" (IHS8). The strongest edges were between "HIV self-perceived badness" (IHS1) and "Ashamed of having HIV" (IHS2), and between "HIV-associated guilt" (IHS6) and "HIV-related disgust" (IHS7). Supplementary Figure S1 shows the standardized estimates of node strength, betweenness, closeness, and expected influence, while Supplementary Figure S2 shows the bootstrapped confidence intervals (CIs) for the edge weights.

TABLE 2 Means, standard deviations, and correlations among study variables.

	$M \pm SD$	1	2
1. Internalized HIV stigma	16.31 ± 5.46	–	0.25***
2. Depressive symptoms	16.73 ± 4.17	0.25***	–

Left/bottom triangle is the Pearson's correlations of all study variables, right/top triangle is the partial correlations of all the variables adjusted by age, sex, and monthly household income. ***$p < 0.001$.

3.2 Depressive symptoms network model

The network model of depressive symptoms is shown in Figure 2, with edge weights [CS (cor = 0.7) = 0.75] and EI values [CS (cor = 0.7) = 0.75] confirming a stable network model of depressive symptoms. The symptom "Mind wandered during tasks" (DEP2) occupied the most central node in the network, while "Negative future optimism" (DEP5) held the position of the least central symptom. The strongest edge within the depressive symptoms network was found between "Negative future optimism" (DEP5) and "Unhappiness" (DEP8). Supplementary Figure S3 details the standardized estimates for node strength, betweenness, closeness, and expected influence, and Supplementary Figure S4 provides the bootstrapped confidence intervals (CIs) for the edge weights.

3.3 Combined internalized HIV stigma and depressive symptoms network model

Figure 3 presents the combined network model that connects internalized HIV stigma and depressive symptoms. The stability of the model is confirmed by CS-coefficient values for edge weights [CS (cor = 0.7) = 0.75] and for BEI values [CS (cor = 0.7) = 0.48]. Within this combined network model, the nodes "Inferiority due to HIV" (IHS4) from the internalized HIV stigma community and "Gloomy feelings" (DEP3) from the depressive symptoms cluster were highlighted as bridge nodes owing to their highest one-step BEI values. The metrics of node strength, betweenness, closeness, and expected influence are standardized and represented in Supplementary Figure S5. Furthermore, Supplementary Figure S6 illustrates the bootstrapped confidence intervals (CIs) corresponding to the edge weights.

4 Discussion

In this study, network analysis was utilized to explore the network structures of internalized HIV stigma, depressive symptoms, and their interactions in a large sample of 1,197 Chinese PLWH during the COVID-19 pandemic. This investigation is innovative because, to our understanding, it is the first to explore network models of internalized HIV stigma and depressive symptoms. It also examines the possible co-occurrence of internalized HIV stigma and depressive symptoms and identifies the bridge between these two psychological phenomena among the marginalized and vulnerable population.

TABLE 3 Descriptions and univariate statistics for network nodes.

Node	Item content	*M*	SD
IHS1	HIV self-perceived badness	2.06	0.81
IHS2	Ashamed of having HIV	2.10	0.83
IHS3	Unclean feeling due to HIV	2.03	0.81
IHS4	Inferiority due to HIV	2.13	0.84
IHS5	Self-degradation due to HIV	1.92	0.76
IHS6	HIV-associated guilt	1.95	0.80
IHS7	HIV-related disgust	1.89	0.78
IHS8	HIV stigma worsens self-perception	2.23	0.88
DEP1	Unusual bothersomeness	1.27	0.53
DEP2	Mind wandered during tasks	1.37	0.62
DEP3	Gloomy feelings	1.42	0.67
DEP4	Increased effort in tasks	1.43	0.69
DEP5	Negative future optimism	2.48	1.10
DEP6	Experiencing fear	1.40	0.63
DEP7	Restless sleep	1.57	0.77
DEP8	Unhappiness	2.59	1.00
DEP9	Loneliness	1.60	0.75
DEP10	Lack of motivation	1.59	0.75

Our study provides valuable insights into the network structure of internalized HIV stigma and depressive symptoms among PLWH during the COVID-19 pandemic. One of the key findings was that "ashamed of having HIV" emerged as the most central node within the internalized HIV stigma network, indicating its pivotal role in the interconnected system of stigma-related experiences. This suggests that shame associated with HIV diagnosis may significantly influence other stigma-related experiences and contribute to the overall burden of internalized stigma. Such a finding is consistent with previous research highlighting the detrimental effects of shame on individuals' self-esteem and psychological well-being (41–44). The central role of shame in the internalized HIV stigma network underscores the need for interventions that specifically target and mitigate feelings of shame associated with an HIV diagnosis, especially when PLWH are facing public health crises. Our research recognizes that some components of internalized HIV stigma, such as the centrality of "ashamed of having HIV," are not limited to the COVID-19 outbreak. Nonetheless, our investigation specifically sheds light on how the exceptional difficulties presented by the pandemic could have intensified and influenced these persistent factors of stigma and depression in individuals living with HIV. The COVID-19 pandemic has led to several challenges for PLWH, including amplified feelings of shame, guilt, and depressive symptoms due to increased social isolation, heightened health anxieties, and disruptions in healthcare services. Our network analysis, while based on established measures, contextualizes these phenomena within the specific challenges faced by PLWH during COVID-19, underscoring the pandemic's impact on their mental health.

The centrality of "mind wandered during tasks" in the depressive symptoms network highlights the impact of cognitive dysfunction on PLWH's daily functioning and mental health status. This finding aligns with previous research showing that cognitive difficulties are a common symptom of depression that can exacerbate other depressive symptoms and impede overall recovery (45–48). Cognitive difficulties can interfere with an individual's ability to effectively engage in self-care behaviors, interpersonal interactions, and other activities critical to managing HIV and maintaining good mental health (49–51). Additionally, the process of mind wandering is often associated with a lack of focus, decreased productivity, and an overall diminished ability to engage in the present moment, all of which are common characteristics of depression (52–54). Frequent mind wandering may indicate a struggle to manage or control thoughts, which can lead to an increased experience of depressive symptoms (55, 56). Within the context of the COVID-19 pandemic, this finding suggests that pandemic-induced stressors, such as prolonged isolation and health anxiety, significantly worsen cognitive disruptions. Specifically, these factors have intensified PLWH's difficulty in maintaining focus on daily tasks, a key aspect of depressive symptomatology.

Our network analysis also identified two critical bridge connections between the internalized HIV stigma and depressive symptoms communities—"inferiority due to HIV" and "gloomy feelings." These bridge nodes suggest a reciprocal influence between these two psychological constructs, where feelings of inferiority due to HIV may lead to or exacerbate gloomy feelings, and vice versa. The bridge node "inferiority due to HIV" suggests that feelings of inferiority due to HIV status may act as a link between stigma and depressive symptoms. It may be that individuals who internalize societal stigma about HIV begin to perceive themselves as less than others because of their HIV status (57, 58). This sense of inferiority could subsequently trigger or exacerbate depressive symptoms. Inferiority could potentially lead to negative self-esteem and lack of self-worth, key aspects often associated with depressive states (59–64). On the other hand, "gloomy feelings" serving as a bridge node indicates that these symptoms are not only a consequence of internalized HIV stigma, but could also potentially feed back into the internalized HIV stigma cycle. Depression can lead to a negative cognitive bias, in which individuals interpret their experiences more negatively (65–67). Therefore, those with depressive symptoms may perceive their HIV status in a more negative light, thereby increasing the internalization of HIV stigma.

These bridge nodes highlight the possible bidirectional and complex relationship between internalized HIV stigma and depressive symptoms, suggesting a potentially cyclical and self-perpetuating system. The more an individual feels inferior because of their HIV status, the more susceptible they may become to depressive symptoms. In turn, these depressive symptoms could further increase feelings of stigma, creating a reinforcing loop. Recognizing the role of "inferiority due to HIV" and "gloomy feelings" as bridge nodes illuminates pathways through which HIV stigma and depressive symptoms may interact and influence each other. This insight underlines the importance of addressing both internalized HIV stigma and depressive symptoms in a holistic and integrated manner in mental health interventions, particularly in the context of the COVID-19 pandemic, which has exacerbated both of these challenges for PLWH.

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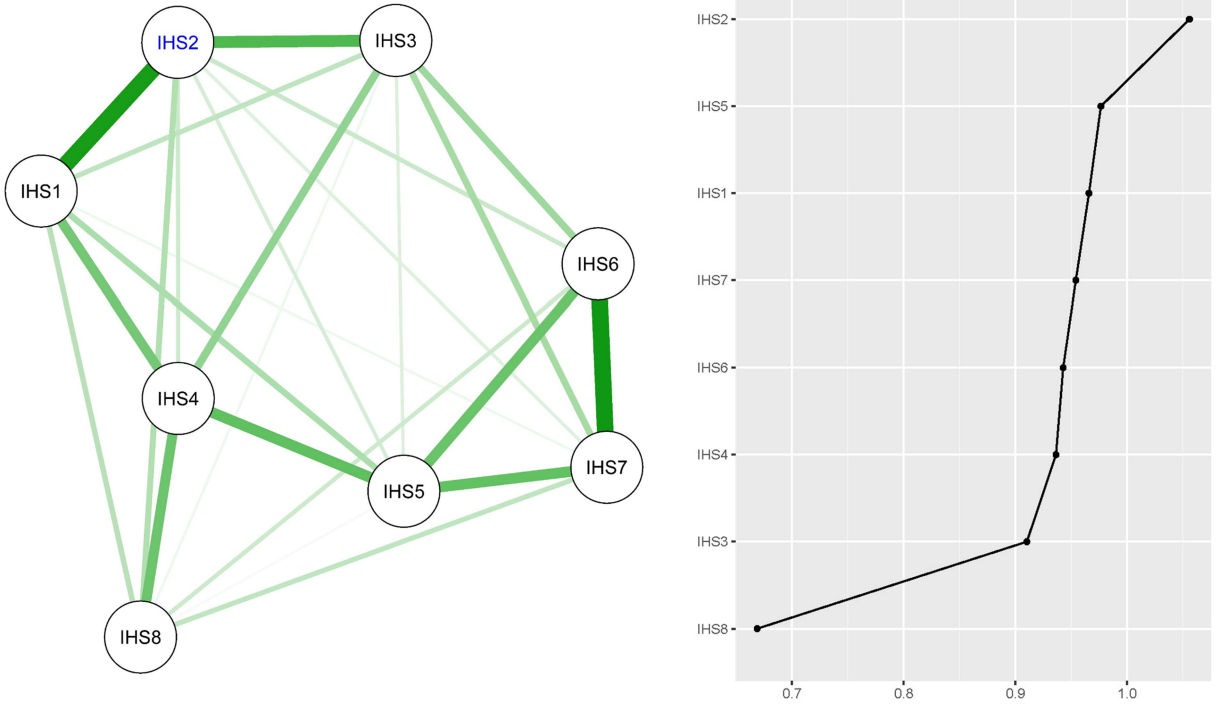

FIGURE 1
Regularized partial correlation network model for internalized HIV stigma (IHS) and expected influence (EI) values for each node. Node with largest EI value is represented by blue text (IHS2).

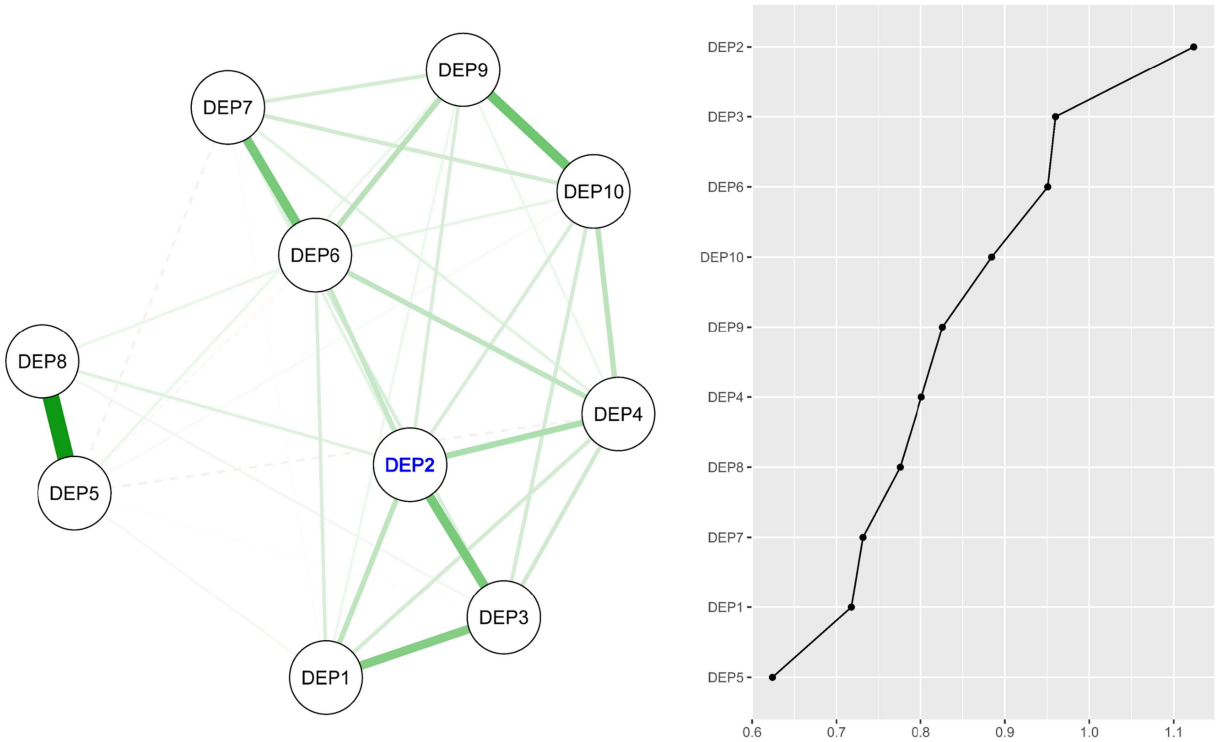

FIGURE 2
Regularized partial correlation network model for depressive symptoms (DEP) and expected influence (EI) values for each node. Node with largest EI value is represented by blue text (DEP2).

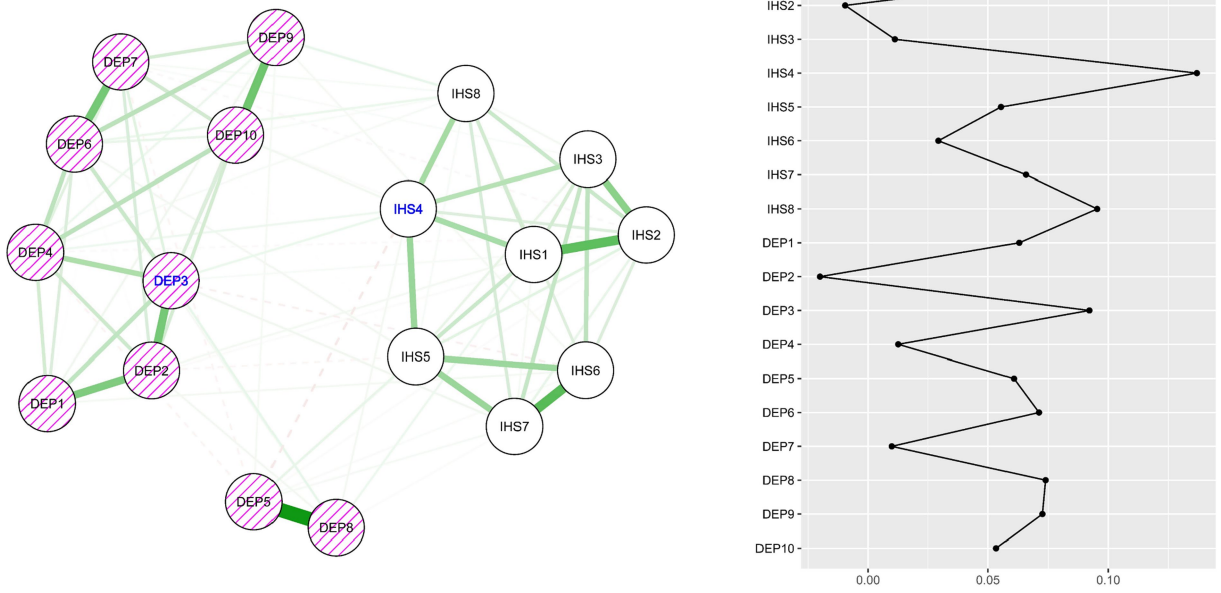

FIGURE 3
Combined regularized partial correlation network model for internalized HIV stigma (IHS) and depressive symptoms (DEP3) and bridge expected influence (BEI) values for each node. Bridge nodes with large BEI values are represented by blue text (IHS4 and DEP3).

4.1 In the context of COVID-19

Our study utilized network analysis to investigate the patterns of internalized HIV stigma and depressive symptoms among PLWH during the COVID-19 pandemic. The results revealed that "ashamed of having HIV" and "mind wandered during tasks" played central roles in the networks of internalized stigma and depressive symptoms, respectively. These findings underscore the significant influence of shame and cognitive dysfunction on the experiences of individuals living with HIV during the pandemic. Notably, the findings suggest that "inferiority due to HIV" and "gloomy feelings" play a critical role as bridge nodes, reflecting a potential bidirectional influence between internalized HIV stigma and depressive symptoms. The results suggest that the COVID-19 pandemic may have intensified these experiences, exacerbating the sense of inferiority and gloominess among people living with HIV. These findings highlight the intricate relationship between internalized HIV stigma and depressive symptoms during the pandemic, emphasizing the necessity for comprehensive and integrated mental health interventions. It is critical to address both internalized stigma and depressive symptoms, particularly given the supplementary stressors caused by COVID-19, including heightened social isolation and health anxieties.

4.2 Limitations and implications

Several limitations of this study must be acknowledged. First, the cross-sectional design of the study limits our ability to make causal inferences regarding the temporal characteristics and directional effects of associations between internalized HIV stigma items and depressive symptoms (18, 19). While our findings provide a preliminary empirical basis for future hypotheses, further longitudinal and experimental studies are needed to explore the temporal sequences and potential causal relationships between these psychological phenomena (20, 21). Second, the study relied on self-reported data, which may be susceptible to response bias. Future research would benefit from using multiple data collection methods, such as observer ratings, structured diagnostic interviews, and mixed methods, to minimize potential bias. Third, it should be noted that in the current study, we used the CESD-10 to assess participants' depressive symptoms. Measurements with diagnostic function are recommended in future research exploring network analysis regarding depression in PLWH. Finally, the interpretation of which bridge symptoms are significant may be influenced by subjectivity, as bridge centrality does not necessarily indicate effect size (68). Therefore, additional research is needed to clarify the role and interpretation of bridge centrality in the context of internalized HIV stigma and depressive symptoms.

Despite the limitations, our research has significant implications for future strategies in public health and medical practice. In particular, this study highlights "inferiority due to HIV" and "gloomy feelings" as key bridging elements linking internalized HIV stigma and depressive symptoms among Chinese PLWH during the COVID-19 crisis. Expanding on these findings, understanding the central role of these bridge elements may provide a new focus for health professionals in addressing mental health concerns among PLWH. Therapeutic interventions should aim to address feelings of inferiority associated with HIV and manage depressive symptoms, such as cognitive behavioral therapy-based and mindfulness-based interventions (69–72). This approach can potentially break the cycle of stigma and depressive emotions, thereby improving mental health outcomes for this population (71–73). In a broader public health

context, these findings highlight the need for stigma reduction initiatives. Programs aimed at improving societal attitudes toward HIV and providing mental health support to those affected could play an important role in reducing both internalized HIV stigma and related depressive symptoms (74). Increasing the availability and accessibility of mental health services for people living with HIV could help manage depressive symptoms more effectively (75). The health care community could use these findings to develop specific tools and resources to facilitate the management of feelings of inferiority and depressive symptoms among PLWH. This could include the development of psychosocial support groups, cognitive-behavioral interventions, or resilience-building programs tailored specifically for PLWH (74). Finally, our findings suggest that depression measurement in PLWH, particularly in the context of the COVID-19 pandemic, may benefit from the inclusion of items that capture the nuanced influence of HIV-related stigma on depressive symptoms and from a greater focus on symptom-specific measurement. These considerations could improve the accuracy and utility of depression measurement, thereby informing more effective interventions for this population. In addition, the implications of our study extend beyond the COVID-19 pandemic. The structures of internalized HIV stigma and depressive symptoms that we identified, along with their interactions, provide valuable insights for mental health interventions in any prolonged crisis or epidemic setting among PLWH. Understanding these intricate relationships aids in customizing strategies for alleviating depressive symptoms and internalized stigma, ultimately leading to improved mental health outcomes. This information is crucial for upcoming public health responses and mental health support structures, guaranteeing their suitability and efficiency during both pandemic and post-pandemic periods.

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 humans were approved by the Institutional Review Board of University of South Carolina. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

GY: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft. SQ: Data curation, Investigation, Project administration, Resources, Supervision, Writing – original draft. XL: Data curation, Funding acquisition, Project administration, Resources, Supervision, Writing – original draft.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. The research was supported by National Institutes of Health (NIH)/National Institutes of Mental Health (NIMH) (Grant no. R01MH0112376).

Conflict of interest

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

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1306414/full#supplementary-material

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frontiers | Frontiers in Public Health

TYPE Perspective
PUBLISHED 09 January 2024
DOI 10.3389/fpubh.2023.1319850

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OPEN ACCESS

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RECEIVED 11 October 2023
ACCEPTED 26 December 2023
PUBLISHED 09 January 2024

CITATION
Rizzi D, Ciuffo G, El Gour F, Erradi J, Barone L and Ionio C (2024) Perspectives on early insights: pediatric cancer caregiving amidst natural calamities – A call for future preparedness.
Front. Public Health 11:1319850.
doi: 10.3389/fpubh.2023.1319850

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Perspectives on early insights: pediatric cancer caregiving amidst natural calamities – A call for future preparedness

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Natural disasters cause immense damage and disruption to the environment, human lives, and property, posing a threat to safety and well-being. These disasters annually affect individuals and communities, severely impacting mental health. Research indicates a significant link between catastrophic events and an increased risk of mental disorders, including anxiety, depression, substance use, and post-traumatic stress disorder (PTSD). Individuals with chronic conditions, like cancer patients, are particularly vulnerable post-disaster due to disrupted healthcare services. The recent earthquake in Morocco highlighted the urgent need for continued care, especially for vulnerable populations living in poverty. Soleterre Foundation's interventions focus on supporting young cancer patients and their families, emphasizing psychological support following the earthquake. Effective disaster response needs coordinated efforts, clear roles, communication, and standardized healthcare procedures, especially for vulnerable groups like cancer patients. Education programs for patients and clinicians are vital for disaster preparedness. Communication challenges and lack of medical history further emphasize the need for well-defined disaster preparedness plans and continued care guidelines for cancer patients.

KEYWORDS

natural disaster, earthquake, Morocco, mental health, cancer, healthcare

Introduction

A natural disaster is a catastrophic event that occurs due to natural processes of the Earth, resulting in significant damage, destruction, and disruption to the environment, human life, and property. These events are often sudden, intense, and uncontrollable, causing widespread devastation and posing a threat to the safety, well-being, and livelihoods of affected populations. Disaster is defined by the World Health Organization (WHO) as a sudden ecological catastrophe or a phenomenon that necessitates outside help (1). Every year, disasters strike, adversely affecting individuals and communities, ultimately undermining their mental health and well-being (2). A recent systematic review and meta-analysis (3) suggested that experiencing a catastrophic disaster is connected to an elevated risk of mental disorders in the general population. The main mental health disorders associated with the disaster catastrophe in most of the studies included were generalized anxiety disorder (GAD), depression,

substance use disorder, adjustment disorder, and post-traumatic stress disorder (PTSD). The prevalence rates for these mental health disorders ranged from 5.8 to 87.6%. Moreover, the likelihood of experiencing psychological morbidity heightened due to the relocation and disruption of essential services. During the first year following a disaster, psychological morbidity commonly afflicts approximately 30 to 40% of the population, and there's a probability of a lingering disease burden becoming chronic (4, 5). However, there's a scarcity of research concerning the influence of disasters on psychopathology (5).

Within the context of natural disasters, the health system is crucial in saving lives and providing social support to vulnerable individuals (6). The initial responses after a disaster emphasize the provision and distribution of critical needs like food, shelter, water, and meeting other essential requirements for the affected population. This includes managing injuries resulting from the disaster, as well as responding to and treating infectious diseases and acute conditions (7). Among those affected by these events, individuals with chronic conditions, such as patients with cancer, stand out as a particularly vulnerable group, facing a range of issues post-disaster (8, 9). Indeed, in the wake of medical facilities collapsing and the overwhelming burden on remaining hospitals and healthcare centers, ensuring continued care for chronic patients became a paramount issue (10). Indeed, insufficiently managed chronic conditions can pose a risk to the community's life and overall well-being immediately following such disasters. However, historically, their treatment has not been acknowledged as a priority in public health or medicine (11). Individuals battling chronic conditions, such as cancer face numerous obstacles and diverse requirements during and following disasters. It's essential for cancer care to persist throughout these challenging times. Cancer represents an ongoing global challenge (12). According to a recent analysis conducted by the Global Burden of Disease, there were an estimated 17.2 million new cancer cases and 10 million cancer deaths globally, in 2019 (13). While the rates of cancer occurrence vary from one country to another, it represents a shared burden across all societies (14, 15). For this reasons, the health system should prioritize bolstering hospital surge capacity and ensuring the availability of human, financial, and medical equipment resources to effectively address catastrophic conditions (16).

Morocco earthquake: what impact on the health system?

The powerful earthquake that hit Morocco's High Atlas Mountains the 8 September 2023 had a magnitude of 6.8, which is the biggest to hit the North African country in 120 years. As reported by the news (17), the earthquake resulted in a tragic loss of life, claiming the lives of at least 2.946 individuals, primarily in Marrakech and five provinces near the earthquake's epicenter, as reported by Morocco's interior ministry. Furthermore, a minimum of 5.674 individuals suffered injuries, with 1.404 in critical condition, according to officials. The final count of casualties is likely to rise considerably, given the challenges faced by rescue teams in reaching remote mountain villages that bore the brunt of the devastation due to obstructed roads strewn with boulders. The World Health Organization (WHO) conveyed that the earthquake has impacted over 300.000 individuals across the nation.

The healthcare access for the Moroccan population has significantly expanded in under 15 years, although there remains a substantial journey ahead to attain Universal Health Coverage (UHC) (18). The Ministry of Health and Social Protection in Morocco (MSPS: Ministère de la Santé et de la Protection Sociale) has implemented a diverse range of strategies and interventions. These efforts primarily revolve around addressing the Social Determinants of Health (DSS) to enhance the overall health of the Moroccan populace and diminish regional disparities and health inequalities. However, much effort is still needed to reduce such inequities (19). Indeed, a quantitative survey on access to care carried out between 2010 and 2011 highlighted how over 80% of the participants found it very challenging to access healthcare facilities. Moreover, the quality of care was rated as substandard or insufficient (20).

Much of the population affected by the earthquake lives in deep poverty. With hospitals severely overstretched because of the earthquake, it is difficult to predict how continuity of care, including psychological care, will be ensured for the chronically ill.

Soleterre foundation intervention in Morocco

Soleterre Foundation is a non-profit foundation and non-governmental organization (NGO) that has been operating in Morocco since 2002, where it runs an international paediatric oncology programme in collaboration with the Mohammed VI Hospital, in Marrakech, which represents the hub for the whole south of Morocco. Soleterre's community home shelter (*Dar Amal House*), opened in 2022 in Marrakech, near Mohammed VI Hospital, accommodates young cancer patients and their families who otherwise often must travel up to 1,500 km to reach the hospital and undergo chemotherapy treatment. The house commonly hosts 30 patients and their families. After the earthquake, many children from the affected neighboring villages were hosted by Soleterre and the home currently accommodates 49 children (aged between 2 and 15 years) with an oncological disease. Soleterre provides psychological support to these children and their families, as well as managing these logistical aspects. Currently, in the aftermath of the earthquake, the Foundation's goal is to train local psychologists to provide psychological support in the hospitals and villages affected, addressing the country's shortage of trained psycho-oncologists. Indeed, the impact of possible multiple traumas, cancer and the earthquake, on the mental health of these children should not be underestimated at this particular time.

Getting started

In the few days after the earthquake, Soleterre Foundation started to collect some first raw data about the caregivers' conditions and well-being. Data collection was conducted in an emergency situation, so the sample size was not predetermined. Participants were given the opportunity to decline participation in the study, which was consistent with ethical standards of research practice. They were repeatedly assured that participation in the study would not affect the services they received. Respondents were first asked to provide sociodemographic information, questions related to the earthquake

experience (such as location and its impact), the number of days caregivers spent at the hospital, and their knowledge about future accommodations—particularly relevant given the loss of homes for most participants. The assessment of caregivers' mental health status was conducted encompassing various domains (i.e., anxiety, depression, coping mechanisms). These inquiries were presented in an interview format, allowing caregivers to express their feelings openly and share their experiences of suffering. Soleterre psychologists crafted the questionnaire by drawing on their observations within the pediatric service and considering how the earthquake impacted the individuals involved. In developing the questions, they closely examined the unique situations and challenges faced by people affected by the earthquake within the pediatric service. The aim was to tailor the questionnaire to capture the specific experiences and emotions of caregivers.20 caregivers were interviewed, the sample size was determined by the capacity of the service, which accommodated 20 families. Their main socio-demographic characteristics are summarized in Table 1.

Table 2 summarises the caregivers' responses regarding their mental health status.

Caregivers showed a deep concern for the health of their loved ones. However, their enduring faith in religion and spirituality played a crucial role in strengthening their psychological resilience in the midst of the disaster.

Conclusion

These initial data suggest the need for early and targeted intervention to prevent long-term psychopathological outcomes, particularly given the impact that caregivers' mental health can have on the young oncological patients. From these raw preliminary data, the quality of sleep seems to play a significant role in how individuals cope with and recover from traumatic situations. Traumatic events can cause disruptions in sleep patterns and overall sleep quality, which can, in turn, affect both physical and mental health. Indeed, addressing sleep-related issues and promoting good sleep hygiene are vital components of trauma recovery and mental health treatment. Therapeutic approaches that focus on improving sleep quality can contribute significantly to the overall well-being and resilience of individuals who have experienced traumatic events. It is important to note that trauma represents a complex situation that needs all-encompassing care. While improving sleep quality is crucial, trauma healing involves many other factors as well. It's also necessary to address other symptoms like depression, anxiety, and post-traumatic stress disorder (PTSD) with the right therapies and support systems. Indeed, a recent systematic review and meta-analysis (3) suggests that the most common long-term consequences of a disaster are anxiety, GAD and PTSD. Over time, people are affected by disasters in different ways; some people report increased symptoms of anxiety and PTSD (21). Others argue that exposure to a single event or a series of them raised the likelihood of psychological morbidity in similar manners (22). The majority of the studies showed that anxiety, depression, and PTSD were more common psychological diseases associated with temporary housing and evacuation. In addition to relocation, a rise in mental illness was noted as a result of the disruption of essential services, employment, or education (23–26). To successfully address the effects of trauma on mental health, caregivers and young patients with cancer must get holistic treatment that incorporates a variety of therapy modalities. This may involve creating specialized support groups for both patients and caregivers, implementing counseling services tailored to the unique needs of this population, and developing clear protocols for local healthcare professionals to identify and address psychosocial challenges promptly. Moreover, to establish a comprehensive "protective shield" that effectively lessens the impact of socio-ecological shocks, it is crucial to assess both the protective capabilities and shortcomings within the systems. Indeed, the presence of family members can transform adversity into a source of strength, as they contribute to the creation of a meaningful universe. Consequently, the family plays a vital role in serving as an anchor for identification and emotional stability (27). While researchers have traditionally recognized the detrimental effects of acute stress, recent studies have adopted a resilience approach (28, 29). These investigations underscore that traumatic experiences may result in dysfunction, but families can endure, recover, and even prosper in the aftermath of adverse events (30). As emerged by our preliminary data, religion and faith can serve as powerful coping strategies in various ways, providing individuals with a sense of meaning, comfort, and support during challenging times. In applying this knowledge, mental health professionals should approach discussions of religion and faith with sensitivity, respect, and cultural competence. Tailoring interventions to align with an individual's belief system and incorporating religious or spiritual practices into therapeutic approaches can enhance the effectiveness of coping strategies rooted in faith. Additionally, fostering an open dialog about the role of religion in coping can contribute to a more holistic and person-centered approach to mental health care.

Moreover, while our preliminary findings emphasize the importance of addressing sleep-related issues in the aftermath of the earthquake, it is crucial to underscore additional critical considerations highlighted during our early observations. Indeed, in the wake of the disaster, Soleterre caught the urgent need to strengthen local mental health resources, particularly focusing on the scarcity of trained psycho-oncologists in the country. The earthquake exposed a

TABLE 1 Caregivers' socio-demographic characteristics.

Socio-demographic characteristics	Value
Age (mean years ± SD)	49.29 ± 14.70
Nationality (%)	
Moroccan	100
Region (%)	
Marrakech Safi Al Haouz	100
Marital Status (%)	
Married	85
Widow	15
Number of children (mean years ± SD)	3.60 ± 1.231
Days spent at the hospital (mean years ± SD)	5.79 ± 2.463
Relatives left behind at the village (%)	
Yes	65
No	35

TABLE 2 Cargivers' mental health status.

Mental health status	Value
Anger (%)	
Low	30
Moderate	25
High	45
Fear (%)	
Low	15
Moderate	50
High	35
Restlessness (%)	
Low	10
Moderate	50
High	40
Anxiety (%)	
Low	15
Moderate	50
High	35
Sadness (%)	
Low	/
Moderate	30
High	70
Sleep quality (%)	
Sleep well	35
Suffer from insomnia	65

significant gap in mental health resources, with the shortage of trained psycho-oncologists emerging as a pressing issue. Soleterre Foundation's commitment to training local psychologists signifies a crucial step toward building sustainable and resilient mental health infrastructure. This intervention not only responds to the immediate needs of caregivers and young oncological patients post-disaster but also lays the groundwork for enhanced preparedness in the face of future calamities. Building local capacity in psycho-oncology is essential for providing ongoing and specialized mental health support to cancer patients and their caregivers, particularly in this situation. The scarcity of trained psycho-oncologists in Morocco is a systemic challenge that requires a multifaceted approach. Soleterre Foundation's intervention could serve as a model for organizations and policymakers, highlighting the importance of investing in local training programs and initiatives. Collaborative efforts between NGOs, governmental bodies, and educational institutions can contribute to the development of a sustainable framework for mental health care, not only during emergencies but also in routine healthcare settings. In light of the resource limitations in this region of Morocco, it's imperative to consider practical and realistic solutions for optimizing care for oncology and pediatric oncology patients. While the call for more psycho-oncologists is a valid concern, it may not be the sole solution given the constraints. Leveraging existing resources, partner with local universities and educational institutions to develop specialized training programs in psycho-oncology could enhance the skills of current professionals and create a sustainable pipeline of expertise. Using telemedicine, the feasibility of virtual consultations for psycho-oncology support could be explored. This can extend the reach of mental health services to remote areas, overcoming geographical barriers. It could also be possible to develop online training programs for healthcare professionals and caregivers, making resources accessible beyond physical constraints. Moreover, launch public awareness campaigns to educate the community about the psychological needs of oncology patients and the available support services may reduce stigma, encourage early intervention, and foster a supportive environment.

To guarantee an efficient response, it is essential to synchronize disaster preparedness efforts with all involved parties, establish clearly defined roles, and outline procedures. Clinicians need thorough education regarding disaster response and appropriate care for cancer patients amidst and following disasters. Additionally, it is imperative to create guidelines for maintaining regular care for cancer patients in adverse situations. Following disasters, communication becomes severely constrained, affecting interactions among healthcare providers, between providers and their patients, and among provider agencies and governmental bodies (31). To ensure effective treatment for cancer patients, it is crucial to have reliable communication channels and standardized health protocols (32). Another significant hurdle is the absence of medical records for cancer patients and limited information on cancer treatment in catastrophic scenarios, posing challenges for patient-caregiver interactions. To address this and enhance preparedness, there is a critical need to formulate an action plan that outlines essential care for cancer patients, aligning with established guidelines. Furthermore, educational programs on disaster preparedness should be conducted for both patients and clinicians.

Data availability statement

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

Author contributions

DR: Conceptualization, Investigation, Methodology, Project administration, Supervision, Writing – review & editing. GC: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. FE: Investigation, Writing – review & editing. JE: Investigation, Writing – review & editing. LB: Writing – review & editing. CI: Conceptualization, Data curation, Methodology, Resources, Supervision, Visualization, Writing – original draft, Writing – review & editing.

Funding

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

Conflict of interest

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

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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TYPE Brief Research Report
PUBLISHED 17 January 2024
DOI 10.3389/fpubh.2024.1272909

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RECEIVED 04 August 2023
ACCEPTED 03 January 2024
PUBLISHED 17 January 2024

CITATION
First JM (2024) Post-traumatic stress and depression following disaster: examining the mediating role of disaster resilience.
Front. Public Health 12:1272909.
doi: 10.3389/fpubh.2024.1272909

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Post-traumatic stress and depression following disaster: examining the mediating role of disaster resilience

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The current study used structural equation modeling to examine the role of disaster resilience as a mediator between disaster exposure and post-traumatic stress and depressive symptoms among a sample of 625 U.S. adults who experienced a disaster event. Results found that disaster resilience mediated the relationship between disaster exposure as a predictor and depression and post-traumatic stress as dependent variables. These findings have important implications for understanding the mechanisms by which disaster resilience supports post-disaster mental health and can inform future disaster mental health interventions and practice models.

KEYWORDS

disaster, mental health, resilience, depression, PTSD

Introduction

Environmental threats such as natural and human-caused disaster events (e.g., tornados, hurricanes, floods, oil spills) are increasing in prevalence and severity in the United States and worldwide. Between 2000 and 2019, approximately 510,837 individuals have died and 3.9 billion people have been affected by disasters (1). Disasters and other environmental threats pose profound risks to human well-being and cause widespread mortalities, morbidities, property loss, and reduced access to food, water, and housing (1). Furthermore, they can contribute to adverse psychological risks and behavioral health disorders, including substance use, depression, anxiety, and post-traumatic stress disorder (2, 3). After a disaster, it is common for people to experience a range of emotional and mental health difficulties, including stress, anxiety, fear, and grief. These effects can be short-term, such as increased stress and anxiety in the immediate aftermath of the disaster, or more long-term, such as the development of post-traumatic stress disorder (PTSD) and depression (3).

Various factors have been found to place individuals more at risk for developing depression and PTSD following disasters. Prior research [e.g., (4–6)] indicates the extent of psychological harm is associated with factors such as the severity of the disaster (e.g., EF-5 tornado), the degree of exposure (e.g., personal injuries, loss of home), and the magnitude of community destruction (e.g., the prevalence of homes, schools, and hospitals destroyed). For example, in a meta-analytic review, Brewin et al. (7) found an association between the severity of the disaster trauma (higher degree of disaster exposure) and the subsequent severity of depression symptoms. In addition, prior studies have indicated that a dose–response effect occurs, wherein PTSD and depression symptoms have been found to increase with greater disaster exposure levels (5, 8, 9).

While disaster exposure has been found to have a direct effect on post-disaster depression and PTSD, it could, however, also indirectly affect depression and PTSD through a third mediating variable, such as resilience. Although different definitions of resilience exist in the literature [for a review, see (10)], most of them generally share the idea that resilience is the ability of an individual to positively adapt in the face of stress, risk, and adversity (10–13). This definition indicates that resilience is a process and that protective factors (e.g., optimism, distress regulation, environmental resources) foster specific processes in the individual that assist in preventing adverse outcomes and promote positive adaption and growth following exposure to stressful or traumatic events (4, 14).

Within a disaster context, (15) described a risk and resilience framework, wherein resources or protective factors counterbalance the threats of disaster exposure. In terms of conceptualizing the process of resilience in a research model, resilience has the potential to operate as a mediator (16, 17) between risk factors (e.g., disaster exposure) and adverse outcomes [e.g., depression, PTSD; (18)]. Known as the "protective factor model," resilience has been found to influence the effect of a risk factor by mediating the adverse impact of risk for predicting negative outcomes (19, 20). For example, in prior research, resilience has been found to mediate the relationship between interpersonal risk factors and hopelessness, and contribute to lower levels of hopelessness in a sample of individuals with clinical depression (19). Resilience has also been found to mediate COVID-19 pandemic-related stress and contribute to lower depression and anxiety (21), and higher academic success among college students (22).

Despite the role of resilience as a potential mediator between risk factors and mental health outcomes, few studies have examined the possible mediating relationship of resilience to mitigate against adverse mental health outcomes following exposure to disaster events (23). While there is a large amount of evidence that indicates disaster exposure and resource loss can have a detrimental impact on mental health after disasters (24, 25), however, less is known about the processes and mechanisms by which resilience mitigates risk factors and reduces the probability of a negative mental health outcome. Uncovering the potential mechanisms by which disaster resilience may be directly and indirectly related to mental health outcomes is important for disaster preparedness and response, as it can provide insights into protective factors that are particularly important in the event of a disaster. Therefore, to address this gap, the objective of the current study was to examine whether disaster resilience had a protective mediating effect on the relationship between disaster exposure and post-disaster depression and PTSD among 625 U.S. adults exposed to disaster (e.g., hurricane, tornado, wildfire, oil spill).

In the current study, disaster resilience was conceptualized as various internal and external factors that interact to influence an individual's ability to adapt and recover following exposure to disaster (26). These results could provide a further understanding of the dynamic process of resilience by understanding its interactive mechanisms between exposure to disaster and post-disaster mental health. Structural equation modeling (SEM) was utilized to test this model, and a cross-sectional study was conducted among a sample of adults exposed to a disaster event ($N = 625$). Based on the evidence reviewed above, the following hypotheses guide this study:

> *H1*. Disaster exposure will be positively associated with PTSD and depression.

> *H2*. Disaster exposure will be positively associated with disaster resilience.

> *H3*. Disaster resilience will (a) have an inverse or negative relationship with PTSD and depression and (b) will mediate the relationship between disaster exposure and PTSD and depression.

Methods

Data collection procedures

Data collection procedures were approved by the [Identity Removed for Review] Institutional Review Board (IRB). Participants qualified for this study if they were 18 or older and had experienced a disaster within the previous 3 years (2016–2019). To ensure the statistical analyses possessed sufficient statistical power with the SEM model, a power analysis was conducted to help determine the adequacy of the sample size required. The criterion was set that the estimated power needed to be 80% or higher, with a significance level (α) set at 0.05, for all the parameters of interest within the SEM (e.g., factor loadings, correlations, and regression paths), with a projected sample size of at least 500 participants was found as adequately powered (27).

Participants were recruited through purposive online sampling using Qualtrics' panel aggregator sampling service. The Qualtrics panel aggregator provides researchers access to market research panels and uses digital technology (e.g., IP address checks, digital fingerprinting) to ensure participants' data are as valid and reliable as possible (28). In addition, Qualtrics can monitor the data collection procedure and controls for issues such as participant inattentiveness or ineligibility, high incompletion rates, duplicate responses, or unreasonably quick completion times (29). Qualtrics was chosen as the online data collection platform following research indicating that samples recruited via online panel aggregators represent the U.S. population demography slightly better and are usually less expensive than convenience samples (30). Qualtrics invited participants to the study by clicking on a link to a screening questionnaire to assess eligibility if they lived in a U.S. state or territory that has experienced a natural or human-caused disaster in the prior 3 years (2016–2019). Accordingly, the states targeted for recruitment included California, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Florida, and Texas. Using the online interface of Qualtrics, participants were provided with study instructions and self-reported questionnaire items. In addition, participants were compensated for their time with incentives through the Qualtrics incentive program (e.g., prize drawings and accumulated rewards).

Measures

Disaster exposure

Disaster exposure ($M = 9.72$, $SD = 1.72$, $\alpha = 0.66$) was measured by participants rating their perceptions of exposure to five main disaster-related stressors: did they lose personal belongs, was their home or property damaged, did they experience bodily injury, did their life or

loved one's life feel threatened, and did they experience feelings of helplessness, fear, or horror [see (31, 32)]. Participants rated their responses on a 4-point Likert scale with response options ranging from 1 = *not at all* to 4 = a *great deal*. All items were summed to create an observed variable.

Disaster resilience

Disaster resilience ($M = 166.51$, $SD = 28.53$, $\alpha = 0.96$) was measured via the Disaster Adaptation and Resilience Scale [DARS; (26)], a 43-item scale consisting of five domains found to support disaster resilience, including: material resources, social resources, distress regulation, problem-solving, and optimism. Each item is rated on a 5- point Likert scale ranging from 0 (*not at all true*) to 4 (*true nearly all of the time*), with higher scores reflecting higher levels of resilience. Participants were prompted to think about the most recent disaster event and answer to report if they possess a specific protective factor (e.g., distress regulation, access to basic resources) on a 5-point Likert scale ranging from 0 = *not at all true* and 5 = *true nearly all the time* to create a latent variable.

Post-traumatic stress

Post-traumatic stress disorder (PTSD) symptoms ($M = 34.76$, $SD = 23.22$, $\alpha = 0.97$) were measured via the Impact of Event Scale-Revised [IES-R; (33)]. The scale consists of three factors of symptoms related to posttraumatic stress: avoidance (eight items), hyperarousal (six items), and intrusion (eight items). Sample items include: "Any reminder brought back feelings about it," "I felt irritable and angry," and "My feelings about it were kind of numb." In the current study, participants will be instructed to report how distressing or bothersome each symptom had been within the past 7 days with respect to the most recent disaster event. Responses for the IES-R are provided on a 5-point Likert-like scale which ranged from 1 = *not at all* to 5 = *extremely* to create a latent variable.

Depression

Depression ($M = 3.93$, $SD = 1.97$, $\alpha = 0.89$) was measured via the Patient Health Questionnaire [PHQ-2; (34)]. The PHQ measures the degree to which an individual has experienced depressed mood over the past 2 weeks in order to screen participants for disaster-related depression. Responses were provided on a 4-point Likert-like scale which ranged from 0 = *not at all* to 3 = *nearly every day* to create a latent variable.

Analyses

The demographic characteristics of respondents were analyzed using univariate methods including means, standard deviations, and frequencies. To examine the relationships between disaster exposure, disaster resilience, and mental health outcomes, structural equation modeling (SEM) was used. Using a two-step procedure recommended by Kline (35), first tested a measurement model (confirmatory factor analysis, CFA) to examine and confirm the factor structure of the latent variables and indicators (e.g., disaster resilience, PTSD, depression). Next, the structural model analyzed the direct effects of disaster exposure and mental health outcomes and whether the impact of disaster exposure on PTSD and depression, can be filtered or mediated by the individual's level of disaster resilience.

For both the measurement and structural SEM models, a maximum likelihood estimation with robust standard errors was performed using R software and the *lavaan* package ((37, 38) R Development Core Team, 2011; Rosseel, 2012). Guidelines for goodness of fit indices were used to evaluate model fit based on the recommendations of Little (36) included the root mean square error of approximation (RMSEA) <0.08, standardized root mean square residual (SRMR) <0.08, and comparative fit index (CFI) > 0.90 and the Tucker-Lewis Index (TLI) > 0.90. Residuals were also inspected for outliers, which can indicate a model misfit that is not due to chance. In addition, modification indices were inspected for high values indicating the possible need to remove an item or change the path of an indicator (35). To test the mediation or indirect effects, the 95% confidence interval of 1,000 bootstrapped resamples of the product of coefficients were generated to ensure the confidence intervals do not include zero, and therefore the effect is considered statistically significant (37). In the case of missing data at random, a full information maximum likelihood estimation will be used, which assumes missing data points have an expectation equal to a model-derived value estimated from the remaining data points (38).

Results

The final sample included 625 participants who experienced a disaster between 2016 and 2019. Missing data in the current study did not exceed 10% for any variable. Three hundred thirty participants were female (53%), and 293 were male (47%). The majority of participants identified as White (62.5%), followed by Black/African American/Afro Caribbean ($n = 105$, 16.8%), Hispanic/Latino ($n = 55$, 8.8%), Multi-racial ($n = 29$, 4.6%) Asian American ($n = 26$, 4.2%), Native Hawaiian/Other Pacific Islander ($n = 9$, 1.4%), and American Indian/Alaskan Native ($n = 4$, 0.6%). Nearly half of all participants had a bachelor's degree or higher ($n = 146$, 49.7%). The average household size was 2.69. The most frequent disasters experienced by participants included hurricanes ($n = 423$, 68%), followed by tornados ($n = 59$, 9.5%), floods ($n = 56$, 9%), and wildfires ($n = 54$, 8.7%). See Table 1 for the complete descriptive statistics of the participants.

For the SEM analyses, a measurement model of the latent variables (e.g., disaster resilience, depression, PTSD) was first estimated and the initial measure model did not achieve an acceptable model fit as both the CFI and TLI were less than 0.90. To remedy this issue, parceling items, or combining indicators, can be a valuable method to improve model fit when latent variables have a high number of indicators and can provide information about the relationships among the latent variables (36). After parceling the 22 indicators for the PTSD latent variable into three equal-sized domain parcels, the measurement model achieved acceptable fit: $\chi 2\ (2108) = 4588.933$, $p < 0.01$, CFI = 0.91, TLI = 0.90, RMSEA = 0.04, SRMR = 0.05. Next, the structural model was estimated and achieved acceptable fit, model fit statistics included $\chi 2\ (1117) = 2484.079$, $p < 0.01$, CFI = 0.91, TLI = 0.90, RMSEA = 0.05, SRMR = 0.06, and allowed for the testing of hypotheses (Table 2 and Figure 1).

In Figure 1, the SEM results revealed significant relationships among all the study variables. The first hypothesis (H1) predicted that disaster exposure would have a significant positive relationship with PTSD and depression symptoms. Results show that H1 was supported, and found that disaster exposure had a significant and

TABLE 1 Descriptive statistics.

Variable		*N*	%	*M*
Sex				
	Male	293	47	
	Female	330	53	
Race				
	American Indian/Alaskan Native	4	0.6	
	Black/African American/Afro-Caribbean	105	16.8	
	Native Hawaiian/Other Pacific Islander	9	1.4	
	Asian American	26	4.2	
	Hispanic/Latino	55	8.8	
	White	397	63.5	
	Multi-racial	29	4.6	
Age				32.49
Income				
	Less than $15,000	75	12	
	$15,000 to $29,999	130	15.6	
	$30,000 to $44,999	117	18.7	
	$45,000 to $59,999	91	14.6	
	$60,000 to $74,999	72	11.5	
	$75,000 to $104,999	61	9.8	
	$105,000 or more	79	12.6	
Education				
	Grade School	4	0.6	
	Some High School	17	2.7	
	High School Graduate	137	21.9	
	Some College	188	30.1	
	College Graduate	196	31.4	
	Advance Degree	80	12.8	
Disaster type				
	Hurricane	423	68	
	Tornado	59	9.5	
	Wildfire	54	8.7	
	Flood	56	9.0	
	Earthquake	12	1.9	
	Chemical Spill	4	0.60	
	Civil Unrest	7	1.0	
	Mass Shooting	4	0.60	

$N = 625$.

positive relationship between PTSD ($\beta = 0.744$, $p < 0.001$) and depression ($\beta = 0.773$, $p < 0.001$). Individuals who had encountered more disaster-related losses and stressors (e.g., injuries, loss of a loved one, property damage) had a higher risk of disaster-related PTSD and depression. Next, the second hypothesis (H2) predicted that disaster exposure would have a significant and positive relationship with disaster resilience. Results found that H2 was supported and disaster exposure was significantly associated with having more disaster resilience ($\beta = 0.109$, $p < 0.05$). The increase in disaster exposure was found to predict an increase in the level of disaster resilience.

Finally, the third hypothesis (H3a) predicted that disaster resilience would be inversely associated with PTSD and depression symptoms. Results found that H3a was also supported as disaster resilience had a significant and negative association with PTSD ($\beta = -0.116$, $p < 0.001$) and depression ($\beta = -0.246$, $p < 0.001$). Furthermore, the third hypothesis (H3b), predicted that disaster resilience would mediate the relationship between disaster exposure

TABLE 2 Structural model: regression paths.

Regression paths	Unstandardized estimate	Standard error	Standard estimate
Disaster resilience ($R^2 = 0.12$)			
Disaster exposure	0.202	0.010	0.109*
PTSD ($R^2 = 0.78$)			
Disaster exposure	0.556	0.025	0.744***
Disaster resilience	−0.333	0.062	−0.116***
Depression ($R^2 = 0.62$)			
Disaster exposure	0.255	0.016	0.773***
Disaster resilience	−0.395	0.060	−0.246***

Model Fit statistics: χ^2 (1117) = 2484.079, $p < 0.01$, CFI = 0.91, TLI = 0.90, RMSEA = 0.05, SRMR = 0.06. PTSD = Posttraumatic stress symptoms. Solid lines with arrows indicate statistically significant.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

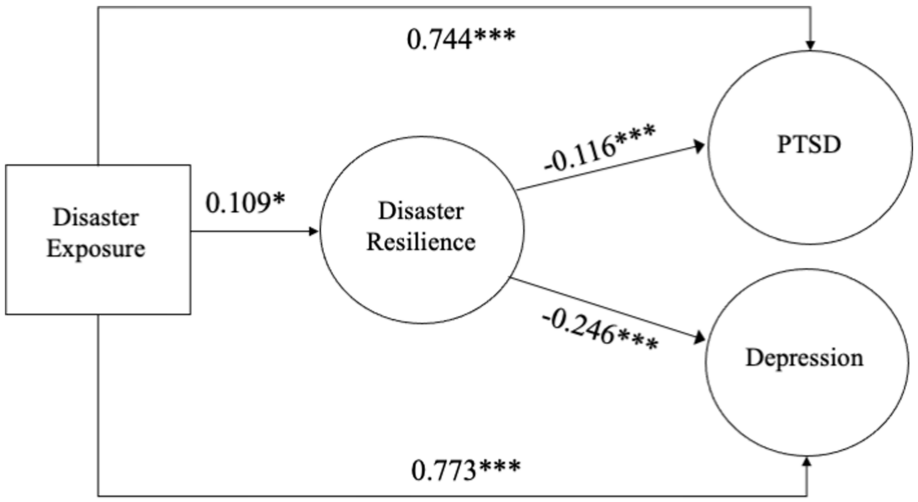

FIGURE 1
Diagram of structural model. *N*=625, Model Fit statistics: x^2 (1117) = 2484.079, $p < 0.01$, CFI=0:91, TLI = 0.90, RMSEA=0.05, SRMR=0.06. PTSD= Posttraumatic stress symptoms. Solid lines with arrows indicate statistically significant. *p<.05, **p<.01, ***p<.001.

and PTSD and depression. Results found that H3b was also confirmed as disaster resilience was to contribute to lower PTSD ($\beta = -0.013$, $p < 0.05$, [CI 95%: −0.028, −0.007]) and depression symptoms ($\beta = -0.027$, $p < 0.01$, [CI 95%: −0.046, −0.006]) based on the 95% confidence interval from 1,000 bootstrapped resamples.

Discussion

Disaster events place stress on human life, livelihood, and health, and can have significant impacts on the mental health and well-being of individuals exposed. To test whether the impact of disaster exposure on PTSD and depression can be mediated by disaster resilience, this study examined direct and indirect relationships between disaster stress, disaster resilience, and mental health using structural equation modeling among 625 U.S. adults. Results from the current study point to several findings. First, SEM analysis found that individuals with more disaster exposure were associated with higher levels of PTSD and depressive symptoms. These findings are consistent with prior studies (2, 8, 41) indicating that individuals exposed to more disaster-related losses (i.e., property damage, injuries) were more likely to demonstrate symptoms of PTSD and depression, and illustrate that disaster exposure can have significant effects on the mental health of individuals.

Second, this study found that more exposure to disaster losses was associated with more resilience. This finding highlights that individuals experiencing greater amounts of disaster-related adversity required greater levels of resilience to help mitigate the negative effects of disaster exposure. Resilience or protective factors have been theorized to be able to help mitigate the effects of stressful and traumatic experiences after a collective trauma, and this study's results confirm prior studies (15, 42) that have found a positive association between exposure to adversity contributing to greater resilience. However, researchers note that at certain doses, individuals may no longer be capable of adapting when exposure levels are cumulative and ongoing (8, 43, 44). For example, previous studies have found that cumulative exposure to multiple collective traumas may predispose people to negative mental health outcomes (43–45, 47). Future research should continue to examine the relationship between disaster exposure

and resilience responses to time-limited stressor events and in the face of chronic, ongoing collective traumas (46).

In addition to acknowledging potential risks and adverse impacts from disasters, is an increased recognition and importance of understanding the mechanisms of disaster resilience (47). Results from this study found that disaster resilience demonstrated a significant mediating relationship between disaster exposure and PTSD and depression among participants. This finding provides further empirical support for conceptualizations of disaster resilience's ameliorating role in contributing to better mental health outcomes following disaster exposure (49–51), and further theoretical understanding of the phenomena of resilience and how it operates in the specific context of disasters (Schneiderman et al., 2005). In other words, disaster resilience was found to play an important role in changing the strength or direction of the relationship between disaster exposure and post-disaster mental health, such that individuals with access to more disaster resilience (e.g., material, social, and psychological resources) contributed to fewer negative mental health effects. Understanding the underlying mechanisms that help to explain the relationships between risk factors and adverse outcomes provides important insights into potential inventions to target to improve disaster mental health response and preparedness. Findings from this study will be able to assist disaster researchers and practitioners in identifying protective factors (e.g., physical, social, and psychological resources) for intervention development that promote resilience and healthy psychological development in communities experiencing disaster.

Finally, these findings also have the potential to contribute to future research on identifying factors supporting the resilience of medical and healthcare professionals working in disaster and emergency response settings. Prior studies have found that working in disaster settings exposes healthcare workers to considerable stress, trauma, and emotional strain and can lead to conditions such as post-traumatic stress disorder (PTSD), depression, suicidality, and anxiety (52, 53), and this study illustrates the important mechanism or process of disaster resilience in reducing mental health symptoms. These findings could be used to inform future research on specific protective factors that could play a beneficial role in reducing negative mental health outcomes among high-risk medical workers in disaster settings (55). By systematically examining and refining these protective factors, future research can contribute to developing targeted interventions, training programs, and support systems tailored to the disaster resilience of the healthcare workforce.

Limitations

In regard to study limitations, this project was limited by non-probability sampling, by self-report measures, cross-sectional design, and the sample's disaster experiences (e.g., majority natural hazards, hurricanes). First, this study utilized non-probability sampling, and therefore, the results may not be generalizable to all individuals experiencing a disaster event. Future studies could improve on this limitation by utilizing a probability sampling design. Second, this study utilized self-report measures that may not be accurate as a full clinical evaluation of PTSD or depression symptomology. A third limitation is that this study is cross-sectional in design, and therefore, the collected data cannot make causal claims of temporal order (56). The current study's cross-sectional limitation could be improved upon by future studies employing a longitudinal design that collects data at several points and could, for example, assess resilience at 1 month, 6 months, and 1 year to increase further knowledge about disaster resilience. Despite these limitations, this study found the presence of important associations that were consistent with theoretical predictions (e.g., disaster exposure and resilience had direct and indirect associations with PTS and depression symptoms).

Conclusion

The current study used structural equation modeling (SEM) to identify the relationships between disaster exposure and disaster resilience on mental health outcomes in a sample of 625 U.S. adult participants. Results found that disaster exposure was significantly related to higher levels of PTS and depression symptoms. Disaster resilience was inversely related to PTSD and depression symptoms and played an important role in mediating the relationship between disaster exposure and mental health outcomes. Findings from this study can assist disaster researchers and practitioners in identifying protective factors to support disaster resilience interventions and practice models.

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 humans were approved by University of Missouri IRB Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

JF: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing.

Funding

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

Conflict of interest

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

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frontiers | Frontiers in Psychiatry

TYPE Systematic Review
PUBLISHED 16 February 2024
DOI 10.3389/fpsyt.2024.1303847

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OPEN ACCESS

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RECEIVED 28 September 2023
ACCEPTED 22 January 2024
PUBLISHED 16 February 2024

CITATION
Renner A, Schmidt V and Kersting A (2024) Migratory grief: a systematic review. *Front. Psychiatry* 15:1303847. doi: 10.3389/fpsyt.2024.1303847

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Migratory grief: a systematic review

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Introduction: Migration is often accompanied by interpersonal, material and abstract losses and can be associated with migratory grief. The correlates of migratory grief have not yet been sufficiently addressed in research. This review aims to systematically investigate the relationship between migratory grief and psychopathology, to map the current state of research on this highly relevant topic and to derive relevant implications for the target group.

Method: A systematic literature search of electronic databases (PubMed/Medline, PsycINFO, Web of Science) was conducted up until January 2023. Primary empirical quantitative and qualitative studies with migrants were included that assessed the association between migratory grief and psychopathology, using a specific instrument for migratory grief (quantitative) or named migratory grief as relevant topic (qualitative). Studies that only captured aspects of migratory grief, were not written in English, or were descriptive/non-peer-reviewed publications, were excluded. A quality assessment of all studies included was performed using the Mixed Methods Appraisal Tool. The results were synthesized using a narrative synthesis approach.

Results: All studies (quan. = 4; qual. = 1) were cross-sectional and used convenience samples. The studies had a mean number of 83 participants with a total of N = 487 participants included in the current review. All included studies reported a significant relationship between migratory grief and psychological distress.

Discussion: Despite the quality of the included studies being limited, our results show that there is a link between migratory grief and depression among refugees and migrants. However, there are only few studies in this currently and certainly also in the future relevant field of research, which is why further studies on factors influencing migratory grief as well as associations with other disorders would be desirable.

Systematic review registration: https://www.crd.york.ac.uk/prospero/, identifier CRD42023403448.

KEYWORDS

migratory grief, migration, mental health, grief, loss

1 Introduction

Grief is commonly defined as a natural reaction to loss, which becomes less intense over time and enables adaptation to a new reality (1, 2). However, certain circumstances and factors can lead to associated mental disorders such as persistent grief disorder, depression, anxiety or PTSD (3, 4). Migration takes relevance in this context, as migrants[1] often experience reactions of grief due to the occurrence of traumatic events and losses. While reasons for migration can be diverse, e.g., the search for protection, saving of lives or opening the access to new opportunities, implications may be devastating (6–8). Migrants can suffer a number of losses that are clearly related to the migration experience. In the following, we refer to these losses as "migration-related losses". These losses may include the loss of relatives and friends (interpersonal losses), of house and income (material losses) but also of status, social role, identity, communication possibilities due to a new language, of a planned future and dreams or simply of the familiar surroundings (abstract losses) (8, 9). Although losses are such a common and presumably consequential sequel of migration, they receive little attention in research. This applies particularly to abstract losses that are often not socially recognized (9–11). Eisenbruch (12) named the distress occurring after loss of homeland, identity and social connectedness due to relocation "cultural bereavement". Achotegui (7) developed the concept of the "Ulysses syndrome" to depathologize the feelings of alienation and stress after migration. Nevertheless, we know that the migration experience is associated with increased prevalence of mental distress. A Meta-analysis by Lindert et al. (13) show prevalence rates of 20% for depression among labor migrants and 44% among refugees as well as 21% for anxiety among labor migrants and 40% among refugees. According to a systematic review by Kokou-Kpolou et al. (14), the pooled prevalence of prolonged grief disorder was 33.2% in adult refugees. A number of risk factors for the mental health of migrants have already been investigated, such as gender, income, language skills, social support and social isolation, discrimination (e.g. regarding housing or employment) and legal status (15–18). It is also discussed that vulnerabilities often do not result from independent risk factors, but from intersectional inequalities based on gender, age, race, ethnicity, social class and legal status (19, 20). Although a number of risk factors for migrants' mental health are associated with various dimensions of loss (17), the processing of loss, i.e. grief, is rarely the focus of research. In addition, since both migration and grief seem to be risk factors for mental disorders, the question arises as to why there is so little research on the specific combination of these two factors and their implications for the mental health of migrants. Therefore, we have set the aim for this review to systematically investigate the relationship between MG and psychopathology (PP) in migrants to clarify its relationship, identify possible research gaps and derive clinical implications.

1 "Migrants" is a broad term that we use in this article to refer to persons with their own experience of migration, i.e. moving away from the place of usual residence for work or education as well as asylum within a country or across international borders (5). As the specific subgroups can be exposed to very different experiences, they are referred to as such in the relevant contexts.

2 Methods

The systematic review was conducted and reported following the PRISMA Statement to the best of ability (21). It was registered with PROSPERO (CRD42023403448).

2.1 Search strategy

A systematic literature search of electronic databases (PubMed/Medline, PsycINFO, Web of Science) was conducted without time or language restrictions to identify relevant studies (final search date: 30/01/23). The search term focused on the link between MG and PP: [(psychopathol* OR depression OR psychiatr* OR depressiv* OR "posttraumatic stress" OR "psychological distress" OR "mental health") AND (displacement OR migratory OR migration OR refugee OR "asylum seeker") AND (grief OR loss OR mourn* OR "bereavement")] NOT (cell migration OR erythema). The „snowball-method" was used to identify additional studies, since a hybrid search strategy increases the probability of identifying all relevant studies (22). Citavi 6 was used to catalogue all identified records and remove duplicates. Two authors (AR and VS) screened abstracts independently. After calculation of agreement and discussion with Supervisor AK regarding inconsistencies in inclusion, AR conducted the full text screening for inclusion or exclusion. VS assisted with full text analysis for individual studies where ambiguity was prevalent. Disagreements were resolved by discussion with AK. Using Cohen`s Kappa statistic, κ (23), inter-rater reliability was assessed and equalled 0.929.

2.2 Eligibility criteria

Primary empirical quantitative and qualitative studies were included in this review. No time limit was set regarding the publication year of the studies up until the latest search in January 2023. Inclusion criteria were: (1) Participants: Persons of all genders and ages that were exposed to any kind of migration experience (e.g. labor migration, internal displacement, refugees). (2) Exposure: In the included quantitative studies, MG had to be assessed with a specific instrument. In qualitative studies, MG had to be named as such or as a synonym (i.e. cultural bereavement, "Ulysses-syndrome"), (3) Outcomes: The association between MG and PP had to be reported. Excluded were studies that (1) only captured aspects of MG (e.g. interpersonal losses only), (2) were not written in English, (3) were case studies, reviews, descriptive studies, expert opinions, clinical guidelines, conference papers or non-peer-reviewed publications.

2.3 Data collection and analysis

When studies met inclusion criteria, the following data was double extracted independently by AR and VS from quantitative studies: (1) Source: author, publication, year, country, journal; (2) Sample: type of sample, sample size, recruitment; (3) Measurements of MG and PP; (4)

methods; (5) Outcomes: Correlation coefficients between MG and Psychopathology were extracted from each included study. Bullet points 1-2 were also collected in qualitative studies, in addition to reports on the occurrence of MG in the population and mention of the association with psychological distress.

Results were synthesized narratively and additionally summarized in a table for better overview. Due to the low number of quantitative studies and the heterogeneity in measurement instruments, no meta-analysis was performed.

2.4 Quality assessment

The Mixed Methods Appraisal Tool (MMAT) (24) was applied to appraise the quality of quantitative and qualitative studies independently by two researchers. The MMAT was chosen for its acknowledged reliability in evaluating mixed methods research (25). It is essential to highlight that the MMAT does not primarily assess the overall 'quality' of a research paper. Rather, it is employed to ascertain whether a study's methodology meets predefined criteria indicative of methodological quality. Ratings depend on fulfilling criteria, with variations based on the study type. A score of 1 is assigned for each fulfilled criterion, allowing for a maximum total of 4 for each study. If criteria are unmet or information is absent in the study, a score of 0 is assigned. AR and VS independently performed a quality assessment of included studies; disagreements were resolved by discussion with AK. A detailed description of the MMAT rating criteria and the categorization of the included studies can be found in Appendix 1.1.

3 Results

The systematic search yielded a total of 2505 results. After removal of duplicates, 1585 records remained for abstract screening. Of those, 54 records were found suitable for full-text screening and five were included in the current review (4 quantitative and 1 qualitative study). The selection process is pictured in Figure 1.

3.1 Study characteristics

The included studies examined the association of MG and PP in samples ranging from N=16 (plus 6 family interviews, not numerically included since exact number of participants remains unclear) (27) to N=150 (9, 28) with a total of N=487 participants included in the current review. Table 1 provides an overview of all included studies. Four studies were conducted in the United States (9, 27–29), one in Australia (30). The target groups included elderly Chinese, Buthanese, or Kurdish refugees and South African immigrants. All studies were cross-sectional and used convenience samples.

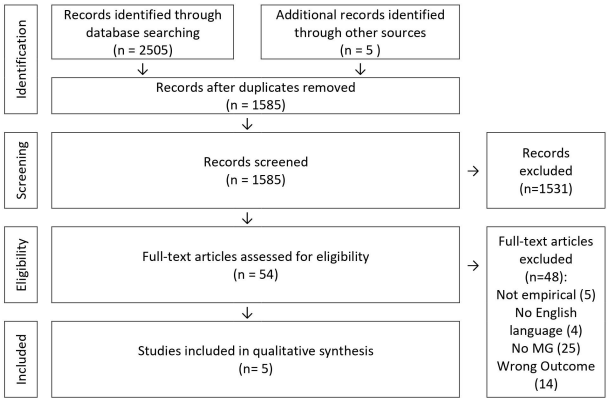

FIGURE 1
Study selection following PRISMA guidelines (26).

3.2 Study quality

All included studies were rated regarding methodological quality applying the MMAT. The quantitative studies showed to be of medium quality ranking between a total score of 3 (9, 30) and 4 (28, 29) out of 6. The qualitative study by Im and Neff (27) scored highest with 6 out of 6. Methodological shortcomings were found in the studies, particularly with regard to detailed definitions of the target groups and the complete outcome data. Khawaja and Mason lacked a validated instrument for recording MG. Details of the quality appraisal can be found in Appendix 1.1.

3.3 Operationalization of MG

All quantitative studies used standardized scales to assess MG and PP. The Migratory Grief and Loss Questionnaire (MGLQ; 9) was applied by three of the four quantitative studies (9, 28, 29). The scale was designed to measure the experience of grief and loss associated with immigration. It captures the dimensions searching and yearning, idealization, and identity discontinuity and consists of 20 items and a 4-point Likert scale (0 = never, 1 = occasionally, 2 = often, 3 = always). Participants are asked how each item applied within the last 30 days. Higher scores indicate higher levels of MG (range 0-60). The fourth quantitative study by Khawaja and Mason (30) used the Grief and Migration Scale to assess immigration-related grief. The instrument is an adaption of the Core Bereavement Scale by Burnett et al. (31) created to capture grief after interpersonal losses. The authors selected fitting items from the scale and adapted the wording to capture the experience of grief for a country rather than a person. The new scale consists of six items and a Likert-type scale ranging from 1 = never to 5 = always. The qualitative study (30) applied an interview guide that explicitly avoided theoretical terms like cultural bereavement with the aim to gather unbiased information in the participants' own words. Instead, the experience of the participants was asked very broadly focusing on the topics of differences between the countries,

TABLE 1 Included studies of MG and PP in alphabetical order.

Author	Design	N	Country of Arrival	Sample			Measurement MG	Measurement PP	Methods	MG/PP Bivariate	MG/PP Multivariate
				Country of Origin / Ethnicity	Reasons for Migration	Average Length of stay in Country of Arrival					
Casado et al., 2010 (9)	Quanti-tative, cross-sectional	150	USA	Chinese	Political: 5.1% Education: 5.1% Family: 28.6% Better life/ opportunities: 52.0% Economic/work: 5.1% Other: 4.1%	M = 10.9 SD = 7.4	MGLQ	Chinese Depressive Symptom Scale-16 (CDS-16)	Exploratory factor analysis, correlation analysis	Significant relation between MGLQ overall score and depression (r = .54, p <.001)	Not investigated
Casado & Leung, 2002 (28)		150	USA	Chinese	Political: 3.3% Education: 4.0% Family: 28.0% Better life/ opportunities: 40.0% Economic/work: 3.3% Other: 3.3% Missing: 18.0%	M = 10.86 SD = 7.39	MGLQ	Chinese Depressive Symptom Scale-16 (CDS-16)	Stepwise regression	Significant relation between MGLQ overall score and depression (r = .65, p <.001)	MG was a significant predictor for depression and contributed to 41.5% of the variance (B = .350; p < .001)
Cummings et al., 2011 (29)		70	USA	Kurdish	Refugees: 71.4% Asylum seekers: 22.9% Other immigrants: 5.7%	M = 12.8 SD = 3.5	MGLQ	Geriatric Depression Scale (GDS)	Multivariate linear regression	Significant relation between MGLQ overall score and depression (r = .24, p =.05); MGLQ subscales: significant association of subscale "Disorganization" and depression (r = .34, p =.01)	Subscale "Disorganization" was a significant predictor for depression (B = 0.23, p < .05)
Khawaja & Mason, 2008 (30)		101	Australia	South African (mainly white people)	Violence in South Africa * Job opportunities in South Africa/Austraulia*	Inclusion criterion: <5 years	Grief and Migration Scale	Hopkins Symptom Checklist (Anxiety / Depression)	Multiple regression analysis	Not reported	MG was the strongest predictor for distress, accounting for 39.8% of the variance (B = 2.61; p < .01)

*No percentages detectable in the publication.

10.3389/fpsyt.2024.1303847

adjustment to the host country and cultural challenges and solutions for the migrated community.

The operationalization of Psychopathology can be found in Appendix 1.2.

3.4 Association of MG and PP

3.4.1 Bivariate analysis

Three out of four quantitative studies reported a bivariate relation between MG and PP (9, 28, 29). Three studies found a negative relationship between MG and depression in elderly Chinese or South African immigrants ($r = .54$, $p < .001$; $r = .65$, $p < .001$; $r = .24$, $p = .05$; 9, 28, 29). Moreover, depression was significantly associated with the „Disorganization" subscale of MG ($r = .34$, $p = .01$), but not the other two subscales (29). Khawaja and Mason (30) did not report a bivariate association of MG and PP.

3.4.2 Multivariable analysis

A multivariate analysis of the association between MG and PP was carried out in the studies by Casado and Leung (28), Cummings et al. (29) as well as Khawaja and Mason (30). The MG overall score was identified as a significant predictor for depression and contributed to 41.5% of the overall variance ($B = .350$; $p < .001$) [2] in Casado and Leungs' publication (2002). Despite a significant bivariate association of the MGLQ total score with depression, Cummings et al. (29) only included the bivariate significant subscale "Disorganization" in the multivariate analysis. This same subscale showed to be a significant predictor for depression ($B = 0.23$, $p < .05$). Khawaja and Mason (30) reported MG as the strongest predictor for emotional distress, accounting for 39.8% of the variance ($B = 2.61$; $p < .01$).

3.4.3 Qualitative analysis

The qualitative analysis of Im and Neff (27) showed the following association between MG and PP: After migration, the target group of Hindu Buthanese refugees showed culture shocks due to the shift of living environment from a collective to individualistic society. According to the authors, the resulting experience of loss and grief led to cultural trauma and bereavement, which again led to mental distress. The authors indicated that a loss spiral would be set in motion by these processes, since mental distress would weaken coping capacities.

4 Discussion

4.1 Summary of key findings

Migration is a global phenomenon as old as human history and its relevance continues to increase due to ongoing conflicts as well as climate change and its consequences (32–34). Losses experienced in the context of migration and the associated mourning must therefore be considered a highly relevant topic. The aim of this systematic review was to provide an overview of available research on the association of MG and PP. Our results show that there is a blatant lack of studies investigating this association. After a comprehensive systematic search, we were able to include five studies, four of which applied a quantitative and one a qualitative design. In summary, all included studies reported a relationship between MG and psychological distress. Three studies reported an association between MG and depression and two studies reported an association between MG and emotional/mental distress. It has to be noted that the target group of four of the five studies consisted of migrants or refugees from the Asian continent to the US. While the samples are unquestionably diverse, it can be generalized that MG occurs among migrants and refugees from the Asian continent in the USA and seems to be related to psychological distress. This is an important finding, since Asian immigration has been an essential part of immigration to the US since the mid-19th century and people from Asia currently form one of the largest groups of immigrants to the US (35, 36).

4.2 Research gaps and potential for future research

Although various losses are discussed in the migration and mental health literature (37–41), the bridge to mourning and its impact on mental health is seldom built. Grief is commonly associated with interpersonal losses exclusively, which is probably why MG has so far received little attention in research as well as in the treatment of persons with migration experiences. Consequently, the relationship between MG and PP is even less studied. The studies included in this review exclusively examined the association of MG with depression or a more general measure of emotional distress. Studies indicated that purely interpersonal losses in refugees and migrants may also be related to PTSD and prolonged grief disorder (14). Since MG may require similar processing mechanisms as interpersonal losses (9), examining the relationship of MG to these same constructs would be desirable in future research, as associations can be presumed. Cummings et al. (29) discussed age and a lack of access to cultural and religious institutions for persons from smaller immigrant communities such as the Kurds as important influencing factors regarding their coping in the country of arrival.

4.3 Implications

In addition to the identification of necessary research in the field of MG, practical implications can also be derived from the results of the present review. Unfavorable environmental factors can complicate grieving processes and thus make the development of mental disorders more likely (42). At the policy level, it would therefore be desirable to create a welcoming structure in countries of arrival that enables migrants and refugees to access their resources and work through grief processes without being hindered in processing and adaptation by long asylum processes or difficult housing conditions. This can not only prevent suffering,

2 B = Unstandardized regression coefficient.

but also avoid additional costs to the health care system in the longer term (43). At the clinical level, MG should be considered in the treatment of refugees and migrants. In the treatment of depression or other PP in refugees and migrants, MG should be considered as a possibly important influencing factor and processing should be supported. In order to be able to adequately support mourning processes, treatment providers should take sociocultural factors into account while avoiding stereotyping or the premature pathologizing of migration-related mourning processes (44–47). For example, Asian Americans are often referred to without specifying to which of the many heterogeneous groups they belong and which specific stressors and needs should be taken into account to provide effective mental health services (48).

4.4 Limitations

The results of this review were subject to some limitations that should be considered. On eligibility, the quality of the included studies is limited. All studies used a snowball- or convenience-sampling method, hence the participants are not representative of the target population. Not all studies reported inclusion- and exclusion criteria clearly. In one study, a MG measure was adapted without testing validity and reliability. Studies were not comprehensively controlled for confounders. Especially structural factors and their interaction, such as legal status and various facets of discrimination might complicate mourning processes and should therefore be analyzed as influencing factors on MG and its association with PP. Further, no cut-offs of MG were reported, therefore it was not possible to assess at which point MG values are considered high. Although it can be assumed that MG changes in the course of the stay in the country of arrival (9), only cross-sectional and no longitudinal studies were conducted. Regarding our methodological approach, it should be noted that we only included studies in English, which may have led to the neglect of relevant studies in other languages. Only peer-reviewed studies were included, which may have led to publication bias but also increased the adherence to scientific quality criteria. It should also be borne in mind that the target group of this review includes both migrants and refugees worldwide, which is a very heterogeneous sample and therefore inaccurate generalizations should be avoided. Moreover, only studies with the focus of MG were included, excluding other potential overlapping constructs, e.g., homesickness. However, despite an overlap in content in both constructs (see 49), no discussion has taken place about delineating the constructs or benefiting from the results from the other areas. Furthermore, we excluded studies that covered only partial aspects of MG in order to make a careful operationalization of the concept more likely. However, this may have resulted in the loss of information about the association of aspects of MG (e.g. loss of status) with psychopathology. Nonetheless, this review provides an important contribution, as, to our knowledge, it is the first systematic review to address the highly relevant topic of migratory grief and to demonstrate its link with psychological distress. Furthermore, it highlights the blatant research gap in this area as well as potential approaches for further studies.

5 Conclusion

This review provides evidence that there is a link between MG and PP among refugees and migrants. However, there are only a few studies in this field of research, which is currently relevant and will presumably be of great relevance in the future, which is why further studies on factors influencing MG as well as correlations with other disorders would be desirable.

Data availability statement

The original contributions presented in the study are cited in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Author contributions

AR: Conceptualization, Data curation, Investigation, Methodology, Project administration, Visualization, Writing – original draft. VS: Conceptualization, Data curation, Investigation, Writing – review & editing. AK: Resources, Supervision, Validation, Writing – review & editing.

Funding

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

Acknowledgments

The authors acknowledge support from the German Research Foundation (DFG) and Universität Leipzig within the program of Open Access Publishing.

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.2024.1303847/full#supplementary-material

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 20 March 2024
DOI 10.3389/fpsyt.2024.1351695

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RECEIVED 06 December 2023
ACCEPTED 26 February 2024
PUBLISHED 20 March 2024

CITATION
Berthail B, Trousselard M, Lecouvey G, Le Roy B, Fraisse F, Peschanski D, Eustache F, Gagnepain P and Dayan J (2024) Differences in predictive factors for post-traumatic stress disorder encompassing partial PTSD and full PTSD: a cross-sectional study among individuals exposed to the November 13, 2015 Paris attacks.
Front. Psychiatry 15:1351695.
doi: 10.3389/fpsyt.2024.1351695

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Differences in predictive factors for post-traumatic stress disorder encompassing partial PTSD and full PTSD: a cross-sectional study among individuals exposed to the November 13, 2015 Paris attacks

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Background: When faced with a surge of physically injured individuals, especially following a traumatic event like an attack, frontline practitioners prioritize early triage. Detecting potential psychological injuries soon after such events remains challenging. Some individuals might develop post-traumatic stress disorder (PTSD) according to DSM-V criteria. Others may exhibit PTSD symptoms without meeting full diagnostic criteria, termed partial or sub-syndromal PTSD, a less-explored area in literature. This study aims to identify predictive factors for both full and partial PTSD.

Method: In a cohort of victims of the 2015 Paris attacks, multinomial logistic regressions explored predictive factors for partial or full PTSD status 8 to 18 months post-attacks. Analyses considered pre, peri, and posttraumatic factors chosen from literature review and univariate analysis within each group.

Results: Within the cohort, 50 individuals showed no signs of PTSD, 35 experienced partial PTSD, and 30 presented with full PTSD. After logistic regression, risk factors associated with full PTSD included a history of trauma (OR = 1.30, CI [1.02-1.66], $p < 0.05$), the intensity of peri-traumatic physical reactions (OR = 1.22, CI [1.09-1.36], $p < 0.001$), the difficulties in suppressing intrusive thoughts (OR = 1.11, CI [1.02-1.21], $p < 0.013$). Only the intensity of peri-traumatic physical reactions emerged as a risk factor for partial PTSD (OR = 1.13, [CI 1.02-1.24], $p < 0.001$).

Discussion: This study revealed that a history of trauma, the intensity of peri-traumatic physical reactions (e.g., tachycardia, trembling, flushes, numbness.),

and the difficulties in suppressing intrusive thoughts constitute risk factors for the development of full PTSD. Moreover, the study identified that only the intensity of peri-traumatic physical reactions emerged as a risk factor for partial PTSD. These findings seem to underscore the significance of peri-traumatic experiences in influencing the development of post-traumatic stress symptoms.

Conclusion: This study emphasizes the significance of examining peri-traumatic reactions in PTSD development, suggesting its potential as a straightforward screening tool for post-traumatic stress disorder. It also underscores the influence of prior traumatic experiences, before *de novo* traumatization, in shaping vulnerability to PTSD and illuminates the crucial role of compromised control of intrusive thoughts that could perpetuate PTSD.

KEYWORDS

post-traumatic stress disorder, partial post-traumatic stress disorder, terrorist attack, predictive factors, Paris attacks

Highlights

Our study explores the predictive factors of post-traumatic stress disorder. Trauma history, intensity of peri-traumatic physical reactions and the difficulties in suppressing intrusive thoughts are risk factors for post-traumatic stress disorder.

1 Introduction

Current literature abundantly highlights the existence of important variabilities in the risk of developing Posttraumatic Stress Disorder (PTSD) after a traumatic event.

The PTSD assessment is enhanced by the DSM5 (1), a reference guide used by mental health professionals to diagnose mental disorders. It provides specific criteria for each disorder, including PTSD, based on observed symptoms in individuals after experiencing a traumatic event. DSM5 criteria for PTSD include symptoms grouped into four categories: Criteria A (exposure to a traumatic event), Criteria B (intrusive reactions), Criteria C (avoidance), Criteria D (negative alterations in cognition or mood), Criteria E (alterations in reactivity), and Criteria F, G, and H (duration and clinical disruption).

The literature on risk factors for PTSD is vast, encompassing pre-, peri-and post-trauma variables independent of acute stress disorder (ASD) (2, 3). Pre-traumatic risk factors are elements present before a traumatic event that can increase an individual's vulnerability to developing mental health issues following trauma. It includes an individual's psychiatric history, cumulative traumatic events, and level of preparedness (4), being female (5, 6), disruption of the individual's concept of reality (7, 8), vulnerable personality (9, 10). Peri-traumatic risk factors refer to elements occurring during or immediately after a traumatic event and includes peritraumatic dissociation (11, 12), intensity of the peritraumatic response (13, 14), as indicated by increased autonomic nervous system activity and fight or flight hormones (15, 16), duration of exposure and proximity to danger and death (11, 17), physical injury (18, 19), intentional nature of the attack (20). Post-traumatic risk factors are elements that arise after the traumatic event and can prolong or exacerbate its negative effects. It involves lack of social support (14), experience of the death of a friend or loved one, financial hardship, and inability to return to work (21).

Traumatic exposure can elicit diverse clinical responses, potentially giving rise to at least partial post-traumatic stress disorder (PTSD) or full PTSD (22). Recognizing the significance of individuals displaying some, but not all, PTSD symptoms following a traumatic event has gained consensus among researchers (22–24). For instance, a longitudinal study focusing on police officers involved in the World Trade Center bombing intervention revealed a gradual increase in reported PTSD symptoms over time (22).

The concept of 'partial' PTSD, initially applied to describe Vietnam veterans (25), lacks consistent criteria across studies (26). Some define it based on the presence of two out of the three DSM5 criteria (B, C, and D) (27, 28), while others refer to it as 'subthreshold' PTSD (29, 30). In this study, partial PTSD was defined as meeting DSM5 criteria A, B, F, G, and H, with traumatic intrusions and enduring clinical suffering lasting over one month.

Despite the challenge of a clear and universal definition, studies indicate that the true impact of traumatic events on populations with PTSD symptoms is often underestimated (31). Individuals

with partial PTSD exhibit higher associated psychiatric comorbidities (23, 29, 31) and experience social dysfunction (32). Interestingly, those with partial PTSD, although less clinically impaired than those with full PTSD, demonstrate functional impairment related to their symptoms and seek care with comparable frequency (24).

However, given the wide range of risk factors identified in the literature, it is challenging to identify factors that could determine predictive models of individual risk for post-traumatic stress after trauma. Accurately identifying the risk factors for PTSD is crucial for medical teams who coordinate the management of victims of traumatic events (33). Despite medical and psychological interventions, more than 20% of individuals exposed to trauma do not respond to treatment, and approximately 40% of those who do recover experience a relapse within a year (34).

The intentional nature of events like terrorism, likely intensified psychological trauma and its persistence over time compared to accidental events (35).

The Paris attacks, a series of terrorist attacks that occurred on November 13, 2015, had a profound impact, causing significant trauma. They targeted diverse groups in multiple public spaces, collectively threatening daily life and received extensive media coverage. The attacks involved kamikaze bombs around the "Stade de France", shootings and bombings in different locations in the 10th and 11th arrondissements of Paris, and an attack on the Bataclan theatre, resulting in 130 deaths and 354 injuries (36). Set in Paris, a cultural symbol, the attacks influenced social fabric, politics, and security. These factors, alongside the attacks' sudden brutality and the intentional nature of events like terrorism, likely intensified psychological trauma, increasing the risk of PTSD and related disorders. Grasping this context is essential for studying PTSD risk factors.

Thus, the main objective of this work is to identify risk factors for PTSD, including partial PTSD, in order to predict post-exposure clinic and improve medical follow-up, by proposing that prior traumatic experiences, peritraumatic physical reactions, peritraumatic dissociation, and difficulties in suppressing intrusive thoughts are risk factors for full and partial PTSD. This study focuses on identifying risk factors, rather than vulnerability factors. The study considers pre-trauma, peri-trauma, and post-trauma factors that have been most studied in the literature on PTSD risk factors.

2 Materials

2.1 Participants and procedures

This monocentric cross-sectional analytical study is a component of the REMEMBER (REsilience and Modification of brain control network following novEMBER 13) biomedical research project, which received prior approval from the Nord Ouest III Personal Protection Committee (12/2016; ID RCB: 2016-A00661-50). Written consent was obtained from all subjects before participation.

It consists of a neuropsychological analysis component, integrated into this work, and a functional imaging analysis. It is an ancillary study to the sociological study "Étude 1000," aiming to analyze the testimonies of 1000 volunteers across 4 exposed and non-exposed groups. The first group (n=360) comprises individuals exposed to attacks according to DSM-5 Criterion A (survivors, witnesses, bereaved relatives, first responders, directly present at any of the attack sites on the evening of November 13, 2015 (including both spontaneous bystanders and professional responders such as emergency services, law enforcement, etc.), or in close proximity to a victim injured or killed during or as a result of the attacks, or present near the site of the assault on November 18, 2015, in Saint-Denis), recruited through victim associations and volunteer calls (37).

Within this group, individuals were invited to a neuropsychological study, subject to restrictions, to form the REMEMBER study analysis group. However, only 120 responded positively, primarily due to the distance to the study location in Caen (approximately 200 km from Paris) and reluctance towards undergoing fMRI examinations. Out of 120 subjects, 115 were included in our study analysis. Data from 5 non-exposed participants were excluded: one couldn't continue, one wasn't truly exposed, one didn't meet the inclusion criterion, and two exhibited re-experiencing symptoms without other categories (including functional significance, Criterion G).

All participants met inclusion criteria: aged 18-60 regardless of gender, right-handed, French-speaking, with BMI <35 kg/m2, individuals comprising the primary exposed group of the "Étude 1000," enrolled in a social security scheme, have provided written informed consent. Exclusion criteria included being pregnant or planning pregnancy, individuals detained by judicial or administrative order, individuals residing in health or social institutions for reasons unrelated to research, participants currently excluded from another research project, history of severe psychiatric conditions such as psychotic disorders, bipolar disorders, obsessive-compulsive disorders, and/or addictive disorders (pre-existing prior to November 13, 2015, excluding tobacco addiction), history of neurological disorders (stroke, epilepsy, head trauma resulting in loss of consciousness for over one hour), use of medication known to affect cognitive and/or cerebral function, and conditions precluding MRI scanning (e.g., claustrophobia, metal implants). Subject inclusion and neuropsychological testing took place between June 13, 2016, and June 7, 2017, 8 to 18 months after the attacks (average one year). Semi-structured interviews and self-reported questionnaires were used to determine the presence of PTSD and to assess protective or risk factors for its development. Measures of post-traumatic stress disorder, pre-traumatic, peri-traumatic, and post-traumatic factors were carried out using questionnaires validated in French and English and chosen for their psychometric and clinical qualities.

2.2 Measurement of PTSD

The Structured Clinical Interview for DSM5 (SCID) (1) was used to diagnose possible disorders related to exposure to the attacks. Any individual meeting criterion A was classified as having full PTSD if they completely met DSM5 specifications, placing them within the *exposed group with full PTSD*.

Individuals meeting DSM5 criteria A, B, F, G, and H, with traumatic intrusions and enduring clinical suffering lasting over one

month, were classified within the *exposed group with partial PTSD*. Participants failing to meet criteria B and/or G were categorized as not experiencing either full or partial PTSD, thereby belonging to the *exposed group without PTSD*.

2.3 Measurement of pre-traumatic factors

Socio-demographic data, including the subject's marital status, professional situation, and level of education were evaluated by a dedicated questionnaire. A childhood questionnaire was used to identify childhood history. The life events checklist for DSM5 was used to determine anterior exposure of traumatic events (38). Finally, the MINI test (Mini International Neuropsychiatric Interview; 39), which is a structured diagnostic interview, was used to evaluate the main psychiatric disorders of the DSM5 during lifetime in a standardized manner.

2.4 Measurement of peri-traumatic factors

Among the 115 participants, the level of exposure was assessed by DSM5 criterion A, which determines whether the subject experienced the trauma directly (criterion A1, *n=78*), witnessed the event experienced by others (criterion A2, *n=14*), was a close friend or close family member of someone who experienced the trauma (criterion A3, *n=6*), or was repeatedly exposed to the distressing details of the traumatic event, such as first responders (criterion A4, *n=17*). Initial reactions were assessed via the Initial Subjective Reaction Physical Scale of the Potential Stressful Events Interview (40) and Initial Subjective Reaction Emotional Scale of the Potential Stressful Events Interview (40). The existence of a peri-traumatic dissociative syndrome was investigated using the Peritraumatic Dissociative Experiences Questionnaire-Self-Report Version (41).

2.5 Measurement of post-traumatic factors

The nature of the reaction, particularly coping processes since the attacks was assessed by using the Brief COPE Inventory (42). The difficulties in suppressing intrusive thoughts has employed the White Bear Suppression Inventory (WBSI, 43). The WBSI concurrently measures the tendency to engage in thought suppression and the frequency of associated intrusive thoughts. Notably, increased efforts to suppress thoughts is often associated with heightened intrusive thoughts (44). This phenomenon has been proposed to reflect a consequence of a compromised inhibitory control system regulating memory activity (45, 46), that could elucidate why some individuals with PTSD encounter challenges in suppressing intrusive thoughts and tend to endorse a higher number of items on the WBSI (47). Depression was measured using the Beck Depression Inventory (48). Anxiety was assessed by the State-Trait Anxiety Inventory, Form Y (STAI-Y; 49). Self-report questionnaires were used to determine the pattern of alcohol use following the trauma. Finally, other vulnerability factors such as social-economic and social-professional deficits were sought by the social support questionnaire.

2.6 Statistical analyses

The statistical methods used to identify explanatory factors for the development of PTSD in trauma-exposed victims included both univariate multinomial logistic regression and multivariate multinomial logistic regression analyses. The group without PTSD was used as the reference group in the analyses. Typically, variables with a p-significance level of less than 0.20 in the univariate analysis were included in the initial multiple logistic regression model (50). This threshold allows for the consideration of possible confounding factors. Additionally, variables that are known in the literature to be associated with pathology but did not reach the significance level of 0.20 in the univariate analysis were also included in the initial model. Finally, in cases of redundancy between variables, only the most significant variable was included in the model (50), (Figure 1).

When aiming to develop an explanatory model, certain procedures can be implemented to select the variables to be included. The objective is to select the model that provides the maximum amount of information on the variable to be explained (Y) from the smallest possible number of explanatory variables (Xi) while adhering to the principle of parsimony (using the fewest possible explanatory variables to explain a phenomenon) (50). To facilitate model estimations and limit problems related to missing data, individuals with missing data were removed from the analysis (13% of the sample).

It is also important to ensure that there are enough events (e.g., patients with PTSD) compared to the number of explanatory variables (Xi). A general rule is to have at least ten times more events than explanatory variables included in the logistic regression model (50).

To retain as many explanatory variables as possible without decreasing power, the selected variables were studied in three independent time blocks: pre-trauma, peri-trauma, and post-trauma. Multiple logistic regression was performed on each block to obtain an explanatory model for the impact of the predictors on the presence or absence of PTSD.

These analyses were performed on R via the glm-package.

3 Results

3.1 Participants

Of the 115 included subjects, 50 participants (43.5% of the total sample) had no PTSD symptoms, and 65 (56.5% of the total sample) exhibited PTSD symptoms. The latter group can be divided into two subgroups according to their PTSD status: a group of 35 participants (30.4% of the total sample) with partial PTSD, and a group of 30 participants (26.1% of the total sample) with full PTSD.

56 participants were women (48.7%) and 59 were men (51.3%). The average age of the study population was 36.4 years (standard deviation: 7.57). Furthermore, 93% were educated to high school level (the French *baccalaureate*), and 40% had received a further five years (or more) of education. Finally, 53% were married or in a common-law relationship, and 83.5% were in employment. Table 1 provides an overview of the descriptive statistics for the study population.

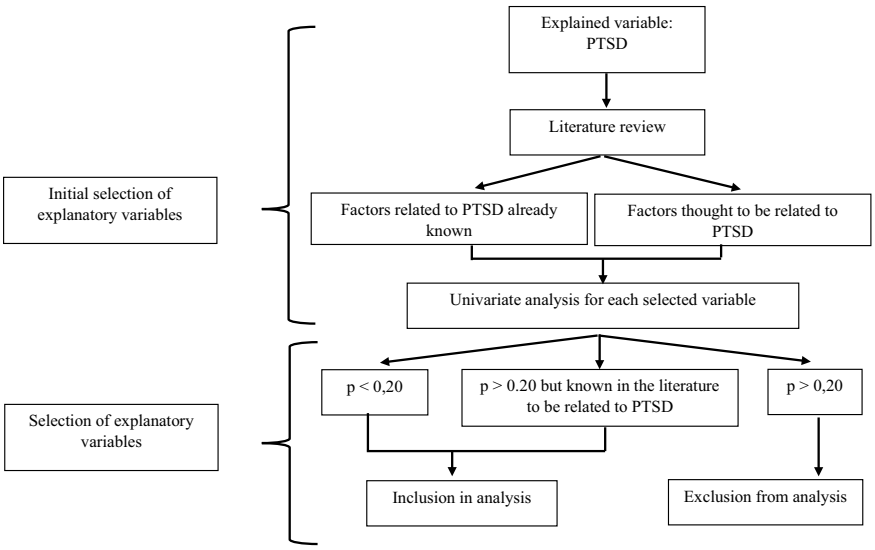

FIGURE 1
Diagram explaining the process of selecting the variables to be included in the multiple logistic regression model.

3.2 Pre-traumatic factors

Table 2 presents the results of the univariate analysis performed on the pre-trauma variables selected for the multiple logistic

TABLE 1 Socio-demographic statistics for the study population as a function of PTSD group (no PTSD, partial PTSD, full PTSD).

Characteristic	No PTSD, N = 50[1]	Partial PTSD, N = 35[1]	Full PTSD, N = 30[1]
Sex			
Men	30 (60%)	16 (46%)	13 (43%)
Women	20 (40%)	19 (54%)	17 (57%)
Age	34 (31,41)	36 (30,43)	36 (31,40)
Marital status			
Single	16 (32%)	15 (43%)	15 (50%)
In a relationship	15 (30%)	8 (23%)	8 (27%)
Married or civil partnership	14 (28%)	9 (26%)	7 (23%)
Separated, divorced or widower	5 (10%)	3 (8.6%)	0 (0%)
Professional status			
No activity	8 (16%)	4 (11%)	7 (23%)
In activity	42 (84%)	31 (89%)	23 (77%)
Education level			
<Bac	3 (6.0%)	3 (8.8%)	1 (3.3%)
Bac – Bac+5	23 (46%)	18 (53%)	20 (66.7%)
> Bac+5	24 (48%)	13 (38%)	9 (30%)
Unknown	0 (0%)	1 (0.2%)	0 (0%)

[1]n (%); Median (IQR).

TABLE 2 Results of univariate analysis of pre-trauma factors.

Characteristic	No PTSD, N = 44[1]	Partial PTSD, N = 31[1]	Full PTSD, N = 25[1]	p-value[2]
Sex				0.3
Men	27 (61%)	15 (48%)	11 (44%)	
Women	17 (39%)	16 (52%)	14 (56%)	
Marital status				0.3
Single	14 (32%)	14 (45%)	15 (60%)	
In a relationship	14 (32%)	6 (19%)	5 (20%)	
Married or civil partnership	13 (30%)	8 (26%)	5 (20%)	
Separated, divorced or widower	3 (6.8%)	3 (9.7%)	0 (0%)	
Professional status				0.6
No activity	7 (16%)	4 (13%)	6 (24%)	
In activity	37 (84%)	27 (87%)	19 (76%)	
Education level				0.6
<Bac	3 (6.8%)	3 (9.7%)	1 (4.0%)	
Bac – Bac+5	20 (45%)	17 (55%)	16 (64%)	
> Bac+5	21 (48%)	11 (35%)	8 (32%)	
Psychiatric history				**0.090**
Absence	32 (73%)	17 (55%)	12 (48%)	
Presence	12 (27%)	14 (45%)	13 (52%)	

(Continued)

TABLE 2 Continued

Characteristic	No PTSD, N = 44[1]	Partial PTSD, N = 31[1]	Full PTSD, N = 25[1]	p-value[2]
Age	34 (31, 40)	36 (30, 44)	36 (30, 40)	0.8
Childhood history	2.00 (1.00, 4.00)	2.00 (1.00, 3.50)	3.00 (2.00, 5.00)	0.3
Trauma history	2.00 (0.75, 3.00)	1.00 (0.00, 3.00)	3.00 (1.00, 4.00)	**0.031**

[1]n (%); Median (IQR).
[2]Pearson's Chi-squared test; Fisher's exact test; Kruskal-Wallis rank sum test.
The p-values highlighted in bold are the values that were included in the multivariate logistic regression analysis because they were p < 0.20.

regression analysis, as described in the methodology section. Psychiatric and trauma history were included in the multiple logistic regression analysis as their p-value was less than 0.20. Age and sex were also included in the multivariate analysis, as they are known risk factors according to the literature, regardless of their p-values (p=0.8 and p=0.3, respectively).

After conducting the multivariate analysis on the pre-trauma factors, it was found that trauma history emerged as a significant risk factor solely for full PTSD (OR=1.30, 95% CI [1.02-1.66], p<0.05). In contrast, neither psychiatric history, gender nor age were identified as significant factors for either full or partial PTSD (Table 3).

TABLE 3 Association between potential pre-traumatic predictors and presence of full and partial PTSD in a multivariate logistic regression (N =99).

Characteristic	OR[1]	95% CI[1]	p-value
Partial PTSD			
Trauma history	0.96	0.75, 1.25	**0.038**
Sex			0.20
Men	–	–	
Women	2.01	0.75, 5.34	
Psychiatric history			0.094
Absence	–	–	
Presence	2.20	0.81, 5.97	
Age	1.03	0.97, 1.10	0.66
Full PTSD			
Trauma history	1.30	1.02, 1.66	**0.038**
Sex			0.20
Men	–	–	
Women	2.37	0.81, 6.97	
Psychiatric history			0.094
Absence	–	–	
Presence	3.02	1.02, 8.98	
Age	1.01	0.94, 1.09	0.66

[1]OR, Odds Ratio; CI, Confidence Interval.
The p-values highlighted in bold are those that emerged as significant following multivariate logistic regression analysis as they were below p < 0.05.

3.3 Peri-traumatic factors

Table 4 presents the results of the univariate analysis of the peri-trauma variables selected for the multiple logistic regression analysis, as described in the methodology. Specifically, degrees of exposure (direct exposure and repeated exposure to painful details), intensity of physical and emotional reactions, and peritraumatic dissociation were included in the multiple logistic regression (p < 0.20).

Subsequently, a multivariate logistic regression was performed on these variables, and the results are presented in Table 5. The analysis revealed that only the intensity of peri-traumatic physical reactions was a significant risk factor for both partial PTSD (OR = 1.13, 95% CI [1.02-1.24], p < 0.001) and full PTSD (OR = 1.22, 95% CI [1.09-1.36], p < 0.001).

3.4 Post-traumatic factors

Table 6 presents the results of the univariate analysis of the post-trauma variables selected for multiple logistic regression, as described in the methodology. Variables with a p-value <0.20 in the univariate analysis were included in the multivariate analysis.

TABLE 4 Results of univariate analysis of peri-trauma factors.

Characteristic	No PTSD, N = 50[1]	Partial PTSD, N = 35[1]	Full PTSD, N = 30[1]	p-value[2]
Direct exposure				**0.004**
Absent	24 (48%)	5 (14%)	8 (27%)	
Present	26 (52%)	30 (86%)	22 (73%)	
Direct witness				0.8
Absent	43 (86%)	32 (91%)	26 (87%)	
Present	7 (14%)	3 (8.6%)	4 (13%)	
Traumatic event involving a close relative				0.5
Absent	48 (96%)	34 (97%)	27 (90%)	
Present	2 (4.0%)	1 (2.9%)	3 (10%)	
Repeated exposure to painful details				**<0.001**
Absent	35 (70%)	34 (97%)	29 (97%)	
Present	15 (30%)	1 (2.9%)	1 (3.3%)	
Initial physical reactions	14 (12, 19)	21 (15, 26)	25 (21, 33)	**<0.001**
Initial emotional reactions	32 (25, 38)	37 (32, 41)	40 (36, 47)	**<0.001**
Peritraumatic dissociation	33 (20, 45)	34 (25, 54)	45 (32, 52)	0.089

[1]n (%); Median (IQR).
[2]Pearson's Chi-squared test; Fisher's exact test; Kruskal-Wallis rank sum test.
The p-values highlighted in bold are the values that were included in the multivariate logistic regression analysis because they were p < 0.20.

TABLE 5 Association between potential peri-traumatic predictors and presence of full and partial PTSD in a multivariate logistic regression (N =99).

Characteristic	OR[1]	95% CI[1]	p-value
Partial PTSD			
Direct exposure			0.23
Absent	–	–	
Present	2.94	0.76, 11.4	
Repeated exposure to painful details			0.32
Absent	–	–	
Present	0.24	0.02, 2.74	
Initial emotional reactions	0.99	0.92, 1.07	0.94
Initial physical reactions	1.13	1.02, 1.24	**<0.001**
Peritraumatic dissociation	1.00	0.97, 1.03	0.99
Full PTSD			
Direct exposure			0.23
Absent	–	–	
Present	1.29	0.33, 4.96	
Repeated exposure to painful details			0.32
Absent	–	–	
Present	0.26	0.02, 3.06	
Initial emotional reactions	1.01	0.92, 1.10	0.94
Initial physical reactions	1.22	1.09, 1.36	**<0.001**
Peritraumatic dissociation	1.00	0.97, 1.04	0.99

[1]OR, Odds Ratio; CI, Confidence Interval.
The p-values highlighted in bold are those that emerged as significant following multivariate logistic regression analysis as they were below $p < 0.05$.

TABLE 6 Results of univariate analysis of post-traumatic factors.

Characteristic	No PTSD, N = 48[1]	Partial PTSD, N =32[1]	Full PTSD, N = 26[1]	p-value[2]
Alcohol consumption	4.0 (1.8, 6.2)	4.5 (3.0, 6.2)	4.5 (3.0, 7.8)	0.4
Depression	3.0 (0.0, 6.2)	5.0 (3.0, 12.0)	11.0 (6.0, 14.0)	**<0.001**
Anxiety trait	28 (23, 33)	35 (27, 40)	37 (29, 46)	**0.006**
Anxiety state	40 (31, 46)	44 (39, 56)	52 (43, 60)	**<0.001**
Social support from a close relative				**0.024**
No	10 (21%)	1 (3.1%)	5 (19%)	
A litle	19 (40%)	7 (22%)	8 (31%)	
A lot	6 (12%)	6 (19%)	7 (27%)	
Very much	13 (27%)	18 (56%)	6 (23%)	
Social support from a friend				0.8
No	4 (8.3%)	2 (6.2%)	1 (3.8%)	
A litle	14 (29%)	8 (25%)	9 (35%)	
A lot	14 (29%)	7 (22%)	9 (35%)	
Very much	16 (33%)	15 (47%)	7 (27%)	
Coping	54 (46, 62)	59 (53,64)	61 (54, 66)	**0.029**
Thought suppression	46 (36, 56)	52 (43, 59)	62 (57, 66)	**<0.001**

[1]n (%); Median (IQR).
[2]Fisher's exact test; Kruskal-Wallis rank sum test.
The p-values highlighted in bold are the values that were included in the multivariate logistic regression analysis because they were $p < 0.20$.

The multivariate analysis identified the difficulties in suppressing intrusive thoughts as the main risk factor for full PTSD (OR = 1.11, 95% CI [1.02-1.21], $p < 0.013$) (Table 7).

4 Discussion

Faced to the wide variety of PTSD risk factors reported in the literature, we have identified some relevant pre-, peri- and post-traumatic factors associated with the PTSD status 8-18 months after the Paris' attacks.

The study of pre-traumatic risk factors has shown that, unlike certain findings in existing literature, no socio-demographic data was identified as correlating with the risk of developing PTSD symptoms in this sample, particularly concerning sex, education level, and age at the time of trauma. Their direct correlation with PTSD risk can vary due to multiple factors. These factors often interact in complex ways with other variables, such as the nature of the trauma, available social resources, or cultural differences. Trauma responses and PTSD expression may be influenced by different cultural norms, making generalization of findings challenging. Additionally, the diversity of studied samples and the intricate interplay between sociodemographic factors and other contextual variables can obscure the direct association with PTSD, leading to variability in study conclusions. This absence of association in this study can be attributed to the relatively limited age diversity within the study group, with almost 48% of individuals falling within the 30 to 40 age bracket. Additionally, over 93% of participants possess a bachelor's degree level of education, encompassing 40% with master's degree or doctoral degree.

The study confirms that prior exposure to traumatic situations represents a significant risk factor for full PTSD (51). There's a pressing need to enhance comprehension of the mechanisms involved in this vulnerability post-trauma (52). Notably, no pre-existing factors were identified as predictive of partial PTSD.

Analysis into peri-trauma risk factors has revealed that the intensity of physical reactions during the trauma strongly correlates with the risk of developing PTSD symptoms, both for partial and full PTSD. This observation underscores the significance of peri-traumatic physical reactions in the onset of post-traumatic stress disorder. An abnormal stimulation of the hypothalamic-pituitary system, and autonomic nervous system, the initial points for stress responses during trauma indicated by the intensity of initial physical reactions, could lead to a maladaptive stress response

TABLE 7 Association between potential post-traumatic predictors and presence of full and partial PTSD in a multivariate logistic regression (N =99).

Characteristic	OR[1]	95% CI[1]	p-value
Partial PTSD			
Depression	1.01	0.86, 1.18	0.42
Anxiety trait	1.03	0.97, 1.10	0.57
Anxiety state	1.03	0.95, 1.13	0.45
Social support from a close relative	7.31	0.84, 63.9	0.057
Coping	1.03	0.98, 1.09	0.14
Thought suppression	1.00	0.95, 1.05	**0.013**
Full PTSD			
Depression	1.10	0.93, 1.31	0.42
Anxiety trait	1.03	0.96, 1.11	0.57
Anxiety state	0.97	0.88, 1.07	0.45
Social support from a close relative	0.86	0.18, 4.10	0.057
Coping	1.05	0.98, 1.12	0.14
Thought suppression	1.11	1.02, 1.21	**0.013**

[1]OR, Odds Ratio; CI, Confidence Interval.
The p-values highlighted in bold are those that emerged as significant following multivariate logistic regression analysis as they were below $p < 0.05$.

(53–55). This initial response might result in pathological alterations in the mechanisms of traumatic memory formation, as demonstrated by the cortico-limbic system, intricately connected to the hypothalamo-hypophyseal system via the hippocampus and cerebral amygdala, pivotal in managing stress responses, memorization, and forgetting mechanisms (56). These stress-induced changes could also impact the inhibitory system, precipitating the formation of traumatic memory, reflected in intrusions (45). The robust association between physical responses during traumatic events and Post-Traumatic Stress Disorder (PTSD) has garnered substantial support in various studies (13, 14). Two meta-analyses (57, 58), encompassing military, civilian, and police populations, elucidated consistent findings. These analyses underscored the significance of peritraumatic factors as stronger predictors of PTSD in contrast to pretraumatic elements. These intense reactions serve as significant indicators of future post-traumatic symptom severity in certain individuals. However, these studies have revealed that the severity of PTSD can be moderated by factors such as social support, individual coping strategies, or perceived control during the traumatic event (14, 59). These elements play a role in how physical responses manifest into PTSD symptoms evolution, potentially elucidating the variations seen in different study outcomes. The intricate interplay among physical reactions, contextual factors, and individual characteristics emphasizes the necessity of considering these interrelated aspects to comprehensively comprehend their impact on PTSD.

Finally, the examination of post-trauma risk factors has indicated that individuals experiencing full and partial PTSD have difficulties in suppressing intrusive thoughts. This result corroborates functional imaging findings, reinforcing the proposal that the intrusiveness and disrupted control process represents a central aspect in the pathophysiology of PTSD (45, 46). Over the past two decades, evidence has emerged indicating that the prefrontal cortex plays a crucial role in halting retrieval of unwanted memories by targeting memory-related regions, thereby suppressing hippocampal and neocortical activity (60). Compromised control mechanisms and the distress associated with such intrusive thoughts maintain PTSD, but could also constitute risk factors for anxiety and depression (61, 62). Although, our findings suggest an association between depression, anxiety, and an increased risk of PTSD, they do not, however, entirely elucidate this risk when compared to other contributing factors. This suggests that depression and anxiety might co-occur with PTSD rather than directly explain its occurrence.

In this study, we investigated both established risk factors for PTSD from existing literature and novel contributing. Firstly, examining prior trauma exposure is pivotal, as it can heighten vulnerability to subsequent traumatic events. Individuals with a history of trauma may demonstrate increased sensitivity to threatening situations, facing challenges in emotion regulation during stress-inducing circumstances, potentially influencing the onset and severity of PTSD symptoms following new traumatic experiences.

The intensity of physical responses during and after traumatic events is another critical area in PTSD research. Heightened physical reactions, such as intense activation of the autonomic nervous system, may correlate with more severe post-traumatic symptoms. Individuals experiencing extreme physical responses during trauma may exhibit a higher likelihood of enduring PTSD symptoms.

Moreover, difficulties in suppressing intrusive thoughts might exacerbate long-term symptoms as they hinder the healthy processing and silencing of traumatic memories.

Integrating these facets into PTSD research underscores the necessity of comprehending the interplay among trauma history, peri-traumatic reactions, and emotional regulation strategies. This understanding elucidates underlying mechanisms and informs more effective treatment approaches. A holistic approach, considering these interrelated factors, enhances comprehension of individual variability in trauma response and offers pathways for targeted and tailored interventions.

5 Implications

Our study explored predictive factors associated with post-traumatic stress disorder (PTSD), specifically within the context of a terrorist attack, providing valuable insights into essential clinical implications. We emphasized that analyzing peri-traumatic physical reactions, coupled with an individual's traumatic history, could serve as a screening tool during the early phase to gauge the risk of developing PTSD.

In a clinical setting, the use of peritraumatic physical reactions to screen for PTSD could involve systematically assessing immediate physical responses after a traumatic event during post-trauma

consultations. Health professionals might utilize standardized questionnaires or scales to gather information about the physical reactions experienced by the patient during or immediately after the trauma. These assessments could be easily used and help identify individuals potentially at risk of developing PTSD, allowing for early and targeted intervention to reduce the risk or severity of the disorder.

Further research is imperative to confirm the role of peri-traumatic reactions in the subsequent onset of PTSD, particularly in the clinical trajectory of PTSD through longitudinal studies.

Additionally, exploring potential connections between the structural and functional alterations associated with peri-traumatic physical symptoms and the operation of central inhibitory control systems (45), alongside amygdalo-hippocampal circuits (56, 63), known to be involved in manifesting classic PTSD symptoms, warrants investigation.

6 Strengths and limitations

Our study is founded on a robust methodological framework, albeit with acknowledged limitations discussed below. We employed standardized and scientifically validated measurement instruments, administered by trained professionals, ensuring the reliability of our data. The study population exhibits relative homogeneity concerning proximity to the traumatic event and sociodemographic characteristics. Our design facilitated an early psychopathological analysis of victims.

Furthermore, our study presents a comprehensive evaluation of a population often overlooked in the literature: individuals experiencing PTSD symptoms who do not meet full DSM5 diagnostic criteria, falling under the classification of partial PTSD. This subgroup represents a significant public health concern. Our findings hold potential to refine the identification of these individuals more accurately, enabling prompt intervention for effective treatment.

However, our study does have limitations that should be considered when interpreting the results. The sample size was relatively small, comprising predominantly young and highly educated participants, which limits the generalizability of our findings to the broader population.

The retrospective measurement of peritraumatic physical reactions may lead to reporting and memorization biases, particularly in the case of dissociative reactions. Nevertheless, a prior longitudinal examination of peri-traumatic reactions within this population failed to demonstrate any consequential impact of this memory bias on the findings (64). Furthermore, devising a peri-trauma measure capable of overcoming this limitation proves to be challenging. Finally, our study is based on psycho-pathological data known to be risk factors for PTSD and does not consider physiobiological mechanistic factors. Nonetheless, the risk factors observed in this context of terrorist attacks can provide a framework for further studies to better understand the mechanisms of vulnerability.

Data availability statement

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

Ethics statement

The studies involving humans were approved by Nord Ouest III Personal Protection Committee (France; 12/2016; ID RCB: 2016-A00661-50). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

BB: Writing – original draft, Writing – review & editing. MT: Writing – original draft, Writing – review & editing. GL: Writing – review & editing. BL: Writing – review & editing. FF: Writing – review & editing. DP: Writing – review & editing. FE: Writing – review & editing. PG: Writing – review & editing. JD: Writing – original draft, Writing – review & editing.

Funding

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

Acknowledgments

We thank all participants for volunteering in this study and the associations of victims who have supported this project. We are grateful to Carine Klein-Peschanski, general secretary to the 13-November Program and Equipment Excellence MATRICE and the researchers; psychologists B. Marteau, L. Besnehard; technicians; and administrative staff at U1077 (Caen), at "Programme 13-Novembre" in Paris, at INSERM "Délégation Régionale Nord-Ouest". We also thank Pierre-Louis Conan for overseeing the statistical analyses and Poppy Mcgeown for editing the English of the main text.

Conflict of interest

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

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 02 April 2024
DOI 10.3389/fpsyt.2024.1367976

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OPEN ACCESS

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RECEIVED 09 January 2024
ACCEPTED 18 March 2024
PUBLISHED 02 April 2024

CITATION
Lee SH, Noh J-W, Kim K-B and Chae J-H (2024) The impact of coping strategies and positive resources on post-traumatic stress symptoms among bereaved families of the Sewol ferry disaster.
Front. Psychiatry 15:1367976.
doi: 10.3389/fpsyt.2024.1367976

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The impact of coping strategies and positive resources on post-traumatic stress symptoms among bereaved families of the Sewol ferry disaster

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Introduction: This study investigated the long-term prevalence of, and factors associated with, post-traumatic stress disorder (PTSD) among the bereaved families of the Sewol ferry disaster, in which 250 students lost their lives during a school excursion.

Methods: Eight years after the disaster, 181 family members were surveyed, and the prevalence of clinical PTSD symptoms was estimated. The Positive Resources Test (POREST), the Duke-UNC Functional Social Support Questionnaire, and the Brief COPE were evaluated using self-report measures. The multivariable binomial logistic regression was used to identify protective and risk factors for PTSD.

Results: PTSD symptoms were present in 49.7% of the family members 8 years after the incident. A one-point increase in the score on the optimism subscale of the POREST was associated with a 20.1% decreased likelihood of having clinical PTSD symptoms (OR = 0.799; p = 0.027; 95% CI = 0.655–0.975). Conversely, a one-point increase in the score on the avoidant subscale of Brief COPE was associated with a 13.2% increased likelihood of having clinical PTSD symptoms (OR = 1.132; p = 0.041; 95% CI = 1.005–1.274).

Discussion: Our results provide evidence of the need for long-term mental health monitoring of bereaved families of disaster victims, along with valuable insights for the development of mental health intervention programs.

KEYWORDS

Sewol ferry disaster, bereaved families, post-traumatic stress disorder, avoidance coping, optimism

1 Introduction

The sinking of the Sewol ferry in 2014 was a tragic incident that claimed the lives of 250 out of the 325 high school students onboard for a field trip. This disaster is regarded as one of South Korea's worst social catastrophes, sparking extensive criticisms and conflicts related to issues like inadequate ship management, errors in judgment by the captain and crew, delayed response, misleading announcements, and perceived mishandling by the government. Even today, the incident remains a highly sensitive and contentious topic, underscoring the severity of the tragedy and the need to address the systemic failures and shortcomings that led to such a devastating loss of life.

Notably, the families of the deceased students continue to suffer from various mental health issues, including depression, anxiety post-traumatic stress disorder (PTSD), and complicated grief (1–3). After conducting a cross-sectional study on the mental health of Sewol Ferry disaster bereaved families 18 months after the incident, the results revealed that 94% experienced complicated grief, 50% reported severe depression, and 70% exhibited clinically significant post-traumatic symptoms (PTSS) (2). When assessing the embitterment of the accident-affected families, it was found to be 63% at 18 months post-incident, increasing to 77% at 30 months. The group experiencing an increase also showed a concurrent rise in anxiety, post-traumatic stress symptoms, and complicated grief (3). Furthermore, the group diagnosed with PTSD and complicated grief among the accident-affected families was found to be associated with a perception of injustice, according to the analysis results (1). Understanding the factors related to PTSD might be crucial to improve these disaster-bereaved families' long-term mental health.

Numerous studies have made significant efforts to identify the risk and protective factors for PTSD (4–10). Coping strategies have been found to play a vital role in mental health outcomes, particularly in individuals who have experienced trauma (4). Adaptive coping strategies often lead to positive outcomes, while maladaptive strategies, such as substance use, may lead to greater impairment (5). Additionally, social support has been identified as a protective factor of PTSD. In a study investigating the impact of a tornado on adolescents, social support, extent of tornado exposure, and sex significantly influenced the development of PTSD (6). Moreover, a meta-analysis study on the influence of social support on PTSS in children and adolescents revealed that most longitudinal studies have indicated that social support is a significant predictor of PTSS (7, 11). According to the results of an online survey conducted among medical students who were locked down during the COVID-19 pandemic period, social support mediated the relationship between positive coping and post-traumatic stress symptoms (8). Furthermore, positive expectancies, self-efficacy, optimism, and hope have been associated with less severe PTSD symptoms. The results of a meta-analysis indicated that positive expectations were predictive of less severe PTSD symptoms (9). Additionally, hope and positivity were associated with post-traumatic growth in oral cancer patients (10).

The burden of PTSD following disasters is known to be significant, and it is associated with various factors such as sociodemographic and background factors, event exposure characteristics, social support factors, and personality traits (12). One of the longitudinal studies on the long-term PTSD symptoms among disaster bereaved families is the research related to the 2011 Utøya terror attack in Norway (13). According to this study, eight years after the disaster, many bereaved parents and siblings were showing long-lasting health consequences with symptoms of PG (Prolonged Grief) and PTS (Post-Traumatic Stress) as well as functional impairment. Moreover, the results of a study conducted 26 years after the 1990 fire on the Scandinavian Star ferry found that high social support plays a significant role in reducing posttraumatic stress symptoms, particularly among individuals with a ruminative coping style (14). In addition, when investigating counterfactual thinking among them, it was suggested that vivid counterfactuals about a traumatic event play a role similar to trauma memories in post-traumatic stress, indicating that they are not beneficial (15).

While various studies have been conducted on the mental health of disaster-bereaved families, there has been relatively limited research on long-term PTSD risk factors and protective factors following disasters. Therefore, this study investigated the plausible predictive role of coping strategies, social support, and positive resources in the long-term prognosis of PTSD in the families of the victims of the Sewol ferry disaster. The study intends to provide valuable evidence that can serve as a foundation for developing mental health-promoting programs tailored to families affected by disasters.

2 Materials and methods

2.1 Study sample and design

This study was conducted in 2022, eight years after the Sewol ferry disaster, targeting parents who lost their children in the accident. With the assistance of the Ansan Onmaeum Center, we met with representatives of bereaved families to explain the purpose and procedures of this study. The representatives understood the intention of our study and promoted it online to the bereaved families, encouraging those interested to participate by sending messages via their mobile phones. Over a period of approximately two months, the research team scheduled individual appointments and conducted surveys with the participants. The analysis included data from 181 participants after excluding 21 individuals with incomplete responses.

2.1.1 Outcome variables

PTSD symptoms were assessed using the PTSD Checklist for DSM-5 (PCL-5), based on the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (16). We ensured that participants responded to PTSD symptoms related to the disaster by adding the phrase 'related to the Sewol ferry incident.'. The PCL-5 comprised 20 items, and total scores range from 0 to 80. A total

score of 33 indicated a provisional diagnosis of PTSD. The Korean version of the PCL-5 was utilized in this study, and it demonstrated good internal consistency and test-retest reliability in the present study (Cronbach's alpha coefficient of 0.963) (17).

2.1.2 Independent variables

In the current study, positive psychological resources were assessed using the Positive Resources Test (POREST), a self-reported instrument for assessing optimism, purpose/hope, self-control, social support, and care (18). The POREST consists of 23 items, and participants provide their responses on a five-point Likert scale ranging from 1 (not true) to 5 (very true). Total scores on the POREST range from 23 to 115, with higher scores indicating more personal positive resources. The Cronbach's alpha coefficient for the POREST in this study was 0.919, indicating good internal consistency.

Social support was measured using the Duke-UNC Functional Social Support Questionnaire (FSSQ) (19). The Korean version of the FSSQ has been validated, demonstrating good psychometric properties (20). The FSSQ comprises 14 items, and participants rate their responses on a five-point Likert scale ranging from 1 (much less than I would like) to 5 (as much as I would like). Total scores on the FSSQ range from 14 to 70, with higher scores indicating higher levels of perceived social support. The Cronbach's alpha coefficient for the FSSQ in this study was 0.954, indicating high internal consistency.

Coping strategies were assessed using the Brief COPE, a well-established self-report measure developed by Carver (1997). The Brief COPE was used to assess coping responses to stress and challenging situations. It comprises 28 items that assess coping strategies commonly employed in response to stressors. The Brief COPE assesses three coping categories: problem-focused coping (active coping, planning, and instrumental support), emotion-focused coping (positive reframing, humor, religion, acceptance, and emotional support), and avoidant coping (self-blame, behavioral engagement, substance abuse, self-distraction, denial, and venting). Each item is rated on a four-point Likert scale. Higher scores indicate greater utilization of stress coping strategies. The Cronbach's alpha coefficient for the Brief COPE in this study was 0.835, indicating good internal consistency.

2.1.3 Covariates

The analyses were adjusted for several covariates, including age, sex, type of health insurance, marital status, and household income. Age was a numeric variable, while sex was dichotomized into male and female categories. The type of health insurance was classified into two groups: national health insurance and "others". The others category included individuals who were beneficiaries of the medical aid program and those who refused to answer. The South Korean medical aid program is comparable to the Medicaid program in the United States, and its beneficiaries include individuals with low socioeconomic status (21). Marital status was dichotomized as married and "others" (those who were separated, divorced, widowed, or had never been married). Household income was categorized into four groups: ≤ 1.99, 2.00–3.99, ≥ 4.00, and those who refused to answer. Household income was measured in monthly units of 1 million South Korean Won, approximately equivalent to USD 1,265 as of 2022.

2.2 Analytical approach and statistics

Descriptive analysis was conducted to summarize the baseline characteristics of the participants and clinically classify the PTSD symptoms. The results are presented as mean and standard deviation (SD) for normally distributed numerical data, median and interquartile range (IQR) for non-normally distributed numerical data, and frequency and percentages for categorical data, as appropriate. To assess the relationship based on the clinical classification of PTSD symptoms, the two-sample t-test was used for analyzing normally distributed numerical data, the two-sample Wilcoxon rank-sum test was used for analyzing non-normally distributed numerical data, and Fisher's exact test was used to analyze the categorical data. Binomial logistic regression was performed to investigate the relationships between related factors for PTSD while controlling for covariates. To assess multicollinearity in the multivariable regression model, the variance inflation factor (VIF) was calculated. Huber-White's sandwich estimator was employed to calculate the heteroscedasticity-robust standard error (22). The threshold for statistical significance was set at $p < 0.05$ for two-tailed tests. All statistical analyses were conducted using Stata/MP 17.0 software (Stata Corp., College Station, TX, USA).

3 Results

Table 1 presents a summary of the baseline characteristics and clinical classifications of PTSD for the study participants. The study included 181 participants with a median age of 53 years, and 56.9% of the participants were female. The proportion of participants exhibiting PTSD symptoms that required clinical attention was 49.7% (n = 90). Among the non-clinical PTSD group, the mean or median score for the FSSQ, and the total score for the POREST and its subscales (except the care subscale), were significantly higher. However, the mean score for the avoidant subscale of the Brief COPE was significantly higher in the clinical PTSD group. Additionally, household income showed a significant negative association with clinical PTSD symptoms. The mean PCL-5 score of study participants were 32.6 ± 19.7.

Table 2 presents the results of the multivariable binomial logistic regression, which aimed to identify protective and risk factors for PTSD. A one-point increase in the score on the optimism subscale of the POREST was associated with a 20.1% decreased likelihood of having clinical PTSD symptoms (OR = 0.799; p = 0.027; 95% CI = 0.655–0.975). Conversely, a one-point increase in the score on the avoidant subscale of Brief COPE was associated with a 13.2% increased likelihood of having clinical PTSD symptoms (OR = 1.132; p = 0.041; 95% CI = 1.005–1.274).

TABLE 1 Clinical classification and baseline characteristics of bereaved family members of the Sewol ferry disaster.

Variable	Post-traumatic stress disorder (PCL-5)						*p-value*
	Non-clinical group (n = 91; 50.3%)		Clinical group (n = 90; 49.7%)		Total (n = 181)		
	n	r%	n	r%	n	c%	
Age (min=26; max=68) *†	54	7	53	6	53	6	0.486
Sex							
Male	41	52.6	37	47.4	78	43.1	0.653
Female	50	48.5	53	51.5	103	56.9	
Type of healthcare insurance							
NHI	80	50.3	79	49.7	159	87.8	0.999
Medical aid	11	50.0	11	50.0	22	12.2	
Marital status							
Married	82	52.6	74	47.4	156	86.2	0.137
Others	9	36.0	16	64.0	25	13.8	
Household income (per million KRW; monthly)							
1.99 or below	9	37.5	15	62.5	24	13.3	0.003
Between 2.00 and 3.99	22	46.8	25	53.2	47	26.0	
4.00 or above	36	72.0	14	28.0	50	27.6	
Not answered	24	40.0	36	60.0	60	33.1	
Positive resources (POREST)							
Total score (min=28; max=106) †	67	21	57	23	64	22.5	0.001
Optimism (min=7; max=32) *	19.1	5.0	15.6	4.8	17.2	5.2	< 0.001
Purpose/hope (min=6; max=30) *	16.4	5.6	14.6	5.2	15.4	5.5	0.044
Self-control (min=5; max=24) *	14.7	4.0	13.2	3.9	13.9	4.0	0.024
Social support (min=3; max=15) †	9	3	8	4	8	4	0.001
Care (min=2; max=10) *	6.7	1.9	6.3	2.1	6.5	2.0	0.154
Social support (FSSQ) (min=14; max=70) *	44.9	14.2	37.4	13.6	41.8	14.4	0.004
Coping strategy (Brief COPE)							
Total score (min=28; max=90) *	55.9	10.5	57.6	10.1	56.8	10.3	0.329
Problem focused (min=6; max=22) †	13	5	12	6	12	5	0.244
Emotion focused (min=10; max=33) †	19	5	17	8	18	6	0.114
Avoidant (min=12; max=42) *	24.3	5.9	27.8	5.7	26.1	6.1	< 0.001

* Values presented as mean and standard deviation (SD).
† Values presented as median and interquartile range (IQR).Clinical subgroup comparisons were performed using Fisher's exact tests for categorical data, two-sample t-test for normally distributed numerical data, and two-sample Wilcoxon rank-sum test for non-normally distributed numerical data.
r%, row percentage; c%, column percentage; NHI, National Health Insurance; KRW, South Korean Won (one million KRW ≈ 1265 US Dollar); PTSD, Post-traumatic stress disorder; PCL-5, PTSD Checklist for DSM-5 (the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders); POREST, Positive Resources Test; FSSQ, Functional Social Support Questionnaire; Brief COPE, Brief Coping Orientation to Problems Experienced.

4 Discussion

In this study, we tracked the mental health of the Sewol ferry disaster victims' families and found that, 8 years after the incident, 49.7% of the families had clinically significant PTSD symptoms. The use of avoidance coping strategies was identified as a risk factor for PTSD, while optimism was a protective factor.

These results have important implications. First, they highlight the lasting impact of traumatic events on mental health, with the prevalence of PTSD being significantly higher in our sample

TABLE 2 Protective and Risk Factors associated with post-traumatic stress disorder.

Variable	OR	Robust SE	*p*-value	LL	UL
Age (min=26; max=68)	1.117	0.100	0.216	0.937	1.331
Sex					
Male	ref				
Female	1.837	1.253	0.373	0.483	6.990
Type of healthcare insurance					
NHI	ref				
Medical aid	0.473	0.513	0.490	0.056	3.971
Marital status					
Married	ref				
Others	6.562	8.314	0.138	0.548	78.606
Monthly Household income (per million KRW; monthly)					
1.99 or below	ref				
Between 2.00 and 3.99	1.943	1.940	0.506	0.274	13.752
4.00 or above	1.000	0.954	0.999	0.154	6.490
Not answered	1.670	1.548	0.580	0.272	10.268
Positive resources (POREST)					
Optimism (min=7; max=32)	0.799	0.081	0.027	0.655	0.975
Purpose/hope (min=6; max=30)	1.093	0.112	0.382	0.895	1.336
Self-control (min=5; max=24)	0.949	0.088	0.570	0.791	1.138
Social support (min=3; max=15)	0.740	0.128	0.082	0.527	1.039
Care (min=2; max=10)	0.827	0.224	0.483	0.487	1.406
Social support (FSSQ) (min=14; max=70)	1.019	0.031	0.548	0.959	1.082
Coping strategy (Brief COPE)					
Problem focused (min=6; max=22)	0.997	0.122	0.981	0.785	1.267
Emotion focused (min=10; max=33)	1.180	0.138	0.155	0.939	1.483
Avoidant (min=12; max=42)	1.132	0.069	0.041	1.005	1.274

OR, odds ratio; SE, standard error; CI, confidence interval; LL, lower limit of 95% CI; UL, upper limit of 95% CI, ref, reference group; NHI, National Health Insurance; KRW, South Korean Won (one million KRW ≈ 1265 US Dollar); PTSD, Post-traumatic stress disorder; PCL-5, PTSD Checklist for DSM-5 (the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders); POREST, Positive Resources Test; FSSQ, Functional Social Support Questionnaire; Brief COPE, Brief Coping Orientation to Problems Experienced.

compared to families affected by other disasters in previous studies. For example, families who experienced the 2004 tsunami disaster had a PTSD prevalence of 34.5%, while bereaved survivors of the 2008 Sichuan earthquake had a prevalence of 16.8% at 18 months after the event (23, 24). The higher prevalence in the Sewol ferry case may be attributable to the nature of the incident, which was a tragic accident during a school excursion (rather than a natural disaster) potentially worsened by the sense of preventability and the role of human error. A systematic literature review on PTSD following man-made disasters reported PTSD prevalence rates ranging from approximately 20% to 75% among survivors or rescuers (12). Bereaved families from the 2011 Utøya terror attack in Norway still showed clinical levels of PTSS in approximately 46% of cases eight years after the disaster (13). While there may be differences in results depending on the research methodology, the prevalence of PTSD tends to be lower following natural disasters compared to human-made and technological disasters (12). Additionally, it should be considered in the interpretation of the results that the participants of this study are parents who have lost children in disasters. According to the review study, bereaved parents exhibited a higher prevalence of mental health issues compared to bereaved spouses and parents who have not experienced loss (25). Furthermore, the study's focus on PTSD symptoms 8 years after the disaster emphasizes the long-term nature of mental health consequences. This underscores the importance of continued monitoring and support for affected families over extended periods, as trauma-related symptoms may manifest or change over time.

Second, the identification of avoidance coping strategies as a risk factor for PTSD among bereaved families aligns with the existing research on maladaptive coping in response to trauma. A meta-analysis revealed that high occupational stress and avoidant coping strategies significantly increase the risk of PTSD among police officers (26). This finding underscores the importance of addressing and modifying avoidance behaviors in therapeutic interventions to promote healthier coping mechanisms and better mental health outcomes for traumatized individuals.

Third, optimism was found to be a protective factor against PTSD, which is encouraging. Previous studies have demonstrated that positive expectancies, such as hope, self-efficacy, and optimism, act as protective factors against PTSD (9, 10). In our study, we specifically found that among the positive resources including optimism, hope, self-control, social support and care, optimism was significantly associated with less severe PTSD symptoms. This suggests that, in the process of striving for nearly a decade to uncover the truth of the tragedy of the Sewol ferry accident, where parents of the victims lost their children, the factor of optimism would be beneficial to their mental health by alleviating feelings of injustice and resentment. This implies that fostering a sense of optimism could play a crucial role in promoting resilience and reducing the impact of trauma on mental health. Integrating optimism-focused interventions into mental health programs may prove beneficial for families affected by disasters.

Fourth, it was noteworthy that this study did not find evidence that social support influences PTSD in the bereaved families of the Sewol ferry disaster. This result contrast with previous research findings in disaster-experienced individuals, suggesting that social support may be one of the protective factors for PTSD (6–8). The bereaved parents have reported experiencing profound embitterment after losing their children in the human-made ferry accident, going through feelings of being cheated, injustice, incompetence, wrongdoing by a perpetrator, and the destruction of their belief and value system (27). In a qualitative analysis of interviews with Sewol ferry disaster bereaved families, it was revealed that they are maintaining only minimal interpersonal relationships due to social withdrawal (28). They reported difficulties trusting others and expressed caution when someone tries to get closer to them since the incident. Survivors who directly witnessed the 2016 attacks in Belgium reported experiencing changes such as aggression, guilt, distrust, or psychosomatic factors like migraine attacks after the incident (29). They felt that others would not understand them, leading to a deterioration in interpersonal relationships. In that regard, it has been suggested that for the improvement of PTSD symptoms, it is important to make clients feel safe in therapy settings and that therapeutic relationships play a role similar to social support (30). Furthermore, the socio-ecological model of resilience has been proposed, suggesting that the best care for trauma survivors is not limited to assisting the individual alone but is achievable when a combination of interpersonal relationships and societal services they belong to is provided. There have been longitudinal studies on the relationship between social support and PTSS depending on the timing after a disaster. Initially after the disaster, it was possible to explain the relationship through social causation (more social support leading to less PTSD), whereas later on, it was found that social selection (more PTSD leading to less social support) was the operative mechanism (31). Therefore, it can be interpreted that, perhaps, bereaved families have experienced significant negative impacts on interpersonal relationships after the incident. As a result, the positive effects of social support on mental health may have been negligible.

The study had several limitations. First, the limited sample, which comprised only 181 families out of an estimated 500 bereaved parents of the 250 deceased students, may impact the generalizability of the findings. Participant recruitment was challenging given the families' anger and skepticism after the accident, which limited the sample size. Nonetheless, the fact that about half of the families registered for the study engaged in long-term follow-up surveys was significant. Second, the method of participant recruitment may have introduced sampling bias, potentially affecting the representativeness of the target population. Therefore, there may be differences between the participating families and those who did not participate. Participants in the study may be more adversely affected by the negative impacts of the incident compared to non-participants. Third, the cross-sectional nature of the study may limit the ability to establish causality between variables, as associations were analyzed at a specific time point. Fourth, even though participants were asked to respond to symptoms related to the Sewol ferry disaster when evaluating PTSD, it is not possible to completely exclude the influence of other events and incidents over the span of eight years. In this regard, given the significantly high prevalence of PTSD among Sewol ferry bereaved parents, follow-up longitudinal studies are necessary.

Despite its limitations, this study provides valuable insights into the mental health challenges faced by parents who lost their children in a human-made disaster and the factors influencing long-term PTSD. The results have practical implications for mental health practitioners and policymakers involved in designing interventions for disaster survivors and victims' families.

Data availability statement

The datasets presented in this article are not readily available because we did not obtain permission from the subjects to disclose the dataset. Requests to access the datasets should be directed to So Hee Lee, sohee.lee@nmc.or.kr.

Ethics statement

The studies involving humans were approved by the Institutional Review Board of the National Medical Center (registration No. NMC-2022-07-079). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SL: Conceptualization, Funding acquisition, Project administration, Supervision, Writing – original draft, Resources, Writing – review & editing. JN: Data curation, Formal analysis, Methodology, Software, Validation, Writing – original draft. KK: Formal analysis, Investigation, Methodology, Resources, Software, Writing – original draft, Visualization. JC: Project administration, Writing – review & editing, Conceptualization, Supervision, Validation.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This research was supported by a grant of the R&D project, funded by the National Center for Mental Health (grant number: MHER22B01).

Conflict of interest

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

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 19 April 2024
DOI 10.3389/fpsyt.2024.1367799

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OPEN ACCESS

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RECEIVED 09 January 2024
ACCEPTED 26 March 2024
PUBLISHED 19 April 2024

CITATION
Schumacher L, Echterhoff J, Zindler A and Barthel D (2024) Depression among refugee youth in an outpatient healthcare center—prevalence and associated factors.
Front. Psychiatry 15:1367799.
doi: 10.3389/fpsyt.2024.1367799

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Depression among refugee youth in an outpatient healthcare center—prevalence and associated factors

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Background: Due to armed conflict and other crises, many children worldwide have to flee their home country and are, consequently, at a high risk for mental health problems.

Objective: As the majority of previous research on refugee minors focused on post-traumatic stress disorder (PTSD), we aimed to assess the prevalence and risk factors for depression in a clinical sample of refugee youth.

Methods: Data were collected during the standard diagnostic process in an outpatient refugee clinic in Germany. We assessed the prevalence of depression based on a diagnostic interview and investigated the association between age, gender, duration of flight, accompanying status, number of interpersonal traumatic experiences, residence status, and PTSD diagnosis with a depression diagnosis. More specifically, we conducted a Bayesian logistic regression with these associated factors as predictors and the presence of depression as the outcome. Additionally, we conducted a Bayesian network analysis including all these variables.

Results: The majority of the 575 included refugee children were male (n = 423, 73.6%) and, on average, 15.1 years old (SD = 2.69). Nearly half of the children (n = 243, 42.3%) met the diagnostic criteria for depression, of which most also showed a comorbid PTSD diagnosis. We found strong evidence that age, gender, number of traumatic experiences, and a diagnosis of PTSD were related to depression. The network analysis indicated that only age, gender, and PTSD were directly associated to depression. Flight-related factors were only indirectly associated with depression due to their associations with number of traumatic experiences and PTSD diagnosis.

Conclusion: The high prevalence of depression and its strong associations with PTSD suggest that refugee minors are likely to experience depressive symptoms which might develop from PTSD symptoms. This implies a need for monitoring depressive symptoms in refugee minors, especially when these have a PTSD diagnosis.

KEYWORDS

refugee minors, associated factors, depression, PTSD, prevalence

Introduction

Exposure to war, armed conflicts, and persecution in many parts of the world have led to the flight of as many people as never before. The number of forcibly displaced people worldwide reached up to 103 million in mid-2022 (1). By the end of 2021, 36.5 million refugees, nearly half of the refugee population then, were children and adolescents under the age of 18 years (1). Refugee children and adolescents are likely to experience a variety of potentially traumatizing events in their home country, during the flight, and also in their host country (2, 3). These potentially traumatic experiences can lead to severe mental health problems (2). Besides post-traumatic stress disorder (PTSD), one of the most common mental disorders in refugee children and adolescents is depression. A recent systematic review and meta-analysis found an overall prevalence of 13.8% of depression in refugee minors (4). Another systematic review reported a prevalence rate of depression between 10.3% and 32.8% in refugee children, which is considerably larger than the prevalence rate of depression in the general population of children and adolescents (3). Refugee minors with mental health problems often met the criteria for more than one mental health disorder (5), but there is little research about the comorbidity of depression and PTSD in refugee children and adolescents. Nevertheless, Im and colleagues (6) found high rates of comorbidity among Somali refugees in Kenya, with estimates ranging from 21.6% to 28.8%. A recently conducted study examining trauma and levels of psychological distress among unaccompanied refugee minors found estimates ranging between 53.3% and 65.2% for a probable comorbidity of PTSD and depression diagnosis (7). In a small sample of Yazidi refugee minors, PTSD and depression were comorbid in 7.3% of the refugee children andadolescents (8). While several symptoms overlap between a PTSD and depression diagnosis, previous research indicated that both disorders constitute two distinct concepts (9–12). A high comorbidity for PTSD and depression remained even when disregarding overlapping symptoms, and the PTSD or depression symptoms were more strongly associated to symptoms included in the same diagnosis compared to symptoms included in the respective other diagnosis (11, 13). Still the comorbidity between both disorders might be due to relations between individual symptoms, i.e., the presence of specific PSTD symptoms might lead to the presence of depression symptoms or *vice versa* (13). Overlapping symptoms such as sleep problems as well as non-overlapping symptoms such as avoidance of thought seem to play a role for connecting depression and PTSD symptoms (13–15). Initial research indicated that PTSD might be a causal factor for developing subsequent depression; however, their relationship is likely to be complex and bi-directional (12, 16).

To better understand the mental health problems of refugee minors, factors influencing their mental health problems have been investigated. The association of gender with depression in refugee minors seems to be rather heterogeneous in previous literature (17, 18). Fazel and colleagues (18) reported in their review that approximately half of the studies found that girls had more depressive symptoms than boys, while other studies did not find such a gender-related difference. The systematic review of Daniel-Calveras and colleagues (17) also displayed such contradicting results. Furthermore, there seem to be an association between the age at migration and mental disorders (17). A higher age seems to be correlated with a higher burden of psychological problems (19) and with less changing symptoms of depression over time (20). Next to demographic variables, factors of the minors' circumstances can also influence the likelihood of developing mental health problems. Most studies show that a larger number of traumatic experiences are related to more mental health problems (17). As a longer duration of flight might be associated with more traumatic events, flight duration might also impact mental health problems. However, so far, this was not explicitly studied. Furthermore, unaccompanied minors were more likely to experience higher levels of depression (21) and PTSD (22) compared to accompanied children and adolescents. Another factor possibly influencing the mental health of the refugee children and adolescents is the security of their residence status in the host country. In Germany, refugee minors receive a rather safe residence status (e.g., permission to stay in Germany for 3 years) if they obtain asylum or require refugee protection (23). In short, refugees receive asylum or refugee protection if they can prove that they are persecuted in their home country (24). Subsidiary protection for an initial period of 1 year is granted when the refugee can provide

compelling reasons why they face serious harm from political or non-political actors in their home country (25). Current literature suggests that the residence status of refugee children and adolescents is associated with a PTSD diagnosis (26). A systematic review reported that refugee minors with only temporary residency had higher mental health problems compared to those with permanent residency (27). Strikingly, most previous evidence on risk factors in refugee minors relate to mental health problems in general or to PTSD, but hardly directly to depression.

Taken together, refugee minors show a higher prevalence of depression than minors in the general populations, and several factors seem to influence the likelihood of mental health problems in refugee minors. However, as pointed out by Kien and colleagues, the evidence for the prevalence of depression is limited for refugee minors due to risk of bias and inconsistency in previous studies (3). Furthermore, the majority of the current studies on risk factors for mental disorders in forcibly displaced children and adolescents refer primarily to PTSD as an outcome and depression more incidentally (17). Thus, no clear picture on the prevalence and risk factors for depression in refugee minors has emerged yet. One issue that further hampers the understanding of risk factors for depression is that the effect of each individual factor has been investigated in isolation to other factors. This ignores that risk factors also influence each other and together impact the development of depression—for example, unaccompanied children seem to experience significantly more traumatic events than accompanied refugee minors (17) and a longer flight duration is also probably related to a higher number of traumatic events. In this, the interplay between risk factors can be seen as a complex system of interacting variables, and it needs to be investigated as such.

Therefore, the aims of this cross-sectional study were threefold: (1) reporting the prevalence of depression and its comorbidity with PTSD in young forcibly displaced patients of an outpatient healthcare center for refugees in Hamburg, Germany, (2) investigating a variety of associated factors as predictors for a diagnosis of depression in these refugee minors, and (3) exploring the associations among all assessed factors and depression as a complex interacting system with a network analysis.

Materials and methods

Participants and procedure

Data were collected between October 2016 and December 2022 during the standard diagnostic process of the outpatient healthcare center for refugee children of the University Medical Center Hamburg-Eppendorf. This outpatient center provides psychiatric, psychotherapeutic, and psychosocial care for refugee children and adolescents that seek treatment for psychological problems. All children and adolescents that approached the outpatient clinic participated in a standardized diagnostic process. Minors that showed excessive psychological distress, current psychotic symptoms, or signs of intoxication entered a stabilization phase before they continued with the diagnostic process. The diagnostic procedure included the assessment of sociodemographic variables (e.g., gender, age, and residence status) and screening questionnaires for PTSD symptoms (CRIES-8 (28, 29)) and depression symptoms (PROMIS (30)). Additionally, modules of the structured clinical diagnostic interview MINI-KID (31) were implemented to diagnose depression and PTSD according to the ICD-10. Finally, the refugee minors were asked how often they experienced different potentially traumatic events. All assessments were administered in an interview with a psychologist. The assessments were conducted with the help of a language mediator, in the native language of the patient or in German. Children and adolescents were only included if their parents or, when unaccompanied, their legal guardians provided informed consent and ethical approval was received from the Chamber of Psychotherapists in Hamburg (05/2017-PTK-HH).

Measures

All screening and diagnostic instruments used in the diagnostic process were reported elsewhere (32). Only instruments used in the current analysis are described in detail in the following. Relevant measures for the present study were diagnosis of depression and PTSD and the following related factors: gender, age, accompanying status during flight, duration of flight, residence status, and number of interpersonal traumatic events.

Diagnosis of depression and PTSD

Two modules of the of the German version of the "Mini-International Neuropsychiatric Interview for Children and Adolescents" (MINI-KID) were used to assess a depression and PTSD diagnosis. The MINI-KID is a structured diagnostic interview assessing psychological disorders in children and adolescents according to the DSM-IV and ICD-10. It showed very good reliability and validity as well as very good to excellent test–retest and interrater reliability (33).

The MINI-KID module A was used for the assessment of depression diagnosis (31). It assesses the presence and severity of a major depressive episode with 11 items. The three main criteria of depression according to ICD-10 were measured: depressed mood, loss of interest/joy, and loss of energy. In addition, other common symptoms, e.g., difficulty in concentration, sleeping problems, and change in appetite, were assessed. In the present study, two further items were added to allow the diagnosis of a major depressive episode with psychotic symptoms (F32.3) and to differentiate a depressive episode from grief and from depressive symptoms caused by drugs. For the current analysis, the depression variable was dichotomized in 0 = no depressive episode or mild depressive episode (F32.0) and 1 = moderate depressive episode (F32.1) or major depressive episode without psychotic symptoms (F32.2).

PTSD diagnosis was assessed with the MINI-KID module K. The items of module K assessed feelings related to a stressful life

event in the month before the interview using dichotomous response categories (yes/no) per item. Experiencing and re-experiencing a traumatic event was assessed with single items, while avoidance was assessed with seven items and hyperarousal with five items. A PTSD diagnosis was present if the items on experiencing and re-experiencing a traumatic event were answered with "yes" in combination with at least two symptoms of avoidance and one symptom of hyperarousal.

Associated factors for a diagnosis of depression

The following sociodemographic variables were assessed by self-report: age, gender (0 = male, 1 = female), number of interpersonal traumatic experiences, accompanying status during flight (0 = accompanied, 1 = unaccompanied), flight duration (in days), and residence status (0 =secure, 1 = insecure). The number of traumatic experiences was measured by a study-specific questionnaire that contains items derived and modified from other questionnaires (32). The instrument assessed the frequency of the occurrence of 12 different specific interpersonal traumatic experiences with "never", "once", "several times", and "not clear", and the life phase in which the traumatic event occurred (home country, flight, and host country/Germany). These traumatic experiences included, for example, exposure to war, neglect, separation from family/close friends, and different forms of abuse. To calculate a sum score for the interpersonal traumatic events, answers were coded with the following scores: "never" = 0, "once" = 1, and "several times" = 2. Accompanying status during flight was defined as the presence of a parent or a legal guardian during the flight. The residence status was dichotomized in 0 = secure (residence permit) and 1 = insecure (temporary resident permit, exceptional leave to remain, and church asylum were not regarded as a secured residence status). It is worth noting that we did not consider home country as an associated factor since it seems a rather indirect approximation for describing the previous experiences of the children. Especially when considering the long time frame of this study (2016–2022), the home country of the refugee minor might have had a different impact depending on the situation in the respective country at a given time point.

Statistical analysis

Missing data of the previously described risk factors and diagnosis of depression were imputed before the analysis with the EM algorithm. The prevalence of depression diagnosis and its comorbidity with PTSD, a Bayesian logistic regression, and a Bayesian cross-sectional network analysis were calculated. A sensitivity analysis with complete cases was also computed. The data was analyzed with R version 4.42 using the packages brms (34) and BDgraph (35).

Prevalence of depression and comorbidity with PTSD

The prevalence of depression diagnosis and its 95% confidence interval were calculated. The 95% confidence interval was calculated with SE= $\sqrt{(p\ (1 - p)/n)}$. Additionally, the comorbidity with a PTSD diagnosis was examined.

Bayesian logistic regression

A Bayesian logistic regression was calculated to test the association between several associated factors with a depression diagnosis. The factors age, gender, duration of flight, number of traumatic experiences, accompanying status, residence status, and diagnosis of PTSD were included in the model as predictors and diagnosis of depression as outcome. We choose weakly informative priors for all parameters using a normal distribution with a mean of 0 and a standard deviation of 2, which grant more weight to small values. The regression was conducted with the R package brms. The model was estimated with Markov chain Monte Carlo sampling with 10 chains, each with 5,000 iterations. For each predictor, we calculated a Bayes factor (BF_{01}) that indicates how much evidence the data provides that the predictor is larger than zero.

Bayesian network analysis

Network analysis is a methodological approach that aims to investigate the interaction between variables. Networks display the conditional dependencies between all included variables, i.e., how variables are associated while taking all other variables into account. Bayes network analysis uses Bayesian inference to estimate the associations among variables, given prior information and the observed data. This method allows to quantify the certainty of each estimated parameter. A Bayesian mixed graphical model was estimated with the R package BDgraph (35). Age, duration of flight, and number of traumatic experiences entered the network analysis as continuous variables, while gender, accompanying status (flight), residence status, PTSD diagnosis, and depression diagnosis were added as categorical variables. A noninformative prior on the network structure was determined, i.e., a prior edge inclusion probability of 0.5 was specified. For the prior of the precision estimate, a G-Wishart distribution with three degrees of freedom was defined. Edges, i.e., associations between individual variables, with a posterior inclusion probability of at least 50%, were displayed in the network models. Edge weights show how strongly two variables were connected. For each estimated edge weight, a Bayes factor (BF) was calculated, which suggests how probable the respective connection is present or absent in the network. A BF_{10} of one indicates equal evidence for edge inclusion and exclusion (36). In the current study, we considered a BF higher than 10 as strong evidence for the presence of an edge/association and a BF between 3 and 10 as weak evidence for this edge/association.

Results

Sample description

Sample characteristics of the $N = 575$ recruited participants are displayed in Table 1. Data on all associated factors was available for 318 refugee minors. Missing data for each analyzed variable ranged from one missing data point for gender to 178 missing data points

10.3389/fpsyt.2024.1367799

TABLE 1 Sociodemographic characteristics of the sample (*N* = 575).

	n	%
Gender		
Male	423	73.57
Female	151	26.26
NA	1	0.17
Home country		
Afghanistan	223	38.78
Syria	111	19.30
Iran	39	6.78
Eritrea	32	5.57
Somalia	26	4.52
Guinea	25	4.35
Egyptian	9	1.57
Other	106	18.43
NA	4	0.70
Accompanying status (flight)		
Accompanied	256	44.52
Unaccompanied	306	53.22
NA	13	2.26
Residence status		
Secure	215	37.39
Insecure	328	57.04
NA	32	5.57
Housing condition (Germany)		
Supervised youth living (full-time)	131	22.78
Housing shelter	103	17.91
Supervised youth living (part-time)	95	16.52
With parents	93	16.71
Own apartment	50	8.70
Primary care facility	31	5.39
Other	55	9.57
NA	17	2.96

N = 575. The participants were, on average, 15.09 years old (SD = 2.69, range = 7–20 years).

for duration of flight, with a median of 69 missing data points for each variable. The majority of the sample was male (*n* = 423, 73.6%), and the participants were, on average, 15.1 years old (*SD* = 2.69, range = 7–20 years). As displayed in Table 1, most refugee minors came from Afghanistan (*n* = 223, 38.8%), were unaccompanied during flight (*n* = 306, 53.2%) and in Germany (*n* = 286, 49.7%), and had an uncertain residence status (*n* = 328, 57.0%). Nearly one quarter of the sample were currently living in a supervised youth living (*n* = 131, 22.8%). The participants had a mean number of 13.6 of traumatic experiences ranging from 0 to 38 experiences, and the mean duration of the flight was 349.5 days (range = 0–3,285 days). About half met the criteria for a PTSD diagnosis (*n* = 301, 52.35%).

TABLE 2 Comorbidity depression diagnosis with PTSD diagnosis.

		No/ mild depression	Moderate/ severe depression	Sum
		N (%)	*N* (%)	*N* (%)
No PTSD	*N* (%)	195 (33.91)	49 (8.52)	244 (42.43)
PTSD	*N* (%)	137 (23.83)	194 (33.74)	331 (57.57)
Sum	*N* (%)	332 (57.74)	243 (42.26)	575 (100)

Diagnosis criteria of the ICD-10 were applied.
PTSD, post-traumatic stress disorder.

Prevalence of depression and comorbidity with PTSD

Nearly half of the refugee minors met the criteria of a depression diagnosis (*n* = 243, 42.26%). More specifically, 2% (CI: 1%–3%) met the criteria for a mild depressive episode, 11% (CI: 8%–13%) for a moderate depressive episode, and 31% (CI: 28%–35%) for a severe depressive episode. Table 2 shows the comorbidity between a diagnosis of moderate to severe depression and a PTSD diagnosis. Most participants had no depression and no PTSD diagnosis or a comorbid PTSD and depression diagnosis (about one-third each). Only a few refugee minors (*n* = 49, 8.5%) had a depression diagnosis and no comorbid PTSD diagnosis.

Bayesian logistic regression

The results of the Bayesian logistic regression are displayed in Table 3. The multicollinearity between predictors was checked with bivariate correlations and the variance inflation factor (VIF), indicating a maximal correlation between predictors of 0.54 and a maximum VIF of 1.62. Significant predictors for a depression

TABLE 3 Results of the logistic regression analysis.

Predictors	OR	95% CI	BF_{01}
Age	1.23	1.11–1.36	Inf
Gender (reference = male)	1.91	1.23–3.00	605.06
Duration of flight (in days)	1	1.00–1.00	0.06
N traumatic experiences	1.04	1.01–1.07	201.02
Accompanying status (reference = accompanied)	0.75	0.47–1.20	0.13
Residence status (reference = secure)	1.07	0.69–1.65	1.62
PTSD	3.85	2.45–6.07	Inf

OR, odds ratio; CI, credibility interval; BF, Bayes factor; PTSD, post-traumatic stress disorder.

diagnosis were age, gender, number of traumatic experiences, and a diagnosis of PTSD, i.e., these predictors had 95% probability of influencing the likelihood of a depression diagnosis. More specifically, the regression analysis showed that older participants had a 1.23 higher chance to suffer from a depression than younger participants (OR = 1.23; 95% CI = 1.11–1.36, BF_{01} = Inf). Furthermore, female refugee minors were twice as likely to receive a depression diagnosis than male refugee minors (OR = 1.91; 95% CI = 1.23–3.00, BF_{01} = 605.06). The number of traumatic events increased the likelihood of a depression diagnosis with 1.04 (OR = 1.04; 95% CI = 1.01–1.07, BF_{01} = 201.02). A PTSD diagnosis had the largest impact on the probability of a depression diagnosis, as patients with a PTSD diagnosis were nearly four times more likely to receive a depression diagnosis than patients without a PTSD diagnosis (OR = 3.85, 95% CI = 2.45–6.07, BF_{01}= Inf). The rather high Bayes factor for each of these predictors indicated that we found strong evidence that these predictors are larger than zero. We found somewhat strong evidence that duration of flight and accompanying status during the flight were not related to the likelihood of a depression diagnosis (BF_{01} of 0.06 and 0.13, respectively). The included predictors explained 21.14% of the variance in depression diagnosis (R^2 Bayes).

Bayes network analysis

Figure 1 shows the cross-sectional network including PTSD diagnosis, depression diagnosis, and all associated factors. Depression had a positive connection with age with weak evidence to be present and a positive association with gender with strong evidence to be present, showing again that older age and female gender were associated with a higher likelihood of depression. The two diagnosis variables depression and PTSD were strongly positively associated, and the association showed strong evidence to be present. Furthermore, PTSD was positively linked to the number of traumatic experiences, and the connection had strong evidence of presence. The other factors were also highly associated between each other. The number of traumatic experiences was positively associated with duration of flight and with accompanying status, meaning that minors with a longer flight duration and unaccompanied minors had experienced more traumatic events. Additionally, being unaccompanied was related with older age and insecure residence status. Furthermore, the network showed negative associations between gender and accompanying status and between gender and number of traumatic experiences, which indicate that male individuals were more likely to be unaccompanied and had less traumatic experiences than females. Evidence plots of the network analysis can be found in Supplementary Figure S1.

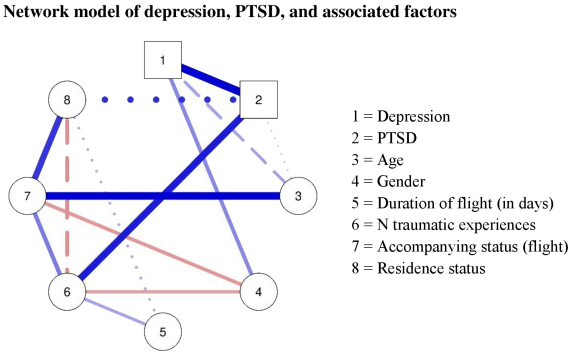

FIGURE 1
Network model of depression, PTSD, and associated factors. Red connections represent negative associations, while blue associations represent positive associations; thickness indicates the strength of the association. A strong evidence for the presence of an association is displayed with a solid line (BF < 10), a weak evidence for an association with a dashed line (BF > 3 < 10), and insufficient evidence (BF < 3) with dotted lines. PTSD, post-traumatic stress disorder; BF, Bayes factor.

Sensitivity analysis with complete cases

As a sensitivity analysis, the prevalence of the depression diagnosis and its comorbidity with a PTSD diagnosis, the Bayesian logistic regression, and the Bayesian network analysis were calculated with complete cases only. The results of the sensitivity analysis are displayed in the supplementary material (Supplementary Tables S1-S3, Supplementary Figure S2) and showed no contradiction to the results of the main analysis.

Discussion

As refugee minors are likely to experience a variety of mental health problems but most knowledge on mental health in refugee minors relate to PTSD, we aimed to assess the prevalence and associated factors for depression in refugee children and adolescents. Furthermore, we assessed how individual factors interact with each other to gain insight into how these factors might directly or indirectly lead to depression. We found that nearly half of this clinical sample met the diagnostic criteria for depression and about half met the criteria for a PTSD diagnosis. Furthermore, about one-third of the young patients experienced comorbid depression and PTSD. Our analysis found strong evidence that older age, female gender, a higher number of traumatic experiences, and a PTSD diagnosis increased the likelihood of meeting the criteria for a moderate or severe depressive episode. With the help of network analysis, we could show that depression was only directly related to age, gender, and PTSD and that flight-related factors were mainly associated to each other and with a PTSD diagnosis.

The observed prevalence of depression is substantially higher than in previous investigations (3, 4), which is not surprising given the clinical nature of this sample (our analyses included children and adolescents that approached the outpatient clinic because of psychological distress). Still, it emphasizes that refugee minors are at a high risk of developing depression and that there is a considerable need for appropriate treatment. The current study also strikingly showed that depression and PTSD are highly comorbid in refugee youth, as the majority of the sample either

had both a depression and PTSD diagnosis or no depression and no PTSD diagnosis. This finding aligns with previous research indicating that depression and anxiety disorders are highly comorbid (37). The finding that older age and female gender are related to depression diagnosis aligns well with research on non-refugee children (38). Similarly, our study could confirm previous literature on the importance of the number of traumatic experiences for experiencing mental health problems (17). With more interpersonal traumatic events experienced, the refugee children were more likely to experience a depressive episode. The strongest predictor of a depression diagnosis was a PTSD diagnosis. This indicates that the activation of PTSD symptoms might have also led to the activation of depression symptoms. Previous studies already showed that depression and PTSD symptoms were strongly linked (14, 15). These findings suggest that PTSD symptoms might lead to the activation of depressive symptoms. Therefore, it might be advisable to also monitor depression symptoms in refugee youth that experience PTSD. However, the pathways between PTSD and depression are likely to be complex and may vary between patient groups (11, 37). Thus, more research on the relation between depression and PTSD is needed.

The network analysis could shed some light on how the different associated factors interacted with each other and directly or indirectly impacted the likelihood of experiencing depression. Interestingly, all environmental factors that related to the fact that children and adolescents fled their home country were only indirectly related to depression. While duration of flight, number of traumatic experiences, accompanying status during flight and residence status were related to each other, we found only evidence for the association between number of traumatic experiences and PTSD, which, in turn, was highly related to depression—that is all environmental risk factors were only connected with depression *via* the number of traumatic events and PTSD. This indicates that in refugee youth flight-related factors seem to influence the likelihood of a PTSD diagnosis which then was associated to depression. Some risk factors might act indirectly through other risk factors on the likelihood of developing depression—for example, female gender, being unaccompanied, and a longer duration of flight were associated with a higher number of traumatic events. This emphasized that risk factors form a complex system of interacting variables, and to promote our understanding of these, we need to investigate their associations simultaneously.

The current study is limited by the fact that we could only investigate cross-sectional associations; therefore, the results can only offer a hypothesis on causal relations between the investigated variables. Furthermore, as all included children and adolescents were recruited at one outpatient center in Germany, future research needs to investigate if such results generalize to other refugee minor samples. Additionally, this study assessed a clinical sample of refugee minors that sought treatment in an outpatient clinic. Thus, the current sample is not representative of the general population of refugee minors in Germany. Finally, the logistic regression indicated that only 21% of the variance in depression were explained by the included variables. Thus, other variables might also play an important role for depression in refugee youth—for example, daily stressors such as worries about family members back in their home countries, perceived discrimination, economic concerns, and others. Still by investigating a large sample and using robust Bayesian analyses, we could gain insights into a highly relevant topic: the mental health of refugee children and adolescents. If future studies replicate our findings, this will indicate that refugee minors with a PTSD diagnosis should be also monitored for depressive symptoms. The next step would be to provide a suitable treatment in order to stop the PTSD symptoms from expanding to depressive symptoms. As our results showed that certain associated factors seem to influence the mental health of refugee minors indirectly, various risk factors and their associations should be considered, as these also might have indirect associations with mental health problems. Most importantly, it seems that a considerable number of refugee minors suffer from depression, and this should not be forgotten when researching and treating the mental health of refugee minors.

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 humans were approved by Psychotherapeutenkammer Hamburg. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

LS: Conceptualization, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review & editing. JE: Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. AZ: Conceptualization, Funding acquisition, Resources, Writing – review & editing. DB: Conceptualization, Data curation, Funding acquisition, Methodology, Project administration, Supervision, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. We acknowledge financial support from the Open Access Publication Fund of UKE - Universitätsklinikum Hamburg-Eppendorf.

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.2024.1367799/full#supplementary-material

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frontiers | Frontiers in Psychiatry

TYPE Original Research
PUBLISHED 28 May 2024
DOI 10.3389/fpsyt.2024.1297953

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OPEN ACCESS

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RECEIVED 20 September 2023
ACCEPTED 26 April 2024
PUBLISHED 28 May 2024

CITATION
Teckchandani TA, Shields RE, Andrews KL, Maguire KQ, Jamshidi L, Nisbet J, Afifi TO, Lix LM, Stewart SH, Sauer-Zavala S, Krakauer RL, Neary JP, Krätzig GP and Carleton RN (2024) Trouble with the curve: the 90–9-1 rule to measure volitional participation inequalities among Royal Canadian Mounted Police cadets during training. *Front. Psychiatry* 15:1297953. doi: 10.3389/fpsyt.2024.1297953

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Trouble with the curve: the 90–9-1 rule to measure volitional participation inequalities among Royal Canadian Mounted Police cadets during training

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Objective: The Royal Canadian Mounted Police (RCMP) Study includes longitudinal multimodal assessments of RCMP cadets from pre-training (i.e., starting the Cadet Training Program [CTP]) to post-deployment and for five years thereafter. The data allow for investigating the multidimensionality of volitional participation in digital health data collection frameworks within serial data collection platforms and the impact of participation inequalities by classifying cadets using the 90–9-1 rule. By classifying cadets as Lurkers, Contributors, and Superusers formally described by the 90–9-1 rule, where 90% of actors do not participate, 9% seldom contribute, and 1% contribute substantially allows for the assessing of relationships between participation inequalities in self-monitoring behaviors as well as whether mental health disorder symptoms at pre-training (i.e., starting the CTP) were associated with subsequent participation.

Methods: Participants were asked to complete a Full Assessment prior to their training at CTP, as well as short daily surveys throughout their training. Participation frequency was described using a process where participants were rank ordered by the number of daily surveys completed and classified into one of three categories. Full assessment surveys completed prior to their training at CTP included screening tools for generalized anxiety disorder (GAD), major depressive disorder (MDD), posttraumatic stress disorder (PTSD), alcohol use disorder (AUD), and panic disorder (PD). The Kruskal-Wallis H test was used to assess differences in participation rates between mental health disorder symptom screening groups for each measure at pre-training, and Spearman's Rho was used to test for associations amongst self-reported Full Assessment screening tool responses and the number of daily surveys completed during CTP.

Results: There were 18557 daily survey records collected from 772 participants. The rank-ordering of cadets by the number of daily surveys completed produced three categories in line with the 90–9-1 rule: Superusers who were the top 1% of cadets (*n*=8) and produced 6.4% of all recordings; Contributors who were the next 9% of cadets (*n*=68) and produced 49.2% of the recordings; and Lurkers who were the next 90% of cadets (*n*=695) and produced 44.4% of daily survey recordings. Lurkers had the largest proportion of positive screens for self-reported mental health disorders at pre-training.

Conclusion: The creation of highly individualized, population-based mental health injury programs has been limited by an incomplete understanding of the causal relationships between protective factors and mental health. Disproportionate rates of disengagement from persons who screen positive for mental health disorders further compounds the difficulty in understanding the relationships between training programs and mental health. The current results suggest persons with mental health challenges may be less likely to engage in some forms of proactive mental health training. The current results also provide useful information about participation, adherence, and engagement that can be used to inform evidence-based paradigm shifts in health-related data collection in occupational populations.

KEYWORDS

mental health, RCMP cadets, public safety personnel, volition, participation

1 Introduction

Public safety personnel (PSP) include, but are not limited to, border services personnel, correctional workers, firefighters, paramedics, police officers, and search and rescue personnel (1). PSP are frequently exposed to potentially psychologically traumatic events (PPTE) as a function of their occupational duties (2). PPTE include direct or indirect exposure to actual or threatened death, serious injury, or sexual violence (1). Exposures to PPTE are associated with increased posttraumatic stress injuries (PTSIs; e.g., major depressive disorder [MDD]; posttraumatic stress disorder [PTSD]) among PSP (3–7). The Royal Canadian Mounted Police (RCMP) report frequent and diverse PPTE exposures (2); in addition, up to half of serving RCMP officers may screened positively for one or more mental health disorders, including PTSD (30.0%), MDD (31.7%), generalized anxiety disorder (GAD; 23.3%0; social anxiety disorder (SAD; 18.7%), panic disorder (PD; 12.0%), and alcohol use disorder (AUD; 3.9%) (4). Early identification of a PTSI could substantially improve prognosis and improve RCMP wellbeing (8).

The RCMP Study (9) provides an opportunity to assess for relationships between completion rates of daily surveys (i.e., regular mental health monitoring) and mental health status. Relative to serving officers, cadets starting the Cadet Training Program (CTP; i.e., pre-training) report far fewer symptoms consistent with mental health disorders (i.e., 2.7% PTSD, 6.6% MDD, 3.6% SAD, 1.6% PD, 0.0% AUD, and 11% GAD; 9). RCMP Study participants volitionally complete short (i.e., ~60 seconds) daily surveys (i.e., assessing mood, attitude, performance, physical wellness, emotional state, hours worked, hours slept, quality of sleep, eating patterns, social activity, physical activity, substance use). The daily surveys allow for ongoing self-monitoring of mental health status. The extant literature suggests an inverse relationship between self-monitoring of mood and self-reported mental health disorder symptoms (8). Self-monitoring of mood can enhance emotional self-awareness and self-regulation (10, 11), thereby increasing help-seeking behaviors (8, 12). Participation analyses are most often used for implementation evaluations associated with digital social health networks, health related blogs, and internet phenomenon (13, 14); however, analyzing daily survey participation may also identify relationships between participation patterns and mental health, informing potential options for providing better supports.

The quantitative evaluation of participation inequalities has emerged as a crucial topic in the successful implementation and management of digital health platforms (15–20). The relationships between participant motivation, use, engagement, and actor status have identified participation inequalities mirroring the 80–20 Pareto principle and participation patterns such as the 90–9-1 rule (18, 21, 22). The 90–9-1 rule classifies user participation into three categories; specifically, Lurkers, Contributors, and Superusers,

where 90% of actors do not participate, 9% seldom contribute, and 1% contribute significantly to the content (15, 17, 18, 22, 23).

The current study was designed to examine the relationship between volitional participation in daily surveys (i.e., the quantity of within-participant daily survey recordings collected during the 26-week CTP) and screening positive for one or more mental health disorders based on self-reported symptoms at pre-training. The current study will also assess for multidimensionality of volitional participation within digital health data collection frameworks and the serial data collection platforms used in the RCMP Study (9). The 80–20 distribution and the 90–9-1 Rule have been applied to biomedical and digital health networks, but the current application is a novel test of RCMP Study participation inequalities associated with groupwise differences across superusers, contributors, and lurkers (9, 17–19, 24). Cadets who screened positively for one or more mental health disorders at pre-training (i.e., starting the CTP) were expected to have fewer recordings than cadets who did not screen positively because of the inverse relationship observed between changes in mental health disorder symptom scores and self-monitoring in RCMP cadets (25).

2 Materials and methods

2.1 Procedure

The current study used data from the RCMP Study, which has been described in detail within a published dedicated protocol paper (i.e., 9). The RCMP Study was approved by the University of Regina Institutional Research Ethics Board (file No. 2019–055) and the RCMP Research Ethics Board (file No. SKM_C30818021312580). The RCMP Study was also approved through a Privacy Impact Assessment as part of the overall approval including the National Administrative Records Management System (NARMS; file No. 201611123286) and Public Services and Procurement Canada (PSPC; file No. 201701491/M7594174191). Study data were collected via online self-report surveys. Mental health disorder symptom self-report surveys were collected at pre-training (i.e., when starting the CTP) and daily surveys were collected throughout the CTP.

2.2 Sample and data

Participants for the current study were RCMP cadets (n = 772; 72% male) who completed the 26-week CTP as part of the Standard Training Program (9). The current study inclusion criteria required participants at pre-training to have completed all items on the administered mental health disorder screening tools administered at pre-training Cadets were Canadian citizens or permanent residents, 19 to 57 years old, who can fluently read, write, and speak either English or French (26). Cadets must meet several recruiting requirements, including security clearances, medical examinations, a polygraph test, and minimum physical standards. There were no conditions requiring exclusion of persons otherwise qualified for the CTP. Participants were provided smartphones free of charge, to facilitate data collection and participation as needed. All communications between the research team and participants, as well as the administration of surveys and individual participant feedback were coordinated through a tailored and dedicated, Protected B status instance of the online learning platform Moodle, paired with an app downloaded to compliant smartphones and accessed using a secured Qualtrics account. Data transfers from participant devices to secured Protected B status research servers in Canada were protected using Transport Layer Security. The RCMP Study also employs a PKI Class 3 SSL Certificate, with a 2048-bit digital signature and 256-bit encryption.

2.3 Self-report measures

Self-report mental health screening tools were administered online at pre-training and included the PTSD Check List 5 (PCL-5; 27); the 9-item Patient Health Questionnaire (PHQ-9; 28); the 7-item Panic Disorders Symptoms Severity Scale, Self-Report (PDSS-SR; 29); the 7-item Generalized Anxiety Disorder scale (GAD-7; 30); the 14-item Social Interaction Phobia Scale (SIPS; 31); and the 10-item Alcohol Use Disorders Identification Test (AUDIT; 32). Questionnaire descriptions and psychometric properties have been provided in the dedicated protocol paper (i.e., 9).

For the PCL-5, per the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5; 33), participants reported on their lifetime exposures (i.e., exposures prior to attending the CTP) to a specific list of PPTEs provided by the Life Events Checklist for the DSM-5 (LEC-5; 27, 34–36). The LEC-5 does not include "sudden and unexpected death of someone close to you" as a potential index PPTE (35). Participants select an index PPTE (i.e., "Consider which event from the list was the worst, most distressing event. If more than one of these events happened to you, select the one event that currently causes you the most distress") against which to rate their past month symptoms using the PCL-5 items. A positive screen on the PCL-5 required participants to report exposure to at least one LEC-5 item, meet minimum criteria for each PTSD cluster, and have a total score >32 (27).

PHQ-9 and GAD-7 items were reported on for the previous 14 days, PDSS-SR items for the previous 7 days, SIPS items for no specified time frame, and AUDIT items for the past 12-months. Based on published guidelines for total scores, positive screens for each scale were established: PHQ-9 > 9 (37); PDSS-SR > 7 (38); GAD-7 > 9 (39); SIPS > 20 (31); and AUDIT > 15 (40). Measures have been validated for screening to identify people who may require follow-up with a clinician.

The daily surveys were brief 20-item self-report surveys completed via smartphone, taking approximately 60 seconds to complete. The daily surveys asked participants to report on the previous 24-hour period. The daily surveys assess participants on several domains including mood, attitude, performance, physical wellness, emotional state, hours worked, hours slept, quality of sleep, eating patterns, social activity, physical activity, and substance use, with details provided in the dedicated protocol paper (i.e., 9).

2.4 Sociodemographic variables

Sociodemographic characteristics were collected for each participant including sex and gender (i.e., male and female), age (i.e., 19 to 29 years, 30 to 39 years, 40 to 49 years, and 50 to 59 years), marital status (i.e., single, separated/divorced, and married/common-law), province of residence (i.e., Western Canada [British Columbia, Alberta, Saskatchewan, Manitoba], Eastern Canada [Ontario, Quebec], Atlantic Canada [Newfoundland & Labrador, Prince Edward Island, Nova Scotia, New Brunswick], or Northern Territories [Yukon, Northwest Territories, Nunavut]), and highest level of education (i.e., high school graduate or less, some post-secondary school, and university degree/4-year college or higher) (9).

2.5 Participation measures

Participation was measured as: (1) the number of completed daily survey recordings completed during CTP; and (2) rank-ordering of participation, in which cadets were rank-ordered by the number of daily surveys completed during their time at CTP and classified into one of three 90–9-1 categories. Superusers were the most frequent contributors to the daily surveys (i.e., top 1%), Contributors were the next most frequent contributors (i.e., next 9%), and Lurkers were the next most frequent contributors (i.e., next 90%).

2.6 Statistical analyses

Sociodemographic characteristics of study participants were described using frequencies and percentages. Percentages were used to describe the prevalence of positive screenings for each mental disorder at pre-training. To test for differences in the number of daily surveys across demographic groups, *t*-tests were used where there were participants in only two groups and analysis of variance (ANOVA) were used where there were participants in three or more groups. The Holm-Bonferroni procedure was used to control the familywise error rate to the nominal $\alpha = .05$ for multiple tests. Effect size estimates for two group comparisons used Cohen's *d* values (i.e., small, *d*=.20; medium, *d*=.50; large, *d*=.80) (41) and for more than two groups used partial eta squared (η_p^2) (i.e., small, $\eta_p^2 = .01$; medium, $\eta_p^2 = .06$; large, $\eta_p^2 = .14$) (41).

The nonparametric Spearman's rho coefficient was calculated to describe the relationship between the number of daily surveys completed and mental health disorder symptom scores at pre-training. Spearman correlations were calculated for the number of daily surveys completed by each cadet and their respective self-report mental health disorder symptom scores at the aggregate and screening category levels (i.e., PCL-5 total scores for all cadets; PCL-5 total scores for cadets that screened negative; PCL-5 total scores for cadets that screened positive) to test for linear relationships within screening categories. The Holm-Bonferroni procedure was implemented to adjust the significance threshold of correlation analyses to reduce the risk of type I errors from multiple comparisons.

The Kruskal-Wallis H test was used to assess differences in participation rates between mental health disorder symptom screening groups for each measure at pre-training (i.e., PCL-5, PHQ-9, SIPS, PDSS, GAD-7 and AUDIT). Shapiro-Wilke tests were performed to test for departures from normality for the mental health disorder symptom scores for the full sample. Complete or 100% participation was defined as at least one record per day for the full duration of CTP, up to a maximum of 182 records over the 26-week CTP. No duplicate recordings were observed. A detailed analysis of attrition, as well as the demographic profiles and pre-training mental health disorder symptoms can be found elsewhere (Carleton et al., submitted[1]). All values were compiled using Microsoft Excel (Microsoft Corporation, Seattle, USA) and imported to IBM SPSS Statistical Analysis Software (IBM, v.26 Premium, New York, USA) for statistical analyses.

3 Results

3.1 Sociodemographics

Details of self-reported participant demographics and symptom scores are provided in Table 1. Shapiro-Wilke tests indicated that no mental health disorder symptom data distributions departed from normality; accordingly, parametric statistical tests were used to compare mental health disorder symptom scores between sociodemographic categories. Participants were mostly male (72.0%), between the age of 19 to 29 years old (59.8%), and single (47.2%) or married/common-law (42.9%). Participants were mainly from Western Canada (52.8%) and reported having either some post-secondary school (43.4%) or a university degree, 4-year College or higher level of education (39.5%). All participants self-identified as cis-gendered, so only sex was used for the analysis.

3.2 Daily survey participation

Kruskal-Wallis tests indicated no statistically significant differences in the quantity of daily surveys completed by participants in screening groups on the AUDIT, $H(1) = 1.247$, $p = .264$, (η_p^2) =.001. There were no statistically significant differences in the quantity of daily survey recordings between screening groups on the PDSS-SR, $H(1) = 2.633$, $p = .268$ (η_p^2) =.001. There were no statistically significant differences in the quantity of daily survey recordings among the negative, mild, moderate, and severe GAD symptom screening groups on the GAD-7 questionnaire, $H(1) = 0.112$, $p = .738$, (η_p^2) =.006. There were no statistically significant differences in the quantity of daily survey recordings among the negative, moderate, and severe MDD symptom screening groups on the PHQ-9, $H(2) = 1.711$, $p = .425$, (

1 Carleton, R. N., Teckchandani, T. A., Sauer-Zavala, S., Maguire, K. Q., Fletcher, A. J., Jamshidi, L., et al. (submitted). Mental Health of Royal Canadian Mounted Police Cadets Completing Training. *Journal of Police and Criminal Psychology*.

TABLE 1 Participant Demographic and Mental Disorder Screening Measure Characteristics.

	Full Survey Sample[2]	PTSD (PCL-5)	*n*	MDD (PHQ-9)	*n*	Generalized Anxiety Disorder (GAD-7)	*n*	SAD (SIPS)	*n*	PD (PDSS-SR)[4]	*n*	AUD (AUDIT)	*n*
	% (n)	*Mean (SD)*		*Mean (SD)*		*Mean (SD)*		*Mean (SD)*		*Mean (SD)*		*Mean (SD)*	
Total Sample													
	100 (772)	5.95 (9.33)	697	3.19 (3.60)	762	4.17 (4.24)	767	5.22 (6.62)	768	4.45 (3.62)	78	3.64 (2.43)	612
Sex													
Male	72.0 (556)	5.36 (8.67)	498	2.93 (3.29)	550	3.77 (3.93)	555	4.74 (6.11)	554	4.79 (3.75)	33	3.81 (2.5)	435
Female	25.1 (194)	7.59 (10.79)	178	4.09 (4.35)	190	5.11 (4.75)	192	6.47 (7.49)	192	5.63 (3.00)	30	3.24 (2.22)	160
Test Statistic[1]	–	t (674) =-2.75**	–	t (738) =-3.84***	–	t(743)=-3.83***	–	t (744) =-3.19**	-	t (61) =-0.98	–	t (593) =2.52**	–
Effect Size (Cohen's d)	–	0.240		0.323		0.321		0.267		0.248		0.233	
Age Group													
19–29 years	59.8 (462)	5.91 (9.29)	413	3.33 (3.75)	458	4.22 (4.29)	460	5.39 (6.64)	463	5.23 (3.84)	39	3.81 (2.53)	370
30–39 years	28.0 (216)	6.25 (9.31)	201	3.31 (3.58)	211	4.38 (4.26)	214	5.52 (6.79)	217	5.50 (2.86)	20	3.43 (2.18)	169
40–49 years	6.3 (49)	6.19 (11.12)	43	2.63 (2.95)	48	3.19 (3.29)	48	3.85 (5.07)	48	^	^	2.67 (1.94)	43
50–59 years	0.6 (5)	^	^	2.40 (1.52)	5	2.40 (2.07)	5	1.40 (2.61)	5	–	–	^	^
Test Statistic[1]	–	F (3,657) =0.48		F (3,718) =0.64		F(3,728)=1.36		F (3,724) =1.47		F (2,60) =0.09	–	F (3,581) =3.54*	
Effect Size (η_p^2)	–	.002		.003		.006		.006		.003		.018	
Marital Status													
Single	47.2 (364)	6.35 (9.62)	328	3.37 (3.78)	358	4.14 (4.08)	362	5.73 (6.78)	362	4.49 (3.85)	35	4.00 (2.63)[a]	280
Separated/ Divorced	1.6 (12)	8.17 (9.39)	12	3.00 (2.63)	12	5.92 (4.64)	12	4.42 (4.60)	12	–	–	4.30 (2.00)[a,b]	10
Married/ Common-Law	42.9 (331)	5.59 (9.06)	300	3.08 (3.55)	327	3.97 (4.24)	328	4.75 (6.29)	329	4.88 (2.94)	26	3.28 (2.17)[b]	264
Test Statistic[1]	–	F (2,637) =0.84		F (2,694) =0.54		F(2,699)=1.31		F (2,700) =2.03		F (2,59) =0.35		F (2,551) =6.46**	
Effect Size (η_p^2)	–	.003		.002		.004		.006		.012		.023	
Province of Residence[a]													
Western Canada (BC, AB, SK, MB)	52.8 (408)	6.63 (9.96)	373	3.43 (3.73)	403	4.62 (4.47)[a]	406	5.73 (6.63)	406	4.49 (3.50)	43	3.56 (2.26)	325
Eastern Canada (ON, QC)	34.6 (267)	4.50 (7.66)	240	2.70 (3.36)	263	3.34 (3.73)[b]	266	4.42 (5.83)	266	3.75 (3.80)	24	3.76 (2.67)	203

(Continued)

TABLE 1 Continued

	Full Survey Sample[2]	PTSD (PCL-5)	*n*	MDD (PHQ-9)	*n*	Generalized Anxiety Disorder (GAD-7)	*n*	SAD (SIPS)	*n*	PD (PDSS-SR)[4]	*n*	AUD (AUDIT)	*n*
	% (n)	*Mean (SD)*		*Mean (SD)*		*Mean (SD)*		*Mean (SD)*		*Mean (SD)*		*Mean (SD)*	
Province of Residence[a]													
Atlantic Canada (PEI, NS, NB, NFL)	11.3 (87)	7.15 (10.52)	75	3.79 (3.69)	86	4.84 (4.38)[a,b]	85	5.48 (8.66)	86	6.10 (3.63)	10	3.80 (2.49)	75
Northern Territories (YK, NWT, NVT)	1.0 (8)	6.14 (9.74)	7	1.38 (0.92)	8	1.50 (1.41)[a,b]	8	2.38 (2.56)	8	–	–	2.43 (1.27)	7
Test Statistic[1]	–	*F* (3,691) =3.04*		*F* (3,756) =3.72**		*F*(3,761)=6.85***		*F* (3,762) =2.61*		*F* (2,74) =1.50		*F* (3,606) =0.99	
Effect Size (η_p^2)	–	.013		.015		.026		.010		.039		.005	
Education													
High school graduate or less	10.2 (79)	6.94 (8.79)	66	3.85 (4.21)	78	4.71 (4.62)	78	5.94 (7.56)	78	6.11 (3.33)	9	3.28 (1.94)	66
Some post-secondary school	43.4 (335)	5.92 (9.32)	309	3.29 (3.57)	328	4.15 (4.28)	332	5.07 (6.41)	332	5.38 (4.13)	21	3.84 (2.61)	262
University degree/ 4-year college or higher	39.5 (305)	5.71 (9.40)	271	3.05 (3.56)	303	3.97 (4.02)	304	5.20 (6.44)	305	4.87 (3.14)	30	3.56 (2.37)	246
Test Statistic[1]	–	*F* (2,643) =0.46		*F* (2,706) =1.56		*F*(2,711)=0.95		*F* (2,712) =0.55		*F* (2,57) =0.46	–	*F* (2,571) =1.65	
Effect Size (η_p^2)	–	.001		.004		.003		.002		.016		.006	

PTSD, post-traumatic stress disorder; PCL-5, PTSD Checklist for DSM-5; PHQ-9, Patient Health Questionnaire; GAD, Generalized Anxiety Disorder; SIPS, Social Interaction Phobia Scale; PDSS-SR, Panic Disorder Symptoms Severity Scale, Self-Report; AUDIT, Alcohol Use Disorders Identification Test.

aAB, Alberta; BC, British Columbia; MB, Manitoba; NB, New Brunswick; NFL, Newfoundland and Labrador; NS, Nova Scotia; NVT, Nunavut; NWT, Northwest Territories; ON, Ontario; PEI, Prince Edward Island; QC, Quebec; SK, Saskatchewan; YK, Yukon.

[1]The test results comparing scores on mental disorder screening measures for demographic variables are reported as t(degrees of freedom)=test statistic for g = 2 groups and as F(numerator degrees of freedom, denominator degrees of freedom)=test statistic for g> 2 groups.

[2]Total percentages may not sum to 100 and ns may not sum to 772 due to non-response or "other" responses.

[4]A limited number of participants reported values for PD (PDSS-SR) because selecting "No" for "ever having experience with panic attacks" or "having panic attack in the last 7 days", meant participants were not presented the rest of the PDSS-SR questions.

*p<.05, **p<.01, ***p<.001 – Statistically significantly different.

^Sample size between 1 and 5, so data not presented. "-" No data available.

Lettered superscripts within each column category indicate statistically significant differences between category groups with different letters on outcome at $p \leq .05$.

η_p^2) =.002. There were no statistically significant differences in the quantity of daily survey recordings between the positive and negative screening groups on the PCL-5, $H(1) = 1.247$, $p = .264$, (η_p^2) =.001.

Bivariate nonparametric within participant correlations indicated a statistically significant inverse relationship between pre-training PCL-5 total scores and the number of daily surveys completed at an aggregate sample level ($p<.05$), but there were no other statistically significant relationships between the number of recordings and the total scores at pre-training. Additionally, no statistically significant linear relationships were observed in pre-training self-report mental health disorder symptom scores amongst screening categories (Table 2).

3.3 Participation classifications

The participants designated as "Superusers" (n=8; i.e., top 1%) contributed 6.4% of all daily survey recordings during the CTP and all screened negative for PTSD, MDD, GAD, SAD, PD, and alcohol use disorder at pre-training (Table 3). The participants designated as "Contributors" (n=69; i.e., next 9%) were mutually exclusive from the Superusers and contributed to 49.2% of all daily survey recordings during the CTP. All Contributors screened negative for PD and alcohol use disorder at pre-training, and fewer than 5 screened positive for PTSD, SAD, or MDD (Table 3). There were 26 (37.7%) Contributors who screened positive for GAD (Table 3). The

TABLE 2 Mental Disorder Screening Prevalence (%) and Descriptive Statistics.

Mental Health Disorder Symptom Scale	Screening Categories	% (n)	Record Count	Score Range	Median Participation % (IQR)	Rho
PTSD (PCL-5)	Total Sample	100 (697)	18557	0-80	13.2 (25.0)	-.103*
	Negative	97.3 (678)	18143	0-32	13.2 (25.3)	-.040
	Positive	2.7 (19)	414	33-80	21.4 (22.5)	-.202
MDD (PHQ-9)	Total Sample	100 (762)	18557	0-27	13.2 (25.0)	-.040
	Negative	93.4 (712)	18420	0-14	13.7 (24.7)	-.028
	Moderate	6.2 (49)	127	15-19	9.9 (20.9)	-.389
	Severe	^ (^)	10	19-27	^	^
GAD (GAD-7)	Total Sample	100 (767)	18557	0-21	13.2 (25.0)	-.063
	Negative	(683)	12884	0-4	13.7 (25.8)	-.010
	Mild	(43)	4258	5-10	12.4 (25.3)	-.066
	Moderate	(29)	1040	11-15	14.8 (23.1)	-.118
	Severe	(12)	375	16-21	10.2 (19.2)	-.061
SAD (SIPS)	Total Sample	100 (768)	18557	0-56	13.2 (25.0)	-.025
	Negative	96.4 (740)	14997	0-33	13.1 (24.0)	.011
	Positive	3.6 (28)	3560	34-56	10.7 (25.3)	.291
PD (PDSS-SR)[1]	Total Sample	100 (772)	18557	0-28	13.2 (25.0)	-.067
	Negative	98.4 (760)	15246	0-11	13.1 (24.5)	.042
	Positive	1.6 (12)	403	12-28	9.0 (17.4)	-.185
Alcohol Use Disorder (AUDIT)	Total Sample	0.0 (0)	18557	0-16	13.2 (25.0)	.060

PTSD, posttraumatic stress disorder; PCL-5, PTSD Checklist for DSM-5; PHQ-9, Patient Health Questionnaire; GAD-7, Generalized Anxiety Disorder Scale; SIPS, Social Interaction Phobia Scale; PDSS-SR, Panic Disorder Symptoms Severity Scale, Self-Report; AUD, Alcohol Use Disorder; AUDIT, Alcohol Use Disorders Identification Test; IQR, Interquartile Range.
*p<.05 – Statistically significantly different.
^Sample size between 1 and 5, so data are not presented to protect participant anonymity.
[1]A limited number of participants reported values for PD (PDSS-SR) because selecting "No" for "ever having experience with panic attacks" or "having panic attack in the last 7 days", meant participants were not presented the rest of the PDSS-SR questions.

participants designated as "Lurkers" (n=695; i.e., next 90%) were mutually exclusive from the Superusers and Contributors and contributed 44.4% of all daily survey records collected during the CTP. The most positive screens at pre-training were among the Lurkers, with 31 (4.5%) screening positive for PTSD, 49 (7.1%) for MDD, 58 (8.3%) for GAD, 28 (4.0%) for SAD, and 12 (1.7%) for PD (Table 3).

4 Discussion

Participating cadets were able to volitionally complete quick (i.e., ∼1 minute) daily surveys with self-assessments as part of the RCMP Study (9). The daily surveys allowed participants to track their physical and mental well-being. Cadets were encouraged to reflect on their emotions, physical health, emotional well-being, amount and quality of sleep, physical exercise, and drug use. The current study was designed to assess for associations between volitional participation inequalities in daily mental health monitoring and pre-training mental health, and subsequently demonstrates the potential for a predisposition to engage in self-monitoring behaviors based on pre-existing self-reported mental health disorder symptoms. Cadets who completed the most daily surveys during the CTP had fewest positive screens for mental health disorders, although the exact relationships are complex and nonlinear.

When interpreting potential confounding factors that contribute to nonresponse bias in the context of participation bias among Superusers, Contributors, and Lurkers within our RCMP Cadet sample, the relationships between pre-training mental health and daily survey participation differ across categories in both strength and direction in ways consistent with previously identified participation biases (15–20). Cadets in the current study also interact with and access the self-monitoring resources and digital social health tools in the same patterns as the general population (17, 18, 42, 43). No statistically significant groupwise differences were observed in the quantity of records produced at the categorical screening level, but groupwise differences were heavily biased by the Contributors and Lurkers (Table 3). Superusers (n=8; i.e., top 1% of Cadets) disproportionately contributed 6.4% of all daily survey recordings and screened negative at pre-training for PTSD, MDD, GAD, SAD, PD, and alcohol use disorder as measured

TABLE 3 Mental Health Disorder Screening Prevalence and Demographics for 90–9-1 Participation Percentile Groupings.

Participation Classification	Current RCMP Study Cadet Participant Results at Pre-Training Assessment		
	Superusers: Top 1%	Contributors: Next 9%	Lurkers: Bottom 90%
Number of Records Produced	6.4% (988)	49.2% (7578)	44.4% (6834)
Disorder	% (*n*)	% (*n*)	% (*n*)
Alcohol Use Disorder – Past 12 Months			
Negative	0.0 (0)	0.0 (0)	0.0 (0)
Positive	0.0 (0)	0.0 (0)	0.0 (0)
PTSD (PCL-5)			
Negative	100 (8)	98.6 (68)	95.5 (664)
Positive	0.0 (0)	^	4.5 (31)
MDD (PHQ-9)			
Negative	100 (8)	98.6 (68)	92.8 (645)
Moderate	0.0 (0)	^	7.1 (49)
Severe	0.0 (0)	0.0 (0)	^
Generalized Anxiety Disorder (GAD-7)			
Negative	100 (8)	62.3 (43)	91.7 (637)
Mild	0.0 (0)	27.5 (19)	3.5 (24)
Moderate	0.0 (0)	^	3.5 (24)
Severe	0.0 (0)	^	1.4 (10)
SAD (SIPS)			
Negative	100 (8)	97.1 (67)	96.0 (667)
Positive	0.0 (0)	^	4.0 (28)
PD (PDSS-SR)[1]			
Negative	100 (8)	100 (69)	98.3 (683)
Positive	0.0 (0)	0.0 (0)	1.7 (12)

AUDIT, Alcohol Use Disorders Identification Test; GAD-7, Generalized Anxiety Disorder Scale; HAMOPD, History of Mood, Anxiety, and Other Psychiatric Diagnoses; PCL-5, PTSD Checklist for DSM-5; PDSS-SR, Panic Disorder Symptoms Severity Scale, Self-Report; PHQ-9, Patient Health Questionnaire; SIPS, Social Interaction Phobia Scale.
^Sample size between 1 and 5, so data are not presented to protect participant anonymity.

by the self-report surveys. Contributors (n=69; i.e., the next 9% of Cadets) produced 49.2% of all daily survey recordings and most screened negative for most disorders. Lurkers (n=695; i.e., the next 90% of Cadets) produced the remaining 44.4% of all daily survey recordings but included the largest number of cadets who screened positive for one or more mental health disorders at pre-training. The results indicate groupwise differences in volitional participation distributions that skew groupwise total scores, and highlight the importance of identifying Superusers, Contributors, and Lurkers with measures of inequality over time, as daily self-monitoring requires consistent, voluntary participation to be therapeutic or prophylactic for mental health disorder symptoms, especially considering that 88.6% of participating RCMP cadets completed fewer than 50% of the possible daily surveys during CTP.

Research and treatment programs that recognize mental health is on a continuum and value promoting well-being may help to minimize stigma and increase help-seeking (7, 44–46). Self-monitoring is an important part of several scientifically validated psychological therapeutic techniques, including dialectical behavior therapy (47), acceptance and commitment therapy (48), Cognitive Behavioral Therapy (CBT; 45, 49, 50), and mindfulness training (10). Patients who record their own thoughts, feelings, and behaviors can analyze their reports as part of a CBT-based intervention and practice self-monitoring (11, 50, 51).

Poor emotional awareness is also a latent cause factor for symptoms of mood- and anxiety-related disorders (52, 53). The ability to identify and appreciate one's own emotions is considered a crucial step in emotional self-awareness that has been positively correlated with adaptive control of emotions and improved mental health (54, 55). Mood self-monitoring can improve emotional self-regulation by increasing general emotional self-awareness (10, 11). By increasing emotional self-awareness and therefore emotional self-regulation through self-monitoring (48, 56), maladaptive anxiety responses can also be restructured, depression-perpetuating behaviors can be challenged (12), and PTSD patients can be well treated in a small but significant percentage of cases (51, 57). Results in the literature demonstrate a positive relationship between self-awareness and self-help behaviors, with a potential link between the process of self-monitoring supported by daily survey completion and therapy methods similar to CBT (12, 45, 49, 50, 58).

The multidimensional dynamicism of volitional participation in digital health frameworks and self-monitoring behaviors has been highlighted regarding digital social health network engagement (13, 16–20) and military applications (59–61). For example, in a cohort of 576,502 newly enlisted United States Military service members between the years of 2003 and 2006, cadets who had a mental health diagnosis at initial eligibility were 77% less likely to deploy and were at higher risk of early attrition (60). Therefore, the likelihood of deployment was considered lower and the risk of early attrition higher for persons with mental health diagnoses at pre-training (60). In the context of the RCMP Study, active engagement with survey material may increase cadet self-awareness and self-reflection, which may impact psychological processes mediating associations between daily survey participation and extant self-reported mental health disorder symptoms (12, 48, 50, 57). Accounting for a link between daily survey participation and self-reported mental health disorder symptoms at pre-training is crucial for subsequent studies assessing patterns of participation, mental health, and attrition, and his evidenced in a related study (25). There may be a voluntary participation bias, such that the non-response bias related to daily survey completions is associated with mental health resiliency, social support, or personality, and interacts

with perceived barriers to help-seeking. The current study results highlight the potential factor of pre-existing mental health disorder status influencing engagement in self-monitoring behaviors, which increases the complexity of successfully implementing regularly administered measurement-based care in occupational and clinical settings.

Evidence-based self-monitoring may implicitly encourage meta-cognitive practices, support active engagement with positive choices for mental health, and facilitate earlier access to care. Accordingly, self-monitoring itself may be an under-used and readily -accessible intervention, in addition to being a tool for measurement-based care or evaluating intervention effectiveness within clinical trials (62). The current results require replication and extension; in the interim, the results provide useful information about participation, adherence, and engagement with self-monitoring, which may inform ongoing assessments of self-monitoring as a proactive intervention for protecting mental health.

4.1 Strengths and limitations

There are several strengths to the current study. First, a large quantity of records was collected from cadets who were recruited to the RCMP Study. The CTP environment facilitates serial data collection and promotes the measurement of participation, adherence, compliance, and attrition by following participants for up to 5 years after completion of the CTP. The classification of cadets using pre-screening self-report surveys facilitates the assessment of volitional engagement without the financial barriers that may otherwise restrict participation because participating cadets were provided with smartphones free of charge, as needed. Participation data collection provides useful information from which to build injury models in retrospect. Participation classification schema allows researchers to investigate the presence or development of changes in volitional engagement and participation that may manifest in the wake of a PTSI. Type I and Type II error risks were protected against by *a priori* statements of expected outcomes (9), and statistical corrections for multiple comparisons, respectively.

There are several limitations to the current study that inform directions for future research. First, there is a lack of data about cadets prior to their pre-screening self-report surveys upon entering the RCMP Study. This left censorship bias is managed by performing a series of evaluations to identify predispositions or underlying mental health disorders. Second, cadets with increased reporting of mental health disorder symptoms may have left the RCMP Study or the CTP because of having worse mental health, creating a self-selection bias within the collected data. Details regarding the causes of participant attrition are limited, with most participants who left the RCMP Study reporting having had insufficient time to participate. Lastly, the replicability and generalizability of the results to a general community sample using a digital health platform is limited by the structural and procedural facilitation of serial data collection during the CTP.

4.2 Future directions

Future directions include the use of survival analyses based on categorical screening variables to examine attrition at defined timepoints, as well as the median time to attrition between groups as data collection continues over the next 60 months. Logistic regression models with discriminant function analyses could also be performed to determine variables that contribute to group identity, considering the participation inequalities identified in the current paper. The 90–9-1 Rule should be implemented longitudinally to assess for changes in participation inequalities as cadets progress through their careers, with recalculations of the 90–9-1 rule participation categories to supplement inequality measures for self-monitoring interventions. The classification schema will allow researchers to assess for changes in volitional engagement and participation that may manifest after a PTSI, whether the injury occurs before a cadet enters the CTP or during field deployment. Effectively examining engagement trends can reciprocally enhance adherence through occupationally- appropriate incentivization or by increasing perceived social and institutional support for mental health monitoring and early intervention.

5 Conclusion

The current results guide future explorations of volitional participation and engagement, as well as the development of adherence promoting interventions that consider the pre-existing mental health status of cadets. The multidimensional relationships between Superusers, Contributors, and Lurkers regarding volitional participation in daily surveys during CTP highlights that RCMP Cadet participation does not differ from the general population (17, 42, 43, 63). Lastly, cadets interact with and access the self-monitoring resources and digital social health tools in the same patterns as the general population (17, 18, 42, 43). Evidence that Cadets exhibit interaction patterns similar to the general population, despite reduced barriers to access self-monitoring resources, provides a basis for making generalizations in future analyses. The under-studied longitudinal links between protective variables and mental health may contributed to the diverse research results associated with the limited data available regarding assessments of proactive mental health programs for PSP (64). Creating highly individualized, population based PTSI mitigation programs may also be hampered by insufficient longitudinal data collections as well as disproportionate rates of attrition and disengagement among the very PSP such programs are designed to help. Better understanding patterns of participation in mental health monitoring may also help to improve program effectiveness.

Data availability statement

The datasets presented in this article are not readily available because of the sensitive nature of the content. Requests to access the datasets should be directed to nick.carleton@uregina.ca.

Ethics statement

The RCMP Study was approved by the University of Regina Institutional Research Ethics Board (file No. 2019–055) and the RCMP Research Ethics Board (file No. SKM_C30818021312580). The RCMP Study was also approved through a Privacy Impact Assessment as part of the overall approval including the National Administrative Records Management System (NARMS; file No. 201611123286) and Public Services and Procurement Canada (PSPC; file No. 201701491/M7594174191). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

TT: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing. RS: Conceptualization, Writing – original draft, Writing – review & editing. KA: Conceptualization, Writing – original draft, Writing – review & editing. KM: Conceptualization, Methodology, Validation, Data curation, Writing – original draft, Writing – review & editing. LJ: Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing. JN: Writing – review & editing. TA: Writing – review & editing. LL: Methodology, Writing – review & editing. SS: Writing – review & editing. SS-Z: Investigation, Resources, Writing – review & editing. RK: Writing – review & editing. JN: Investigation, Data curation, Writing – review & editing. GK: Methodology, Validation, Investigation, Resources, Data curation, Writing – review & editing. RC: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. The RCMP Study is funded by support from the RCMP, the Government of Canada, and the Ministry of Public Safety and Emergency Preparedness. L. M. Lix is supported by a Tier I Canada Research Chair in Methods for Electronic Health Data Quality. T. O. Afifi is supported by a Tier I Canada Research Chair in Childhood Adversity and Resilience. S. H. Stewart is supported by a Tier 1 Canada Research Chair in Addictions and Mental Health. The development, analyses, and distribution of the current article was made possible by a generous and much-appreciated grant from the Medavie Foundation.

Acknowledgments

The RCMP Study is made possible by a large and diverse team, with detailed acknowledgements available online: http://www.rcmpstudy.ca.

Conflict of interest

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

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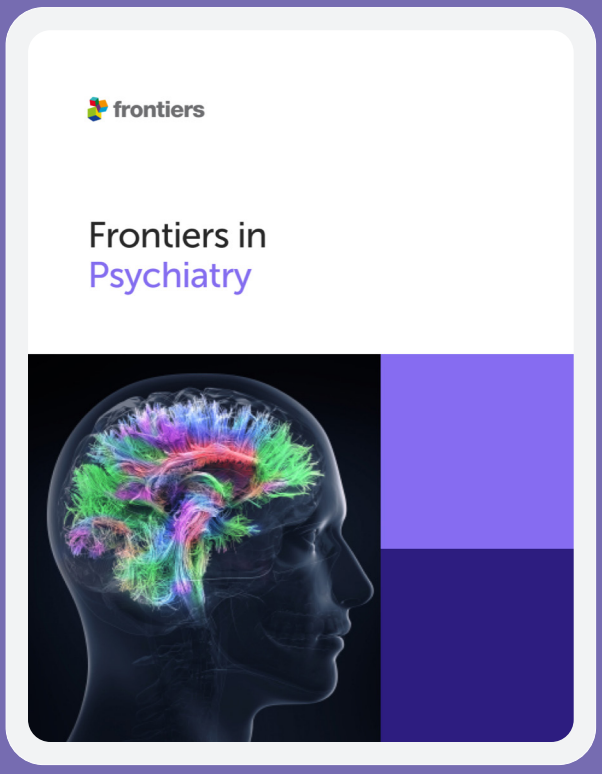

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