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Coping with life stress, volume II

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Coping with life stress, volume II

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Care burden on family caregivers of patients with dementia and affecting factors in China: A systematic review

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Background: Dementia is a chronic and progressive illness characterized by severe impairment and high dependencies. Under the influence of Chinese traditional culture, 80% of patients with dementia are watched over at home by family caregivers as primary caregivers. However, long-term care brings formidable burdens to them and reduces the quality of their life. It is necessary to find out the influencing factors of caregivers' burden.

Methods: A scoping search was conducted on eight electronic databases from 1 January 2010 to 14 June 2022: PubMed, Embase, the Cochrane Library, Web of Science, China National Knowledge Infrastructure, China VIP Database, China Biomedical Literature Database, and Wanfang Data Knowledge Service Platform. Research articles included in this review discussed the factors affecting Chinese dementia family caregivers' care burden or stress, and the level of care burden was evaluated by a standardized care burden scale.

Results: A total of 1,888 related articles were found and 23 cross-sectional studies were eventually included. After quality assessment, 12 were of good quality and 11 were of fair quality. A total of 32 factors were identified that were associated with caregiver burden, and the results were grouped into three categories: patient, caregiver, and society. The severity of disease, poor self-care ability, neuropsychiatric symptoms, care time, number of helpers, poor health status, economic stress, poor psychological status, social support, and age were reported in many previous studies.

Conclusion: In this review, the factors that affect the caregiver burden for people with dementia were clarified. By identifying these factors, hospitals, decision-makers, and communities can carry out special projects for these populations, provide appropriate assistance, or design corresponding intervention measures to reduce the caregiver burden and improve the quality of care for patients with dementia.

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KEYWORDS

family caregivers, dementia, care burden, caregiving, systematic review

Introduction

Dementia has increasingly become a universal public health issue (1). In China, the incidence rate of dementia in elderly people from 60 to 69 years is 2.9%, while it is 31.9% for those above 90 years (2). With the aging of China's population, the number of elderly patients with dementia has risen (3). According to the latest statistics, in 2019, over 15.33 million Chinese people were suffering from dementia and the number is expected to be 45.33 million in 2050 (4). Dementia is a chronic and progressive illness characterized by severe impairment and high dependencies (5, 6). Patients with moderate-to-severe degrees of dementia also need full-time care; caregivers' duty mainly includes daily tasks, meeting emotional needs, and paying bills. Therefore, caregivers are expected to take more responsibilities as the condition of patients with dementia deteriorates.

Home care is essential in China and around the world since people with dementia and Alzheimer's disease are on the rise. Especially, in China, Filial piety (or Xiao) in Confucianism values is the core of Chinese traditional culture and an important part of family ethics, and it mandates adults to respect and take care of their parents (7). Traditionally, only childless or poor elderly people enter public care, and Chinese elder individuals also feel ostracized and prejudiced against entering nursing homes (8). The influence of the filial piety notion forces the relatives of the elderly to be more willing to care for the elderly at home, and 80% of patients with dementia are therefore watched over at home with family caregivers as primary caregivers (5).

However, studies have demonstrated that dementia exerts a heavy burden on the family. Providing care for patients with dementia can be a daunting task for family caregivers and also an uncomfortable experience, involving physical, mental, financial, and social aspects (9, 10). Caring for a person with dementia presents challenges that are different from other caregiving situations, mainly because the family can feel bereft since patients are unable to communicate effectively, express love, or even forget everything, which can add to their internal pain and induce mental burnout (11). In addition, the level of depression and mental health issues among family caregivers was significantly higher than among other caregivers for chronic diseases according to the findings of recent studies (12, 13). Given the high prevalence of dementia and the considerable effect of care burden on caregivers' health, it is necessary to better understand the influencing factors of caregivers' burden.

Unfortunately, although a growing number of studies have concentrated on the family care burden for dementia in China, some factors remain controversial. For example, Wang et al. (14) concluded that increasing helpers would not reduce the caregiving burden, but Bai (15) came to the opposite conclusion; He et al. (16) believed that financial burden was the most important factor affecting the caregiver, while Huang et al. (17) believed that the number of nocturnal awakenings had the greatest impact. Moreover, a systematic review (18) of the care burden of patients with dementia in Turkey identified that older age patients increased caregiver burden; nevertheless, some studies in China were contradictory. Therefore, our research aims to systematically identify factors and the existing problems and to help the healthcare system to lay down intervention schemes based on our review; the review will also provide evidence for the development of dementia care services in other countries, especially those similar to China in culture and social landscape.

Materials and methods

This review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement (PRISMA) guideline. The methodology of this systematic review has been published in Prospero Platform (CRD42022347816), and we have recently revised the protocol to improve the rigor of the method description.

Search strategy

A scoping search for studies published from 1 January 2010 to 14 June 2022 was conducted on eight electronic databases: PubMed, Embase, the Cochrane Library, Web of Science, China National Knowledge Infrastructure (CNKI), China VIP Database (VIP), China Biomedical Literature Database (CBM), and Wanfang Data Knowledge Service Platform. The search strategy employed MeSH terms and keywords to identify the potential studies. Search terms for the review were ("dementia" OR "Alzheimer's disease" OR "dementia*" OR "Alzheimer*" OR "vascular dementia" OR "senile dementia" OR "mixed dementia" OR "Senile Paranoid Dementia" OR "Amentia*") AND ("caregiver" OR "caregiv*" OR "carer*" OR "family caregiver" OR "informal caregiver" OR "home caregiver") AND ("burden" OR "strain" OR "stress" OR "distress" OR "suffer" OR "overload") AND ("Chinese" OR "China"). The search strategy was jointly determined by two reviewers, and the reference list of all selected studies was manually retrieved to find out eligible articles.

Eligibility criteria

The eligibility criteria for review were based on the "PICOS" principles. Populations: family caregivers of dementia aged 18 years and above in China, including spouses, children, siblings, friends, or other relatives; outcomes: affecting factors of family caregivers' care burden or stress and the level of care burden were measured at any course of dementia by a standardized care burden scale; and study design: observational studies, such as descriptive studies, cohort studies, and cross-sectional studies. Considering the outcomes to be explored, intervention and control are not applicable here. Furthermore, these studies were published in Chinese or English. The exclusion criteria were health professionals or salaried caregivers; reviews, case reports, conference abstracts,

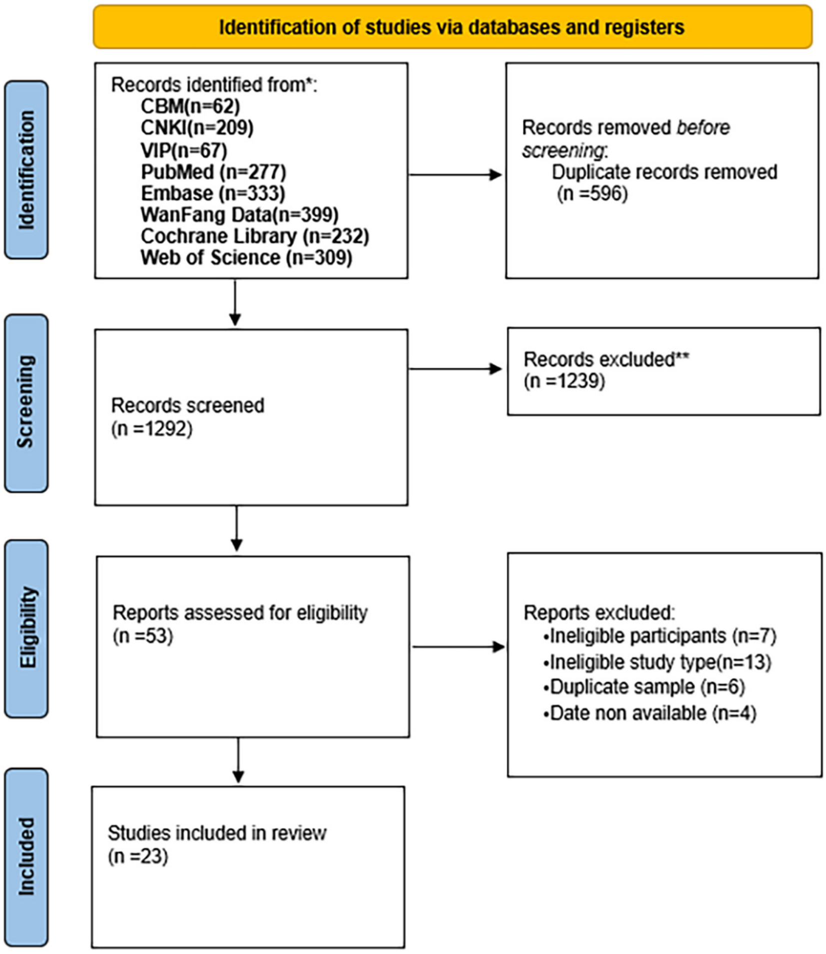

FIGURE 1
Preferred reporting items for systematic reviews and meta-analyses statement (PRISMA) study flowchart of study selection.

trial protocols, non-peer-reviewed articles, and original studies without full texts or reliable data; and studies were also excluded if the quality appraisal score was 0–4.

Study selection and data extraction

The searched studies were first imported in EndNoteX9.1, then duplicate studies were deleted, and the title and abstract of articles were screened. Finally, the full text was read and the studies meeting the inclusion criteria were included. Two reviewers (LW and YZ) independently screened and extracted literature and cross-checked it, and any disagreements were discussed by LW and YZ to reach a consensus, or differences of opinions were eliminated by asking for a third party's suggestion. The following characteristics of included studies were extracted: author, publication year, study design, sample size, caring relationship, co-residence, research tools, burden/stress score, and influencing factors.

Quality assessment

Two reviewers (LW and YZ) independently used the modified Newcastle–Ottawa Scale (NOS) (19, 20) to assess the methodological quality of the included studies. This tool is adapted for cross-sectional studies and contains seven questions in three groups, including representativeness of the sample, sample size adequacy, non-respondents, ascertainment of the exposure (risk factor), comparability in different outcome groups based on the study design or analysis, assessment of the outcome, and statistical test. All items are one point, except for the fifth, which is two points. Studies that received seven-eight and five-six points were considered good and fair quality, respectively. In addition, any disagreements would be solved by the third reviewer (XFF).

Analyses

This review used qualitative analysis to systematically summarize and describe the information and results of the included studies. The main contents include (1) basic information about the studies; and (2) classification and description of the relevant results based on different influencing factors.

Results

Search results and quality assessment

A total of 1,888 potentially related articles were found. Among them, 596 duplicated studies were removed, 1,239 were also excluded after reading the title and abstract, 53 studies were chosen for full-text screening, and 23 cross-sectional studies were eventually included in the review. **Figure 1** shows the PRISMA study flowchart of study selection (**Figure 1**). After quality assessment, 12 studies were of good quality and 11 were of fair quality. The result is shown in **Supplementary Table 1**.

Characteristics of included studies

Supplementary Table 2 depicts the characteristics of the included studies. Of the 23 studies, 8 (14, 21–27) (34.8%) were in English and 15 (15–17, 28–39) (65.2%) were in Chinese. In addition, 14 studies (14–16, 21, 23, 27–29, 32, 34–39) (60.9%) employed Caregiver Burden Inventory (CBI), 7 (17, 22, 24–26, 31, 33) (30.4%) employed Zarit Burden Interview (ZBI), 1 (30) (4.3%) employed Family Burden Scale (FBS), and 1 (15) (4.3%) employed Perceived Stress Scale (PSS). This review included 4,076 participants, and the sample sizes ranged from 94 to 335. Studies (15, 30, 33, 37) have indicated that 70.3–100% of family caregivers bear the burden of care. In addition, primary family caregivers in 14 studies (14, 16, 22, 23, 26, 28–30, 32–37) (60.9%) were offspring or other relatives and in six studies (15, 24, 25, 27, 31, 38) (26.1%) were spouses, but three studies (17, 21, 39) (13%) were failed to mention the proportion of caregivers.

Description of associated factors of caregiver burden

A total of 32 factors were identified that were associated with caregiver burden. These factors have been analyzed and grouped into three categories based on their characteristics, including patient, caregiver, and social factors (**Table 1**). The detailed description is as follows.

Patient factors

Notably, 12 patient factors were identified, and the severity of dementia, poor self-care ability, and neuropsychiatric symptoms were the three most frequently mentioned patient factors. In terms of patient demographics, studies reported that patients with younger ages (14, 30, 37), less or no retirement pension (29, 30, 37), low education (37), and religious belief (39) were associated with higher care burdens. In disease-related factors, studies indicated that patients with higher severity of dementia (14, 15, 24, 26, 30, 34, 36), poor self-care ability (24, 25, 28, 32, 34, 35, 37), neuropsychiatric symptoms (14, 22, 25, 30, 32, 33), low cognitive function (23, 27), memory behavior problems (22, 36), Alzheimer's disease (17), and physical dysfunction (28) were risk factors for increased caregiver burden. In addition, one study (34) found that low patients' quality of life is an independent influencing factor for increased burden.

TABLE 1 Summary of factors associated with caregiver burden.

	References	Participant number
Patient factors		
Demographics		
Retirement pension	3 (29, 30, 37)	534
Ounger age	3 (14, 30, 37)	502
Low eucation level	1 (37)	160
Religious belief	1 (39)	105
Disease-related		
Severity of dementia	7 (14, 15, 24, 26, 30, 34, 36)	1,751
Poor self-care ability	7 (24, 25, 28, 32, 34, 35, 37)	1,525
Neuropsychiatric symptoms	6 (14, 22, 25, 30, 32, 33)	1,060
Low cognitive function	2 (23, 27)	462
Memory behavior problems	2 (22, 36)	436
Low quality of life	1 (34)	335
Physical dysfunction	1 (28)	152
Disease type	1 (17)	97
Caregiver factors		
Demographics		
Economic stress	6 (16, 25, 31, 32, 37, 38)	1,061
Caregiver's age	3 (17, 25, 36)	1,001
Unemployed or retired caregiver	3 (14, 26, 30)	642
Female caregivers	3 (14, 22, 37)	454
Low education level	2 (35, 38)	270
Divorced or widowed caregiver	1 (38)	176
Religious belief	1 (21)	152
Caregiving-related		
Care time	13 (14–17, 21–23, 28–31, 35, 38)	2,064
Number of helpers	5 (15, 28, 31, 33, 35)	671
Cohabiting with the patient	3 (14, 17, 32)	532
Role perceptions	3 (15, 21, 35)	417
Number of nocturnal awakenings	2 (17, 37)	393
Positive aspects of caregiving	2 (23, 27)	277
Disease awareness	2 (28, 35)	246
Feel discrimination	1 (39)	105
Undertake household duties	1 (16)	97
Health status		
Poor health status	7 (14, 15, 24, 30, 31, 33, 39)	1,181
Poor psychologic status	4 (15, 24, 29, 37)	824
Social factors		
Social support	3 (14, 23, 27)	429
Usage of community service	1 (27)	109

Caregiver factors

A total of 18 caregiver factors were found, of which the number of helpers and positive aspects of caregiving were protective factors, meaning that caregivers would have less caregiving burden if they have helpers (15, 28, 31, 33, 35) or a higher degree of positive aspects of caregiving (23, 27). In terms of caregiver demographics, family caregivers with economic stress (16, 25, 31, 32, 37, 38), female (14, 22, 37), unemployed or retired (14, 26, 30), low education level (35, 38), divorced or widowed (38), and religious belief (21) experienced higher levels of care burden. Caregivers who had poor health status (14, 15, 24, 30, 31, 33, 39), cohabiting with the patients (14, 17, 25, 32), poor role perceptions (15, 21, 35), a high number of nocturnal awakenings (17, 37), poor disease awareness (28, 35), undertake household duties (16), and feel discrimination (39) were associated with higher degrees of care burden. Of the 23 studies, 13 studies (14–17, 21–23, 28–31, 35, 38) found a significant and negative relationship between family caregivers and care time. Notably, four studies reported that psychological status was closely related to caregiver burden, especially depression (24, 29) and anxiety (15, 29, 37). the age of the caregiver also has an impact on the care burden. One study (17) showed that older caregivers experienced more burden, whereas another two studies (25, 36) showed that younger people experienced more burden.

Social factors

A total of two social factors were identified, including social support and usage of community service. While three studies (14, 23, 27) showed that social support was negatively related to care burden. Liu et al. (27) found that caregivers would have a higher level of burden after using community service.

Discussion

This review identified and consolidated many different variables that affect the burden on Chinese caregivers for patients with dementia, and it is possible to achieve some general conclusions from the results. Among the factors, the severity of dementia, poor self-care ability, neuropsychiatric symptoms, economic stress, care time, number of helpers, poor health status, and poor psychological status could be found in many studies.

For patient factors, the severity of dementia, poor self-care ability, and neuropsychiatric symptoms were the most burdensome to caregivers, which were consistent with the previous research (9, 18, 40). As the severity of dementia increases, the need and difficulty in taking care of patients also increase. Patients with severe dementia presented poor self-care ability and mobility; thus, family members need more time and energy for intensive care (14, 15, 24, 26, 30, 34, 36). Chinese healthcare providers have implemented the continuum of care for dementia to raise awareness, risk assessment and screening, and early diagnosis of dementia; however, low diagnosis rates and delays in seeking care for patients with dementia remain a significant concern (3, 33, 41). Thus, more efforts are needed to enhance the early detection of the disease.

Furthermore, we also found that there was a strong positive correlation between neuropsychiatric symptoms of patients with dementia and caregivers' burden (14, 22, 25, 30, 32, 33), especially when patients had symptoms such as agitation, irritability, abnormal motor behavior, depression, and hallucinations (25, 42). These symptoms would not only hinder the treatment and increase the difficulty of care (30, 33) but also make caregivers feel helpless and sad and even contribute to anxiety and depression when they faced unfamiliar family members (11, 32). In a comparison between Australia and China, Xiao et al. (5) concluded that the prevalence of behavioral and psychological symptoms of dementia (BPSD) among Chinese patients is higher than the 61–88% prevalence in Australia, which may be attributed to underdeveloped geriatric care facilities and lack of behavioral management and services for dementia, and Wang et al. (14) also showed the same result. Strong establishment and improvement of caregiver rehabilitation programs and dementia behavior management services will be needed in the future to reduce neuropsychiatric symptoms of dementia (14, 30, 33).

It is noteworthy that the time spent providing care was considered an important factor of caregiver burden, as this was not strongly emphasized in the previous systematic reviews (18, 40). Wang et al. (14) study showed that Chinese caregivers spent an average of 127.6 h per week on care, which is significantly more intensive than the 27.1 h per caregiver per week reported in developed countries (12). This can be explained by the fact that cultural awareness of caregiving obligations may augment the time burden felt by caregivers (26). Caregivers are influenced by filial piety and view taking care of family members as their responsibility. Moreover, they believe that it is unacceptable to share family affairs with outsiders, and the fear of discrimination, if others know about it, may prevent them from actively seeking others' help (14, 27, 35, 39). However, several studies have consistently stated that if other helpers were available, the burden on family caregivers would be significantly reduced (15, 28, 31, 33, 35, 43). Therefore, in the future, we should draw on the successful experiences of other countries to establish community-based day-care centers, short-term care facilities, and respite service measures such as providing in-home care to reduce direct caregiver time (30, 31, 35). In addition, the number of nocturnal awakenings also indirectly increases the caregiver's care time and prevents caregivers from meeting their sleep needs (17, 37).

The result of this review was consistent with Adana et al. (18) and Chiao et al. (40), indicating that female caregivers had a higher care burden (14, 22, 37). A previous study demonstrated that female caregivers performed caregiving tasks 2.5 times more than male caregivers (44), which may be in line with the traditional Chinese saying of men rules outside and women rules inside (nan zhu wai and nu zhu nei). Women always play the role of primary caregivers for all the family members with multiple household tasks (18, 22, 37). Moreover, female caregivers pay more attention to the quality of care and the relationship with patients, devote more energy and time, and tend to experience intense guilt and stress (45), resulting in both physiological and psychological burdens. However, a systematic review (46) emphasized that male caregivers experienced a higher care burden because of a lack of social readiness as they faced role changes. Men are also likely to become primary caregivers in the future (47), but less is known about the condition and needs of male caregivers (48). We, therefore, need more research to be conducted in the future to explore how male caregivers cope with their caregiver role.

Some studies identified that caregivers with poor health and financial issue are more stressed. When caregivers suffer from diseases, they usually cannot take care of themselves through tedious care. Coupled with lasting mental stress, caregivers are under great pressure, which will formulate a vicious circle and aggravate their illness (15, 30, 31, 33, 39). The median monthly direct medical cost of caregiver expenditures reported in He's study was 600 RMB and 78.4% of caregivers felt financial stress (16), and one study has stated that patients with severe dementia spent nearly two times as much on annual expenses as those patients with mild dementia (10). Thus, more severe dementia indicates a more severe financial burden for caregivers. To ease the financial burden of caregivers, Sweden and the United States have offered caregiving as a formal profession and paid for full-time caregivers, and Canada, Sweden, and the United Kingdom have offered tax benefits for caregivers, while China does not have care subsidies directly for family caregivers (49, 50). Furthermore, dementia drug costs have been integrated into health insurance in China, but some problems such as few illness types and little money for reimbursement still exist, and families still have to bear most of the medical bills (16, 32, 37).

Also, some studies have reported that caregivers were significantly more vulnerable to suffering from anxiety and depression (15, 24, 29, 37, 51, 52). The psychological burden has become the most important aspect (29, 52), and this may be related to the fact that the caregiver's life is mainly focused on caring for the patient and has no time for personal life, employment, and social life (37), which creates a strong role conflict. In addition, the high cost of treatment, the patient's BPSD symptoms, and the poor health status of caregivers can have a negative impact on the caregiver's psychology (15, 29, 37). Meanwhile, lasting negative emotions increased the risk of patient abuse among family caregivers (53). Consequently, caregivers need psychological support to help them develop reasonable emotional expressions, enhance their ability to seek help and solve problems, and prevent and reduce the occurrence of psychological problems.

The effect of age on the burden remains controversial. Two studies (30, 37) revealed that caregivers perceived the heaviest burden when patients were less than 70 years of age. Younger patients commonly undertake many family responsibilities and higher expectations, so the absence of patients' roles could cause higher dissatisfaction; meanwhile, diagnosed patients usually felt embarrassed so they are likely to hide their illness and delay therapy. However, Adana et al. (18) and Thyrian et al. (54) found contradictory results and suggested that disease and advanced age resulted in this finding. The age of the caregiver also influences the care burden. One study (17) demonstrated that older caregivers have greater physiological and psychological burdens, while other studies (14, 18, 25, 36, 46) hold the opposite view. Future large-scale and high-quality longitudinal studies should be undertaken to authenticate the age factor.

Low education level (35, 38) and poor disease awareness (28, 35) were associated with a higher caregiving burden. Caregivers with low education levels are less knowledgeable about dementia disease and are prone to mood swings when faced with disease-related events such as the prognosis of recovery and deterioration of the disease, resulting in a heavier psychological burden (35, 38). Compared to 40% of dementia caregivers in the United States who have a college degree or higher (12), caregivers in China have a relatively low level of education (55). Furthermore, 49.0% of Chinese caregivers had disease awareness significantly lower than the overall level of 56.5%, and only 35.7% of patients had disease awareness (56). Therefore, caregivers need the training to enhance their knowledge on disease and caregiving skills. It is noticeable that there are only 6.25% of the 752 Chinese dementia caregivers had received caregiving training according to a questionnaire result (57).

The current review shows that social support is a protective factor that can lessen the caregiving burden (14, 23, 27). Social support is a buffer to regulate life events and psychological stress (58), which is beneficial to physical and mental health. When receiving more supportive services from family, friends, occupation, and community, caregivers can markedly reduce their burden (23, 27, 58). Long-term care insurance policy has been implemented in 15 pilot cities in China since 2016, and one study found that patients covered by long-term care insurance were only required to pay 10% of the cost for the services they received (59), which significantly reduces the financial burden on families. However, many patients with dementia were not covered. The policy was still not powerful enough to meet the need of the patient family (60). In some developed countries, daily care has been jointly undertaken by the home and community. However, the community does not work well due to the sociocultural background in China, the lack of professional dementia care services, and insurance support (26). Thus, a hospital–community–family-integrated social support model can be established to assist caregivers in all aspects (61).

We critically analyze the caregiver burden of home-based families in the Chinese cultural context and identify some problems, highlighting the way to future construction. In addition, our review can also bring inspiration to some developing countries to help alleviate their caregiver burden. There are also several limitations to this study. First, the included articles are cross-sectional studies with poor causation. Second, the study used different scales to measure the caregiving burden, which may differ in the interpretation of the results, and finally, although we included two studies from Hong Kong and Taiwan, we did not conduct a detailed analysis because their policies and circumstances are different from those of the mainland.

In summary, family caregivers of patients with dementia generally have burdens, and 32 factors were identified that were associated with caregiver burden. Among them, the severity of disease, poor self-care ability, neuropsychiatric symptoms, care time, poor health status, economic stress, poor psychological status, and social support were considered as main factors, but there was no conclusion on age. By identifying these factors, hospitals, decision-makers, and communities can carry out special projects for these populations, to provide appropriate assistance, or design corresponding intervention measures to reduce the caregiver burden and improve the quality of care for patients with dementia.

Data availability statement

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

Author contributions

LW and YZ conducted the study, carried out the statistical analysis, and wrote the manuscript. XF supported the development of the study methodology and reviewed the manuscript. GQ supported the writing of the manuscript and supervised the whole process. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.1004552/full#supplementary-material

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Mediating effect of workplace violence on the relationship between empathy and professional identity among nursing students

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Background: Studies have reported that empathy had a positive effect on professional identity (PI) in nursing students. However, little was known about the mechanism underlying this relationship between empathy and professional identity in nursing students.

Objective: The purpose of this study was to analyze in depth the mediating effect of workplace violence (WVP) between empathy and professional identity in nursing students.

Methods: A total of 405 nursing students participated and were investigated using the Chinese version of the Jefferson Scale of Empathy-Health Professional (JSE-HP), the scale of professional identity about nursing students, and the workplace violence Incident Survey in this study. Hierarchical regression was used to analyze the mediating effect of workplace violence on the relationship between empathy and professional identity among nursing students.

Results: The score of nursing students' professional identity was 103.69 ± 17.79. Workplace violence had a significant negative correlation with empathy ($r = -0.449$, $P < 0.001$) and professional identity ($r = -0.330$, $P < 0.001$). Workplace violence accounted for 14.59% of the total mediating effect on the relationship between empathy and professional identity for nursing students.

Conclusions: In this study, the level of professional identity of nursing students was low. Workplace violence had a partially significantly mediating effect on the relationship between empathy and professional identity. Maybe, it was suggested that nursing students' professional identity might be improved and driven by a decrease in workplace violence. Targeted interventions at reducing nursing students' workplace violence should be developed and implemented. In addition, nursing managers and educators should be aware of the importance of empathy and improve professional identity in nursing students.

KEYWORDS

workplace violence, empathy, professional identity, nursing students, mediating effect

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Introduction

Shortage of nurses is a perennial problem that is currently being experienced throughout the world (Chen et al., 2020). Nursing students are the successors to nursing careers. Therefore, the nurse scientists should pay additional attention as to whether after their graduation, the nursing students would choose nursing as their career or not (Bakker et al., 2018; McCarthy et al., 2020). On the contrary, an increasing number of nursing students are not continuing in the nursing profession after graduation but are pursuing other careers. Many reasons are attributed to this changeover of careers by nursing students. Some nursing students opine that nurses have a low social status and are not recognized, despite their best humanitarian efforts at bringing succor and relief to patients through their sisterly care. One study shows that the nurses have a low social status and the public image of a nurse is not as good and powerful as a doctor, especially when seen from the perspective of cultural and educational factors (Guo et al., 2017). Yet another impression held about the nursing profession is that the nurses, who do repetitive and routine work to some degree, have to execute the orders from the doctor, which is the adhered-to-practice in many parts of the world (Holroyd et al., 2002). Another section of students after clinical practice have a more intuitive understanding about nursing majors and think nursing work to be an arduous and intense task. The heavy work coupled with physical burden due to working in shifts results in the low professional identity (PI) among Chinese nurses (Feng et al., 2017). Some nursing students have even suffered unexpected maltreatment, such as Workplace violence (WPV), at others' hands during their clinical practice. WPV is usually directed at healthcare teams, but it is now becoming a widespread growing phenomenon targeting nursing students and affecting them as well (Warshawski, 2021). WPV is common in hospitals, with a study showing that about half of the nursing students would have already experienced WPV (Tee et al., 2016). It can be observed that, to some degree, WPV has a deep negative impact on professional identity (PI). Earlier, one study had shown that the lack of PI may be a contributing factor to nursing students leaving the nursing program abruptly, and graduate nurses leaving the nursing profession itself (Deppoliti, 2008). It is equally worrying to note that the overall level of the PI of nursing students is low (Guo et al., 2018; Wu et al., 2020). Empathy is seen as a cognitive ability, which consists mainly in understanding others' thoughts, intentions, and motivations (Di Lorenzo et al., 2019). It is a basic competency of helping relationship and an integral component of person-centered care (Gholamzadeh et al., 2018). Some studies dealing with the empathy of nursing students portray the fact that their empathy is at a low ebb and it needs to be given special attention to reflect the original empathy, as is wont of nurses (Williams et al., 2016; Larti et al., 2018). Consequently, some scholars have even carried out relevant research works on the ability of empathy of nursing students, and found that empathy is a teachable competency (Gholamzadeh et al., 2018). Literature shows that empathy strengthens the relationship between patients and healthcare professionals and also improves the patient's and healthcare professional's satisfaction, which in turn helps to bring out the best clinical outcomes (Petrucci et al., 2016). Therefore, we have reason to assume that empathy affects PI to some extent.

To our knowledge, few studies have explored the role of WPV in mediating empathy and PI in nursing students. Knowledge about the specific role of WPV in the relationship between empathy and PI helps to develop effective interventions to promote nursing students' professional honor and to look for the possibility of a career in nursing. Thus, the purpose of this study was to investigate the mediating effect of WPV on the relationship between empathy and PI.

Methods

Study design

This was a cross-sectional study which was conducted at five universities (Central South University, Hunan Normal University, Huaihua College, Xiangnan College, Shaoyang College) in the Hunan province of China from 21 October 2021 to 21 November 2021. Our study adopted the purposive sampling method to gather responses from the nursing students and collect related valuable data. The nursing student participated in the study and completed three different questionnaires. In detail, each student spent about 15–20 min for the questionnaires and signed the informed consent in person.

Participants and procedures

Inclusion criteria for this study were as follows: Students were included, if they (1) were full-time nursing students, including junior, undergraduate, and postgraduate; (2) were nursing students who had completed an internship, as required by the school of nursing; (3) spoke Chinese and communicated well with others; and (4) had already provided informed consent to participate in this survey. Exclusion criteria for this study were as follows: Students were excluded, if (1) their internship period was <6 months and (2) their absence during the internship period was more than or equal to 1 month.

Ethical considerations

This study was approved by our hospital's Ethics Committee (No: E202071). We acquired the written consent of all participants to take part in this study. The participants were informed that they could terminate participation in the study, without offering any explanation or think of consequences to their career, at any time during this study. In addition, the questionnaire was conducted anonymously, so the acquired data were kept strictly confidential and used only for the purpose of this study.

Data collection

The research team that administered the questionnaire to the nursing students comprised five trained researchers. Except for the chairman, two members of this team went as a group to the target university or college. With permission from the headmaster, we, the research team, recruited subjects from department meetings. After obtaining oral consent from these subjects, we then handed out the questionnaires to the nursing students face to face (which also required the participants to give their written informed consent). At this stage, nursing students were explained the purpose and methods of the present study so as to make them ready to fill the questionnaire. Then, the completed questionnaires were retrieved. Ultimately, a total of 410 surveys were distributed.

Measures

The questionnaire materials included a demographic questionnaire, the WPV Incident Survey, the Jefferson Scale of Empathy-Health Professionals (JSE-HP) (Hemmerdinger et al., 2007), and a questionnaire on the PI of nursing students. We obtained permission from the authors of all the published scales *via* email to use the scales for this study.

Sociodemographic characteristics

The following information about patients' sociodemographic and clinical characteristics was collected using a self-made questionnaire: age, gender, education level, origin of student, the only child, personality type, relationship with parents, any dispute with the patient during the internship, positions, voluntary choice of nursing profession, and degree of interest in nursing.

Workplace violence incident survey

The questionnaire was adapted from the hospital's WPV questionnaire that was designed by Chen (2011). The questionnaire consists of four parts. The first part includes the frequency of different types of WPV (10 items). The second part contains the victim's description of the time of the most profound WPV they had suffered during the last 6 months before the survey (including the characteristics, attitude, coping style, impact, and measures of the violence, a total of 19 items). The third part includes the cognition and attitude of interns toward WPV and coping with it (10 items). The fourth part deals with measures taken by the hospital to address WPV (8 items). The Cronbach's α coefficient of the scale was 0.986. The KMO (Kaiser–Meyer–Olkin) value was 0.948 and the Bartlett sphericity test statistic was 109,238.644 ($P = 0.000$).

Jefferson scale of empathy-health professionals (JSE-HP)

The English version of the JSE-HP, developed in 2001 by Dr. Mohammadreza Hojat and his research team at Thomas Jefferson University, was used to measure the healthcare workers' empathy. This scale comprises 20 items, each assessed on a 7-point Likert-type scale including three dimensions: perspective taking, compassionate care, and standing in the patient's shoes. Higher scores indicated more empathy. We used the Chinese version of this scale, which was shown to have good reliability and validity in a previous study on nursing students. The Cronbach's alpha coefficient in the present study was 0.836 (Li and Sun, 2011).

The scale of professional identity about nursing students

The researchers prepared and distributed a questionnaire about "the research on PI of Nursing students," which was adapted from "the research on PI of medical students" compiled by Zhang (2010). The statistical results presented good credibility and validity. The PI of the nursing students consisted of six dimensions, which were vocational cognition (7 items), vocational emotion (5 items), vocational comments (6 items), vocational behavior (3 items), vocational expectation (3 items), and vocational values (7 items). The questionnaire contained a total of 31 items. Using a 5-point scale, the subjects were asked to choose the answer that was consistent with themselves from "very inconsistent", "relatively inconsistent", "no clear opinion", "relatively consistent", and "very consistent" in the description of the items according to their consistent situation. Among them, 5 points were allotted for clicking "very inconsistent", 4 points for clicking "relatively inconsistent", 3 points for clicking "no clear opinions", 2 points for clicking "relatively consistent", and 1 point for clicking "very consistent". We tested the reliability and validity of the revised scale and it showed good reliability and validity. Cronbach's alpha coefficient in the present study was 0.929. The KMO value was 0.952 and the Bartlett sphericity test statistic value was 7,556.07 ($P = 0.000$).

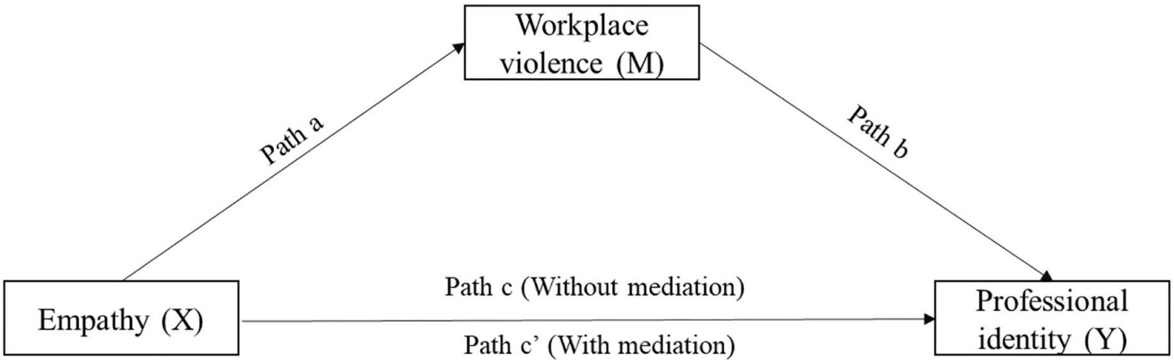

FIGURE 1
Theoretical framework of this study.

Data analysis

The IBM SPSS statistics software version 22.0 (IBM Corp., Armonk, NY, USA) was chosen to analyze the obtained data. All continuous variables with a normal distribution were described using means and standard deviation (means ± SD). In addition, the categorical variables were summarized by numbers or percentages. The independent-sample *t*-test or analysis of variance (ANOVA) was used to compare the scores of WPV, empathy, and PI among nursing students and sociodemographic characteristics. The correlation among WPV, empathy, and PI was determined by the Pearson correlation analysis. Additionally, the mediation analytical framework described helped to guide the analysis plan (Baron and Kenny, 1986). The capital letters X, M, and Y were chosen to represent empathy, WPV, and PI, respectively. Variable M was considered a mediator if: (1) X significantly predicted Y directly (Path c in Figure 1), (2) X significantly predicted M (Path a in Figure 1), or (3) M significantly predicted Y after controlling for X (Path b in Figure 1). Path c' meant the direct effect of X on Y after controlling for M (Path c' in Figure 1). If the regression correlation coefficient of path c' was not significant, then this mediating effect of M was complete mediation. If the regression correlation coefficient of path c' was significant, then this mediating effect of M was partial mediation. The mediation effect value was calculated as $a * b$, and the ratio of the mediating effect to the total effect was $a * b/c$.

Results

Current situation of empathy, workplace violence, and professional identity in nursing students

In total, 410 nursing students were surveyed in this study, and 405 surveys were completed, yielding a response rate of 98.78%. Demographic characteristics, empathy value, WPV, and PI scores of the studied participants are presented in Table 1. Voluntary choice of nursing profession had significantly different scores of empathy, WPV, and PI. Location of their home difference in students could lead to varying empathy levels and WPV in a significant situation. Dispute with the patient had significantly different outcomes of WPV and PI. Education levels and a strong influence on professional understanding also have significantly different effects on WPV. In addition, a good relationship with parents, interest in nursing profession, and academic achievement level have a significant influence on WPV. In addition, ninety (i.e., 22.22% of nursing students) nursing students had experienced WPV. The average scores for empathy and PI were 83.17 ± 20.71 and 103.69 ± 17.79, respectively.

Correlations between workplace violence, empathy, and professional identity

The situation for the total WPV was negatively correlated with the score for the empathy-health scale at a significant level ($r = -0.449$, $p < 0.001$). The situation for the total WPV was negatively correlated with the score for the PI scale at a significant level ($r = -0.330$, $p < 0.001$). In addition, the empathy-health level was positively correlated with the score for the PI ($r = 0.466$, $P < 0.001$).

Analysis of the mediating role of workplace violence between empathy and professional identity

Figure 2 indicates the mediating role of WPV in the relationship between empathy and PI. The results showed that

TABLE 1 Scores on workplace violence, empathy, and professional identity of nursing students of different characteristics.

Factors	**Items**	**Workplace violence**	**Empathy**	**Professional identity**
Gender	Male	8 (23)	4.296± 1.536	3.454 ± 0.544
	Female	82 (382)	4.150 ± 1.000	3.338 ± 0.576
F/X^2		2.226	0.449	0.942
P		0.136	0.658	0.347
Whether the only child	Yes	16 (58)	4.029 ± 0.900	3.297 ± 0.573
	No	74 (347)	4.180 ± 1.056	3.353 ± 0.574
F/X^2		1.127	−1.025	−0.686
P		0.288	0.306	0.493
Origin of student	Rural areas	57 (302)	4.224 ± 1.030	3.351 ± 0.571
	Urban areas	33 (103)	3.967 ± 1.034	3.326 ± 0.584
F/X^2		7.701	2.187	0.379
P		0.006	0.029	0.705
Conflict with patients during the internship	Yes	37 (77)	3.981 ± 1.091	3.155 ± 0.580
	No	53 (328)	4.200 ± 1.019	3.390 ± 0.564
F/X^2		36.700	−1.677	−3.272
P		0.000	0.094	0.001
Internship position	Student	72 (340)	4.200 ± 0.996	3.357 ± 0.548
	Team leader	11 (37)	3.930 ± 1.037	3.303 ± 0.663
	Group leader	7 (28)	3.950 ± 1.422	3.257 ± 0.744
F/X^2		1.547	1.754	0.501
P		0.461	0.174	0.606
Whether they chose nursing profession voluntarily	Yes	59 (299)	4.222 ± 1.056	3.446 ± 0.556
	No	31 (106)	3.978 ± 0.956	3.059 ± 0.528
F/X^2		4.097	0.290	0.448
P		0.043	0.037	0.000
Relationship with parents	Harmoniousness	63 (278)	4.225 ± 1.094	3.393 ± 0.579
	General harmoniousness	19 (90)	3.947 ± 0.839	3.286 ± 0.510
	Ordinary	8 (34)	4.203 ± 0.992	3.028 ± 0.533
	Less harmoniousness	0 (2)	3.500 ± 0.707	4.436 ± 0.753
	Disagreeable	0 (1)	4.400	3.839
F/X^2		0.986	1.468	5.565
P		0.912	0.211	0.000
The degree of interest in nursing profession	Full of interest	12 (52)	4.427 ± 1.454	3.746 ± 0.758
	Interest	37 (190)	4.145 ± 0.928	3.505 ± 0.452
	Ordinary	35 (152)	4.109 ± 0.981	3.057 ± 0.429
	Disinclination	3 (6)	4.200 ± 0.596	2.973 ± 0.986
	Dislike	3 (5)	3.340 ± 1.403	2.297 ± 0.305
F/X^2		7.716	1.766	31.788
P		0.103	0.135	0.000
Education Level	Technical secondary school students	2 (6)	3.783 ± 1.097	3.344 ± 0.744
	Junior college students	70 (344)	4.186 ± 1.068	3.372 ± 0.582
	Undergraduate students	11 (41)	4.105 ± 0.625	3.187 ± 0.496
	Graduate students	7 (14)	3.796 ± 1.162	3.150 ± 0.422

(Continued)

TABLE 1 (Continued)

Factors	Items	Workplace violence	Empathy	Professional identity
F/X^2		7.881	0.950	1.831
P		0.049	0.417	0.141
Whether to learn nurse-patient communication course at school	Yes	81 (378)	4.148 ± 1.028	3.347 ± 0.575
	No	9 (27)	4.298 ± 1.144	3.317 ± 0.563
F/X^2		2.066	−0.726	0.265
P		0.151	0.468	0.791
Academic performance level	Excellence	16 (73)	4.162 ± 1.189	3.466 ± 0.629
	Good	43 (229)	4.212 ± 0.961	3.376 ± 0.546
	Medium	28 (94)	4.088 ± 0.965	3.219 ± 0.533
	Pass	3 (9)	3.500 ± 1.908	2.882 ± 0.831
F/X^2		5.332	1.566	4.916
P		0.149	0.197	0.002
Factors influence your understanding of major during the internship	Teaching teacher	59 (274)	4.167 ± 1.067	3.360 ± 0.575
	Grades of internship hospital	4 (7)	4.114 ± 1.896	3.539 ± 0.529
	Internship department	10 (27)	4.074 ± 1.362	3.252 ± 0.763
	Practical nursing work	17 (97)	4.161 ± 0.740	3.313 ± 0.513
F/X^2		9.681	0.069	0.665
P		0.021	0.976	0.574
Grades of Internship hospital	Level III A hospital	87 (387)	4.164 ± 1.038	3.357 ± 0.572
	Level III B hospital	0 (4)	4.150 ± 0.673	3.186 ± 0.590
	Level II A hospital	2 (8)	3.763 ± 0.814	3.048 ± 0.612
	Others	1 (6)	4.350 ± 1.386	3.043 ± 0.582
F/X^2		1.301	0.460	1.434
P		0.729	0.711	0.232

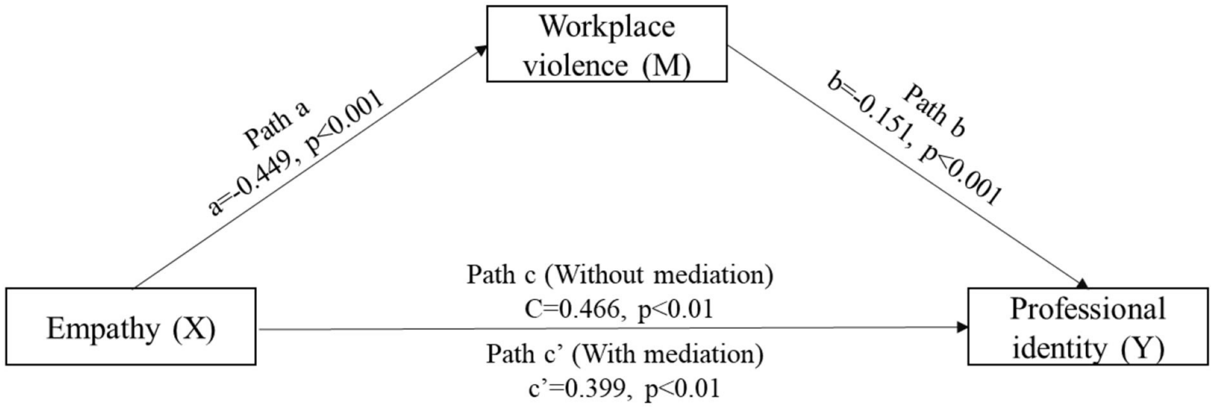

FIGURE 2
Mediating role of workplace violence in the relationship between empathy and professional identity among nursing students.

after controlling for sociodemographic variables, a significant total effect of empathy on PI was identified (Path c: $c = 0.446$, $t = 10.585$, $p < 0.001$). In path a, empathy had a negative impact on WPV (Path a: $a = -0.449$, $t = -10.080$, $p < 0.001$). In path b, WPV had a negative impact on PI (Path b: $b = -0.151$, $t = -3.098$, $p < 0.001$). In addition, in path c, empathy had a positive impact on PI (Path c: $c = 0.339$, $t = 8.170$, $p < 0.001$).

The mediation effect value was calculated as $-0.449*(-0.151)$, that is, 0.068, and the ratio of the mediating effect to the total effect was 14.59% ($0.068/0.466 = 0.1459$). A summary of the mediating effects of WPV between empathy and PI is shown in Table 2.

The regression correlation coefficients of Path a, Path b, Path c, and Path c' were all significant. Therefore, WPV had a partial mediating effect on the relationship between empathy and PI. Empathy predicted nursing students' PI partially through WPV.

Discussion

Professional identity is theoretically a key factor in providing high-quality care to improve patient outcomes and is thought to mediate the negative effects of a high-stress workplace and improve clinical performance and job retention (Sun et al., 2016). In this study, the level of PI about nursing students is not satisfactory. This result was consistent with the findings from other studies worldwide (Guo et al., 2018; Chen et al., 2020). That could be a major problem for nursing student's employment options upon graduation. In addition, the poor level of PI aggravates the shortage of nursing staff in hospitals, increase the difficulty of nursing management, and ultimately lead to patients being unable to get good care and assistance.

Professional identity is the professional self or self-concept of nursing that represents how nurses or nursing students perceive the nursing profession to be. In our study, we found that the PI was influenced by the conflict with patients during the internship, whether they chose nursing profession voluntarily, the degree of interest in nursing profession, academic performance at school, and the degree of close relationship with parents. Another study found that demographic factors such as family residence and presence of relatives in medical service were positively related to PI (Chen et al., 2020). However, the level of PI has no significant difference between students from different family residences in our survey. Nursing college and internship are critical periods when the PI is formed (Chen et al., 2020). Effort taken to improve nursing students' PI is an ongoing process and it is necessary to arouse the common attention of educators, clinical managers, and society.

Empathy is an underlying foundation for nursing. Having nursing knowledge alone is just not sufficient for nurses to care for patients and their families (Li et al., 2019). Patients and their families value not only nurses' expertise but also their empathetic behavior (Wei et al., 2018). So, the total score for the value of empathy was 83.17 ± 20.71 in our study. This result indicates that the level of empathy of nursing students is low. It can be seen that the level of nursing students' ability of empathy is not satisfactory. While the ability of empathy has a significant positive effect on PI, which is consistent with the findings of other researchers (Percy and Richardson, 2018; Messineo et al., 2021). Thus, we need to pay more attention to this aspect. Moreover, empathy can effectively improve the relationship between the patients and the doctors and enhance patient satisfaction (Petrucci et al., 2016).

In the previous study, the overall mean empathy scores for undergraduate nursing students were lower than those reported in studies conducted in Western countries (Candilis, 2002; Bas-Sarmiento et al., 2017). More and more studies are showing that it is imperative to pay attention to the cultivation of nurses' empathy value (Díaz Valentín et al., 2019; Di Lorenzo et al., 2019). Another study examined the empathy levels of students who were enrolled in different health disciplines from two large Australian universities. The results of the findings of that study revealed that paramedic students had statistically lower empathy results than all other health professions, except nursing students (Brett et al., 2014). Besides, female students reported a higher mean score on the JSE (Piumatti et al., 2019; Messineo et al., 2021). McKenna et al. also looked at empathy levels in nursing students and found that there were no significant differences in empathy relating to age, sex, or year of study (McKenna et al., 2011; Brett et al., 2014), which is quite similar to the results found in our research. While a recent study suggests that empathy levels decline as a student progresses through a program (Paula et al., 2011). It would be worth exploring the innumerable factors that contribute to these results, such as experience gained during student placements and mentoring during study.

In the present study, students who choose to engage themselves in the nursing profession tended to have higher empathy levels and PI. We speculate that students who choose nursing majors voluntarily have a better understanding of professional connotation, which is of great significance to the formation of PI. Therefore, nursing students who are not choosing nursing majors voluntarily should be targeted for empathy and PI improvement. We also found that those who were born in the countryside have higher empathy levels, one possible explanation is that children born in rural areas have higher levels of resilience and dare to face life's challenges. Moreover, children who grow up in the countryside have more freedom to play with their peers and have a more harmonious neighborhood.

Furthermore, empathy was found to be positively correlated with PI for nursing students in the present study. This was consistent with the study about graduate students (Dobrowolska et al., 2014). It has been explicitly demonstrated that empathy strengthens the relationship between patients and health professionals and also improves their satisfaction, which in turn

TABLE 2 Summary of the mediating effects of workplace violence between empathy and professional identity.

Effect	Independent variables	Dependent variables	*B*	*T*	*P*	R^2	*F*
Total effect(c)	X	Y	0.466	10.585	0.000	0.218	112.050***
Indirect effect(a)	X	M	−0.449	−10.080	0.000	0.201	101.605***
Indirect effect(b)	M	Y	−0.151	−3.098	0.002	0.236	62.017***
Direct effect(c')	X	Y	0.399	8.170	0.000		

$^{***}P < 0.001$.

helps to promote the best clinical outcomes (Petrucci et al., 2016). In contrast, inadequate levels of empathy shown by the nursing students could result in an unsatisfactory result in both patients and health professionals (Doyle et al., 2014; Ferri et al., 2015).

The WPV phenomenon is prevalent in various nursing clinical settings (Edward et al., 2016). About 22.22% of the nursing students experience WPV as reflected in our study. WPV was found to be negatively correlated with PI for nursing students. In addition, WPV was also confirmed to be an independent predictor of PI in the present study. This result was consistent with that of the previous study (Luthans and Youssef, 2004). One of the proper explanations put forth is: when experiencing WPV physically or mentally, nursing students suffer from poor productivity, a lower quality of work, and a decline in individual sense of accomplishment. Students with an experience of WPV are more likely to display a lower PI. In other words, nursing students who have not experienced WPV were more likely to choose a career as a nurse. Possible reason might be attributed to the fact that nursing students who had already experienced WPV think of nursing to be a dangerous profession. A similar study about the doctor arrived at the same opinion that WPV was negatively related to PI (Qiu et al., 2019). Moreover, we found that birthplace, conflicts with patients, voluntary selection of nursing profession, different levels of education, and a strong impact on the professional understanding during their internship were all closely related to WPV. Interestingly, a study about the nurses who were the only children in their families tended to have higher odds of experiencing physical and non-physical violence (Zhang et al., 2017). However, we found no difference in this aspect.

Workplace violence was found to be a partial mediator in the relationship between the levels of empathy and PI in the present study and the mediating effect value was 14.59%. Consequently, WPV exerted a significant effect on partially mediating the association between the levels of empathy and PI, despite a high level of empathy including three factors in the process of choosing nursing being extremely important for nursing students to have a better PI, while WPV also played a critical mediating role in curbing the PI. A possible explanation for this interaction is that optimal levels of empathy could be basic essentials for nursing students to have a better PI, but not experience WPV, even if they convince themselves to believing that their choice to be a nursing student is the right step in the right direction. Therefore, WPV is a vital mediating predictor of PI.

Based on the results of this study, we put forward some valuable suggestions which are of immense benefit, from two aspects, to improve the nursing students' PI. First, effective interventions to improve nursing students' levels of empathy should be designed and implemented. When more and more researchers evinced a strong interest in this direction and pay adequate attention to improving nursing students' levels of empathy, they argue, can empathy be improved with certain interventions (Bas-Sarmiento et al., 2017; Ding et al., 2020; Peng et al., 2020). Teachers should pay more attention to cultivating students' levels of empathy. Nursing educators should focus more on the formation of the students' PI and caring as a contributing factor to it. Second, we found that WPV also had an important effect on PI. Maybe, the occurrence of WPV can be effectively reduced from the following aspects. For nursing students, it is imperative that they need to learn to identify the factors associated with WPV and report them on time. For nursing educators and clinical managers, it is imperative that they inform students about the WPV preventive measures and provide them with a safe working environment. The last, health organizations must act to examine how cases of WPV against students are handled (Warshawski, 2021).

Conclusion

Our study demonstrates that WPV has a partially significant mediating effect on the relationship between the levels of empathy and PI. Nursing educators should pay attention to the cultivation of students' levels of empathy. Considering the prevalence of low level of PI among nursing students, targeted interventions to protect them from WPV could increase the chances of choosing a nursing career. WPV is common among nursing students, which has a huge impact on PI.

On the one hand, practice hospitals should strengthen the protection of interns; on the other hand, schools and practice hospitals should strengthen the recognition and training of interns, especially those with low empathy, in dealing with WPV.

This study, however, has some limitations which need to be illustrated. First, although questionnaires about WPV and PI have good reliability and validity, they have not been tested by using large samples. The results of this study should be confirmed by a longitudinal study. Second, we selected nursing students only from five universities in Hunan Province. Therefore, the sample may not be completely representative of all Chinese nursing students. Lastly, we will extend the investigating areas in the future research.

Implications for nursing management

Although the hospitals are facing the shortage of nurses, more and more nursing students are escaping from nursing work in China. Workplace violence, professional identity, and empathy are the important factors that influence the nursing students' decision in whether to choose nursing as their career or not. The low professional identity and workplace violence are the important reasons for nursing students not choosing nursing as their careers. While empathy is positively correlated with professional identity and can improve the professional identity of the nursing students, it also encourages nursing students to continue with the nursing job. Therefore, the mediating effect of workplace violence on the relationship between empathy and professional identity among nursing students is studied. This study can guide nursing managers to take targeted measures at improving the professional identity of nursing students to enable them to wholeheartedly engage in nursing work, thereby contributing to patient care and welfare.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by The Second Xiangya Hospital's Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

LZ and LW: conceptualization, methodology, and data curation. CF, HL, QC, and LC: formal analysis. LW: writing—original draft preparation and writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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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Effect of caregiver burden on anticipatory grief among caregivers of elderly cancer patients: Chain mediation role of family functioning and resilience

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This study aimed to explore the relationship between caregiver burden and anticipatory grief among caregivers of elderly cancer patients, and to examine the chain mediation effects of family functioning and resilience. A total of 624 valid questionnaires were collected. The Structural Equation Model was established to test the mediating effects of family functioning and resilience. Results showed that caregiver burden has a direct positive effect on anticipatory grief, both family functioning and resilience have negative effects on caregiver burden and anticipatory grief, and that resilience moderates the mediating effect of family functioning. Our findings suggest that reducing the caregiver burden among caregivers of elderly cancer patients, improving family functioning, and enhancing resilience have important effects in alleviating the anticipatory grief of caregivers. Our findings provide some references for further research. Medical staff should better understand the grief experience of caregivers and implement interventions to enable caregivers to better cope with anticipatory grief and psychological stress, so as to promote the quality of care for elderly cancer patients.

KEYWORDS

cancer, caregivers, anticipatory grief, caregiver burden, family functioning, resilience

Introduction

Cancer is one of the major diseases threatening human health, and its incidence has shown a progressive increase over the years (Sung et al., 2021). Caregivers of cancer patients, from the time of diagnosis to the deterioration of the disease, experience a series of physiological and psychological stress reactions, including the anticipation of death resulting in anticipatory grief (Yu et al., 2021). Anticipatory grief is commonly defined as the mourning, coping, planning, and psychological reorganization of one's life in response to an impending loss as well as the past, present, and future losses (Rando, 1986). This phenomenon acts as a "safe-guard" against the impact of sudden death of patients with life-threatening diseases on family caregivers, who are likely to express a mixture of calm and relief after the death due to this emotional preparation (Sweeting and Gilhooly, 1990). However, it can also be a contributor to the psychological distress among caregivers (Seyedfatemi et al., 2021). Anticipatory grief can lead to physiological, psychological, cognitive, and mental problems for caregivers, including insomnia, headache, anxiety, anger, forgetfulness, depression (Liew et al., 2019), and other symptoms, and even suicidal tendencies in severe cases (Coelho et al., 2018). Thus, it is especially important for caregivers to appropriately cope with the impending death of a loved one. At the same time, timely assessment of the psychological state of caregivers by medical staff can enable caregivers to improve their ability to cope with care burden.

Caregiver burden is described as a biopsychosocial strain experienced by the caregiver due to caring for a family member or a loved one over time (Liu et al., 2020), which includes the personal strain and role strain. Personal strain refers to a person's self-perception of caregiving difficulties. Caregivers of elderly cancer patients typically devote a lot of energy and time to caring for patients while rarely caring for themselves, which can lead to a decline in their physiological and psychological health (Song et al., 2011). Role strain refers to the negative reaction to the caregivers' social, occupational, and family roles. Chronic exposure to role strain may result in poor well-being, social isolation, and financial challenges (Campbell et al., 2014). Additionally, previous studies have identified other adverse effects of caregiver burden, such as reduced quality of care provided (Bastawrous, 2013), and increased intensity of anticipatory grief (Axelsson et al., 2020).

Family functioning is described as how well family members communicate, fulfill family responsibilities, accept family routines, and cope with and adjust to family stress (Zhang, 2018). Five types of families (supportive, conflict-resolving, intermediate, sullen, and hostile family) illustrate the different degrees of family functioning. Individuals in a supportive family or conflict-resolving family have greater ability to respond to challenges, are more pleased with their emotional connections, and perceive a higher quality of life, all of which contribute to active coping with a family crisis (Huang et al., 2022). Family functioning is also a protective factor during the grief process (Smilkstein, 1978). Good family functioning can help caregivers wane over the grief in 13 months (Kissane et al., 1998).

Resilience has various definitions in extant theoretical writings. Rutter (2012) emphasized that resilience was a dynamic process encompassing positive adaption in response to major adversity. Connor and Davidson (2003) defined resilience as a personal characteristic that enables people to resume normal functioning in the face of significant adversity and traumatic psychosocial events. In this study, resilience was seen as a personal trait, which has a positive effect on physiological, psychological (Dionne-Odom et al., 2021), and social function (Luo et al., 2020). Exposure of individuals to chronic psychological stressors can lead to deterioration of their health and accelerate aging (Canevelli and Bersani., 2022). People with high resilience could perceive themselves to cope with stress more resourceful and less overwhelmed by stressors (García-León et al., 2019). Additionally, strengthening resilience of caregivers and its associated psychological variables (e.g., optimism) was shown to reduce the stress caused by biological, psychological, social, and spiritual changes, and improve caregivers' role adaptation (Palacio et al., 2020).

Studies have shown that caregiver burden can cause family problems and family conflicts (Jeong et al., 2020), and may negatively affect resilience (Li et al., 2018). Anticipatory grief may be reduced by increasing family functioning (Chiu et al., 2010), and by increasing resilience (Vegsund et al., 2019). Because talking about death is a taboo in China, caregivers seldom communicate illness and death with patients, and always make decisions based on their understanding of the disease and social customs. The resultant poor communication between caregivers and patients tends to increase caregiver burden as well as their anticipatory grief (Yu et al., 2021). However, this ignores the internal mediating effects of caregiver burden and anticipatory grief. Furthermore, no study has concomitantly explored the role of both family functioning and resilience in mediating the effects of caregiver burden on anticipatory grief.

Therefore, this study aimed to investigate the role of family functioning and resilience to better characterize the mechanism by which caregiver burden is translated to anticipatory grief. We conducted the study in a sample of caregivers of elderly cancer patients. Firstly, cancer is a leading cause of morbidity and mortality in older population. Although death is expected, it is often experienced as too sudden, and there is a high incidence of anticipatory grief among caregivers of elderly cancer patients (Coelho et al., 2018). Secondly, caregivers of elderly cancer patients are often also older persons, and approximately a third of them are in a bad health condition (Balducci, 2019). Caregivers of elderly cancer patients play an important role in improving the outcome of cancer treatment and quality of life, which may cause a huge caregiver burden (Deshields et al., 2012). According to a systemic review, the prevalence of caregiver burden among caregivers of elderly cancer patients ranges from 1% to more than 35% (Dionne-Odom et al., 2017). Thirdly, caregivers of elderly cancer patients represent a vulnerable caregiver group, but there are few evidence-based intervention resources available to support the demands and challenges of cancer caregiving (Sun et al., 2019). Identifying the relationship between caregiver burden, family functioning, resilience, and anticipatory grief in caregivers of elderly cancer patients may help inform interventions to improve their coping ability for anticipatory grief.

Theoretical foundations and hypotheses development

Conservation of resources theory

Despite considerable evidence on the downsides of caregiver burden, the mechanism through which caregiver burden exerts its effects on anticipatory grief is still under exploration. Various theoretical models that elucidate potential mechanisms of caregiver burden have been proposed, including but not limited to experiencing some sort of stress and overload (Buglass, 2010); multiple losses (Holley and Mast, 2009); and depletion of coping resources (Boerner and Schulz, 2009). Given caregiver burden and anticipatory grief have potential adverse outcomes among caregivers of elderly cancer patients, more in-depth research on the relationship between them is warranted to inform the precise interventions to improve caregivers' negative emotions. Our study is based on the framework of the conservation of resources (COR) theory. It is essentially a theory of motivation that provides a framework for understanding the associations among the consequences of major and traumatic stress. According to this theory, people are inherently motivated to obtain, protect, and pursue the acquisition of resources. Actual loss or threat of loss of resources and lack of accrual of adequate benefits from resource investments result in stress (Snyder et al., 2020). This suggests that individuals perceive loss of resources as an external threat, and they do their best to acquire and maintain available resources, thus making self-adjustment to the environment, and promoting their mental health.

According to the COR theory, the resources include object resources, conditions, personal characteristics, and energy. In addition, social relationship is an important part of accessing these resources (Hobfoll Stevan, 1989). Object resources include assets, salaries, and similar items. Condition resources include marriage, seniority, and employment. Personal characteristics include positive personality traits and psychological resources such as resilience, self-esteem. Energy resources include time, knowledge, and learning ability. Personal characteristics and social relationship are regarded as the resources that facilitate the preservation of valuable resources. Inspired by this theory, this study considers caregiver burden as a stressful event for caregivers, family functioning as a representative variable of social relationship, resilience as a representative variable of personal characteristics, and anticipatory grief as an emotional response to the loss. The purpose of the study was to explore the effect of family functioning and resilience in mediating the relationship between caregiver burden and anticipatory grief of caregivers of elderly cancer patients. Application of this theory in a variety of circumstances has shown that people with adequate resources tend to cope better with stress (Sumer et al., 2005; Merino et al., 2021).

Caregiver burden and anticipatory grief

Caregiver burden is essentially related to anticipatory grief. Caregiver burden affects anticipatory grief due to the resultant physiological and psychosocial stress, which has a detrimental effect on health, social life, and economic status (Yu et al., 2021). Drown into a caregiving role, caregivers require unremitting dedication to demands of the patients. The burden of caring has been identified as an important cause of damage to caregivers' physical and mental health, and it may subsequently lead to loss and grief experiences (Al-Gamal and Long, 2014). In addition, taking up a caregiver role for a patient diagnosed with cancer, caregivers may experience more changes in their life and suffer from higher mental tension, for example, denial, anxiety, depression, uncertainty, and fear, which limits their ability to participate in social and recreational activities and to remain highly involved in their own occupational and family roles, causing them to feel lost the primary control over life (Noyes et al., 2010). These emotional reactions are considered as the main psychological expressions of anticipatory grief (Al-Gamal and Long, 2010). Having such losses due to being a caregiver has been found a positive association with anticipatory grief in previous studies (Holley and Mast, 2009; Cheng et al., 2019). Based on the above empirical studies, we proposed the following hypothesis:

> *H1*: Caregiver burden is positively associated with their anticipatory grief.

Family functioning as mediator between caregiver burden and anticipatory grief

Caregiver burden may result in impaired family functioning. Caregivers perceive an imbalance in the distribution of caregiving responsibilities due to family members regarding the caregiving provision as the specific responsibility of a particular individual (Jeong et al., 2020). In addition, dissatisfaction with the amount and quality of attention accorded to a patient may cause family conflicts (Pearlin et al., 1990). Besides, the caregiver burden also causes relationship deprivation between the caregiver and patients. The relational deprivation is also a manifestation of poor family functioning, and leads to different levels of anticipatory grief (Noyes et al., 2010). With worsening of the patients' illness, caregivers and patients are unable to interact normally and maintain the previous communication style. Moreover, caregivers tend to spend less time together in family activities, which prevents the establishment of a close, intimate relationship among them.

Family functioning as a mediating role can weaken the effect of caregiver burden on anticipatory grief. A well-functioning family is characterized by open communication among family members and freedom to express feelings, which facilitates adaptive adjustment and grief resolution among the members (Delalibera et al., 2015). A previous study demonstrated the important role of family functioning in relieving anticipatory grief (Li et al., 2019). Family members can provide practical support (such as financial support) and emotional support (such as encouragement and hope) by working together to manage demands (Zhao et al., 2021), this can help reduce the level of physiological and mental exhaustion among caregivers, and reduce the risk of depression and anxiety (Shin et al., 2018). Therefore, caregivers with good family functioning can reduce the grieving process by receiving beneficial emotional responses and available assistance. Based on the discussion above, we proposed the following hypotheses:

> *H2*: Caregiver burden is negatively associated with their family functioning.
>
> *H3*: Family functioning moderates the positive relationship between caregiver burden and anticipatory grief, in that the higher the family functioning, the weaker is the positive relationship between caregiver burden and anticipatory grief.

Resilience as mediator between caregiver burden and anticipatory grief

There is a general consensus that caregiver burden is negatively related to resilience (Hoang et al., 2018). Resilience as a protective element refers to a caregiver's ability to adapt to the physiological and psychological demands of their role (McKenna et al., 2022). However, some caregivers adopt an avoidance style to deal with caregiver burden when experiencing challenges such as the high demands of caregiving (Junkins et al., 2020). At the same time, lack of adequate resources to cope with these challenges can inculcate negative emotions such as anxiety and depression, and may even disrupt their relationship with the patients (Noyes et al., 2010).

Resilience was found to negatively related to grief symptoms. This emphasizes the role of positive psychology in empowering human strength to cope with adversity. Individuals with high resilience can adjust successfully in the face of stressful events, including the loss of a loved one (Arizmendi and O'Connor, 2015). A systematic review found that resilience is associated with alleviated caregiver burden in end-of-life and palliative care (Palacio et al., 2020). However, it was unknown how resilience was associated with anticipatory grief symptoms. In general, the level of resilience was crucial for a healthy adaptation to grief. Therefore, the following hypotheses are proposed:

> *H4*: Caregiver burden is negatively associated with their resilience.
>
> *H5*: Resilience moderates the positive relationship between caregiver burden and anticipatory grief, in that the higher the resilience, the weaker is the positive relationship between caregiver burden and anticipatory grief.

Family functioning to resilience

Previous studies have shown that a positive experience of family functioning can foster resilience (Kukihara et al., 2020). Family functioning refers to the feeling of being socially connected and a sense of belongingness among family members. Family functioning can foster love, trust, and encouragement for caregivers to increase their resilience (Hawkley et al., 2021). Therefore, the following hypothesis is proposed:

> *H6*: Family functioning is positively associated with the resilience of caregivers.

Materials and methods

Research framework

It illustrates a hypothetical model of the relationship between the following variables, caregiver burden as an independent variable, anticipatory grief as a dependent variable, and family functioning and resilience as mediating variables. Based on the study hypotheses, the proposed research framework is presented in Figure 1.

Participants and procedure

It was a descriptive cross-sectional research design, data were collected through a questionnaire survey conducted using a convenience sample of primary caregivers of elderly cancer patients. Patients diagnosed with cancer and aged ≥ 60 were recruited in this study. Caregiver's inclusion criteria were as follows: (a) act as a primary caregiver (spouse, child, daughter-in-law, son-in-law, etc.); (b) be aware of the patient's illness condition; and (c) volunteer for this study. We excluded caregivers who were unable to complete the questionnaire because of cognitive impairment, communication disorders, or weakness.

Researchers conducted unified training for three investigators from different hospitals who were required to contact participants and assist those who had difficulty understanding the questionnaires. After explaining the purpose of the study and obtaining informed consent from tumor ward managers and participants, investigators distributed the questionnaires to caregivers in a one-to-one manner. Questionnaires consisted of the scales of the Chinese version of Zarit Burden Interview, the family APGAR Questionnaire, the Connor-Davidson Resilience Scale, and the Anticipatory Grief Scale. Before the formal investigation, a preliminary investigation was conducted in a Class III Grade A hospital in Lanzhou city, China. The formal survey was carried out at three Class III Grade A hospitals in Lanzhou city, China between October 2019 and September 2020. The questionnaires were returned on the spot after completion. The total questionnaires took about 15 min to complete, and all participants were given small gifts after filling out the questionnaires as compensation. A total of 650 questionnaires were distributed and collected. After excluding incomplete questionnaires and outliers, the final valid sample size was 624 (valid response rate: 96%). The demographic characteristics of the study population are summarized in Table 1.

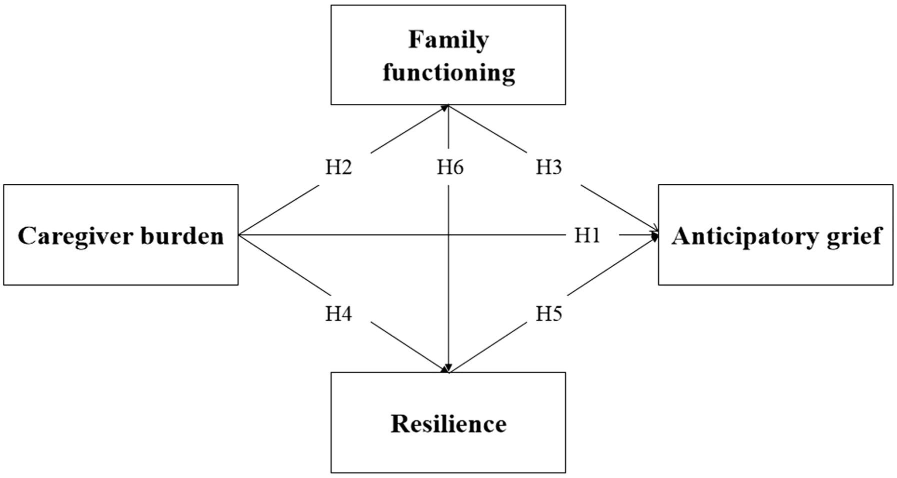

FIGURE 1
A hypothetical model of the relationship between variables. Influence of caregiver burden on anticipatory grief through family functioning and resilience.

Measures

Caregiver burden

Caregiver burden was assessed using the Zarit Burden Interview developed by Zarit et al. (1985). The scale consists of 22 items, including two subscales: personal strain and role strain. All items were scored on a five-point Likert scale ranging from 0 (mild caregiver burden) to 88 (strong caregiver burden). Higher scores reflect a higher level of caregiver burden. The present study adopted the Chinese version that is more suitable for Chinese caregivers of elderly cancer patients (Wang et al., 2006). The Cronbach's α coefficient of this sample was 0.870, while those of two subscales were 0.890 and 0.830.

Family functioning

Family functioning was assessed using the family APGAR Questionnaire developed by Smilkstein (1978), which has been translated and validated in China (Lv et al., 1999). The scale includes 5 items: adaption, partnership, growth, affection, and resolve. Each item was rated on a scale ranging from 0 (hardly ever experience) to 2 (often experience). All items are scored on a four-point Likert scale ranging from 0 to 10. The levels of family functioning are defined based on the total scores as follows: 0–3 indicates a low level of family functioning, 4–7 indicates a moderate level of family functioning, and 8–10 indicates a high level of family functioning. The questionnaire was shown to be reliable and has good test–retest validity (correlation coefficient: 0.800–0.830). The Cronbach's α coefficient of the scale in the present sample was 0.910.

Resilience

Resilience was assessed using the Connor-Davidson Resilience Scale (Connor and Davidson, 2003), which was translated into Chinese, and its psychometric properties were verified (Yu et al., 2007). It consists of 25 items, and 3 subscales: optimism, self-improvement, and toughness. All items are scored on a four-point Likert scale ranging from 0 to 100. A higher score on a certain demission indicates higher resilience. In this study, the Cronbach's α coefficient of the overall scale was 0.910, and the Cronbach's α coefficients of the subscales ranged from 0.730 to 0.890.

Anticipatory grief

Anticipatory grief was assessed using the Chinese version of the Anticipatory Grief Scale, which was developed by Theut et al. (1991) and modified by Zhou et al. (2017). It consists of 27 items and 7 subscales: guilty, anger, anxiety, irritability, sadness, feeling of loss, and decreased ability to function at usual tasks. All items are scored on a five-point Likert scale ranging from 27 (low anticipatory grief) to 135 (high anticipatory grief). Higher scores reflected a higher level of anticipatory grief. The Cronbach's α coefficient of this sample was 0.870 and those of three subscales ranged from 0.840 to 0.910.

Data analysis

Means, standard deviations, and correlations of the variables were computed using SPSS 24.0. Multiple regression analysis was used to analyze the associations between the

TABLE 1 Demographic characteristics of participants (*N*=624).

Characteristics	Items	Frequency	Percentage (%)
Age	48.3 ± 11.4 years		
Gender	Male	331	53
	Female	293	47
Relationship with patients	Spouse	112	18
	Children	474	76
	Others	38	6
Education level	Primary school and below	75	12
	Secondary school	218	35
	High school	150	24
	College and above	181	29
Residence	City	349	56
	Countryside	275	44
Working status	Employed	205	33
	Unemployed	324	52
	Retired	94	15
Monthly income	≤ 3,000 Yuan	262	42
	3,001–6,000 Yuan	281	45
	≥ 6,001 yuan	81	13

TABLE 2 Means, standard deviations (SD), and intercorrelations among study measures.

Measure	Mean	SD	1	2	3
1. Caregiver burden	38.32	11.05			
2. Family functioning	5.14	1.28	−0.49**		
3. Resilience	58.49	12.08	−0.43**	0.31*	
4. Anticipatory grief	88.49	10.65	0.52**	−0.51**	−0.38**

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed).

caregiver burden and anticipatory grief. We controlled caregiver's age, gender, and relationship with patients, and then conducted with two types of caregiver burden as independent variables and anticipatory grief and its seven different dimensions as dependent variables. Besides, the role of family functioning and resilience as mediators was tested *via* Structural Equation Modeling (SEM) using AMOS 23.0, which is a multivariate technique to analyze the observed and latent variables relationships. It was similar to a mixture of both factor analysis and multivariate regression analysis.

We applied the two-step procedure of SEM using AMOS 23.0. Firstly, we calculated the measurement model and obtained results. Secondly, we assessed the overall fit of the model of data to examine the structural model. The goodness-of-fit indices were used to test the hypothesis model, and generally χ^2/degrees of freedom (*df*) < 5, root mean square error of approximation (RMSEA) < 0.08, comparative fit index (CFI) > 0.9, Tucker-Lewis index (TLI) > 0.9, and Standardized root mean square residual (SRMR) < 0.05 indicated a good overall fitness of the structural model. The mediation effects of family functioning and resilience were tested by using bootstrapping procedures in AMOS 23.0.

Results

Descriptive statistics and analysis of the correlations between variables

Means, standard deviations, and correlations of all the study variables are shown in Table 2. There was a significant correlation between caregiver burden, family functioning, resilience, and anticipatory grief. Caregiver burden showed a positive association with anticipatory grief. Family functioning and resilience showed a negative association with anticipatory grief. In turn, family functioning and resilience showed a negative association with caregiver burden. Family functioning showed a positive association with resilience. The results of the above correlation analysis suggest that it is suitable for the subsequent mediating effect analysis, and it also lays a foundation for further hypothesis testing.

Multiple regression analysis between caregiver burden and anticipatory grief

In the multivariate analysis, the results found that the variables "personal strain" and "role strain" increased, and the odds of feeling anticipatory grief were significantly increased when holding the other independent variables (e.g., age, gender, and relationship with patient). Both personal strain and role strain were found to be positively correlated with each item of anticipatory grief, and the caregiver burden was significant contributor to anticipatory grief (Table 3).

Testing the mediating effects of caregiver burden and anticipatory grief

The hypothesized path model of this study comprised 17 observed variables and 4 latent variables (caregiver burden, family functioning, resilience, and anticipatory grief). This model showed an excellent fit with the data: χ^2/degrees of freedom (df) = $2.37 < 5$, $p < 0.001$, RMSEA = $0.05 < 0.08$, CFI = $0.92 > 0.9$, TLI = $0.95 > 0.9$, and SRMR = $0.04 < 0.05$. The results showed that the direct path coefficients in the proposed directions were significant, and indicated that family functioning and resilience partially mediated the relationship of caregiver burden to anticipatory grief (Figure 2).

TABLE 3 Multiple regression analysis of each dimension of caregiver burden to anticipatory grief (age, relationship with patients were statistically controlled).

Dependent variable	Independent variable	*B*	SE	*t*	*P*
Anticipatory grief	Personal strain	0.648	0.094	6.682	< 0.001
	Role strain	1.440	1.038	3.547	< 0.001
Sadness	Personal strain	0.527	1.384	2.145	< 0.001
	Role strain	0.436	2.114	1.398	< 0.001
Feeling of loss	Personal strain	0.547	0.964	2.374	0.024
	Role strain	0.368	0.853	3.481	< 0.001
Anger	Personal strain	0.429	1.622	4.210	< 0.001
	Role strain	0.341	1.915	3.896	< 0.001
Irritability	Personal strain	0.513	2.061	4.518	0.020
	Role strain	0.378	1.931	2.947	< 0.001
Anxiety	Personal strain	0.354	0.861	3.077	0.014
	Role strain	0.419	0.766	2.581	0.006
Guilty	Personal strain	0.286	0.628	4.263	0.017
	Role strain	0.294	0.833	4.013	0.035
Decreased ability to function at usual tasks	Personal strain	0.632	0.950	2.950	< 0.001
	Role strain	0.548	0.764	3.811	0.031

$R^2 = 0.419$; Adjusted $R^2 = 0.36$; $F = 6.343$, $p < 0.001$.

Using the original data set ($N = 624$), we generated 2000 bootstrapping samples by random sampling. The mediating effects of family functioning and resilience, and their 95% confidence intervals (CI) are shown in Table 4. 95% CI values of indirect effects indicated that family functioning and resilience significantly mediated the relationship between caregiver burden and anticipatory grief. Thus, findings support that family functioning and resilience all have a partial mediating role in the effect of caregiver burden and anticipatory grief among caregivers of elderly cancer patients.

The direct path from caregiver burden to family functioning was significant ($\beta = -0.36$, $p < 0.05$), as was the direct path from family functioning to anticipatory grief ($\beta = -0.16$, $p < 0.05$). Moreover, the indirect path (path 2) from caregiver burden to anticipatory grief through family functioning was significant (effect = 0.06, 95%CI = [0.02,0.08]). Thus, we suggest that there was a mediating effect of family functioning existed between caregiver burden and anticipatory grief.

Additionally, the path from caregiver burden to resilience was significant ($\beta = -0.58$, $p < 0.05$), as was the direct path from resilience to anticipatory grief ($\beta = -0.68$, $p < 0.05$). Moreover, the indirect path (path 3) from caregiver burden to anticipatory grief through resilience was significant (effect = 0.39, 95%CI = [0.18,0.40]). Thus, we suggested that there was a mediating effect of resilience existed between caregiver burden and anticipatory grief.

Discussion

Our study adopted a chain mediating model to explore the influence of caregiver burden, family functioning, and resilience on anticipatory grief in caregivers of elderly cancer patients. We verified the mediating role of family functioning and resilience in the relationship between caregiver burden and anticipatory grief. The findings support the proposed hypotheses as follows: (1) Caregiver burden has a direct positive effect on anticipatory grief. (2) Family functioning not only has a direct negative effect on anticipatory grief, but also plays a mediating role between caregiver burden and anticipatory grief. (3) Resilience has a direct negative effect on anticipatory grief, and plays a mediating role between caregiver burden and anticipatory grief. (4) Resilience moderates the mediating effect of family functioning.

The findings unveiled that family functioning and resilience partially mediate the relationship between caregiver burden and anticipatory grief. It revealed that caregivers with high levels of family functioning and resilience might perceive lower anticipatory grief despite the difficult caring circumstances resulting from heavy caregiver burden. Cancer treatment brings tremendous economic pressure, which may contribute to poverty or poverty reinstatement (Liu et al., 2022). In addition, caregivers may experience increased physical symptoms and declined body function due to caring work (Song et al., 2011). Well-family functioning provided by the family was significant to assist caregivers in reducing economic burden, maintaining social and mental health, and encouraging them to address issues actively, eventually improving their resilience (Hawkley et al., 2021), and leading to an adjustment in anticipatory grief (Coelho et al., 2018).

Caregivers of elderly cancer patients in this study showed a high level of anticipatory grief, which was higher than that reported by Li et al. (2022a). Their study was conducted on caregivers for adult Chinese patients with advanced lung cancer. On one hand, elderly cancer patients often have more severe physiological disorders, resulting in higher basic care needs and more prominent emotional problems. Thus, the caregivers of elderly cancer patients are under greater psychological stress (Sun et al., 2022). On the other hand, elderly cancer patients are more likely to have complications and closer to death than adult cancer patients. Caregivers of elderly cancer patients have a heightened sense of imminent loss of a loved one, which may result in a strong sense of loss and separation (Seyedfatemi et al., 2021).

Caregivers of elderly cancer patients in this study showed a moderate level of caregiver burden, which is higher than that reported by Menon et al. (2022). Their study was conducted in India, and most of the participants were caregivers for elderly patients with lung carcinoma and gastrointestinal cancers. The family-centered concept is deeply rooted in Chinese culture, and caregivers in China often regard caring for a family member as an obligation or responsibility, and thus are more likely to take on a lot of caregiving responsibilities. Since elderly cancer patients often have multiple comorbidities and complications, and are more likely to have more severe disease compared to adult cancer patients, it is more difficult for caregivers to cope with the care burden (Shin et al., 2018). Studies have shown that caregivers of elderly cancer patients are less likely to maintain a healthy lifestyle, such as regular exercise, healthy diet, adequate sleep, and actively seeking preventive health care, which increases their physiological burden (Lee et al., 2022).

In our study, both personal strain and role strain were found to be positive associations of anticipatory grief. There is a relationship between caregiver burden and anticipatory grief, with caregiver burden explaining about 36% of the variance in anticipatory grief, $F = 6.343$, $p < 0.001$, Adjusted $R^2 = 0.36$. Elderly cancer patients tend to suffer from fatigue, loneliness, nausea, vomiting, diarrhea, weight loss, anxiety, pain, depression, and multiple morbidities (Kyriazidou et al., 2022). Therefore, caregivers need to provide long-term assistance with activities of daily living such as grooming, feeding, bathing, walking, and dressing (Bonin-Guillaume et al., 2022). Moreover, it is crucial to offer spiritual support and company to patients. Because of these demands, caregivers of elderly cancer patients are likely to experience a loss of personal freedom and inability to find adequate time for their personal needs (Li et al., 2022b), which can also cause anticipatory grief (Holm et al., 2019).

From a theoretical perspective, our study highlights the means to relieve caregiver burden in line with the conservation of resources theory. Based on the existing proposition, obtaining resources from environmental and internal factors can assist people in confronting stress or burden. Elderly cancer patients will require more support from caregivers as their health conditions change and their socioeconomic status deteriorates. Caregivers of elderly cancer patients are under a tremendous burden, such as physiological discomfort and emotional instability, and also need to incur heavy medical expenses (Jones et al., 2015). Therefore, provision of resources to caregivers can help them cope better with the caregiver burden. The social relationship is imperative for caregivers of elderly cancer patients.

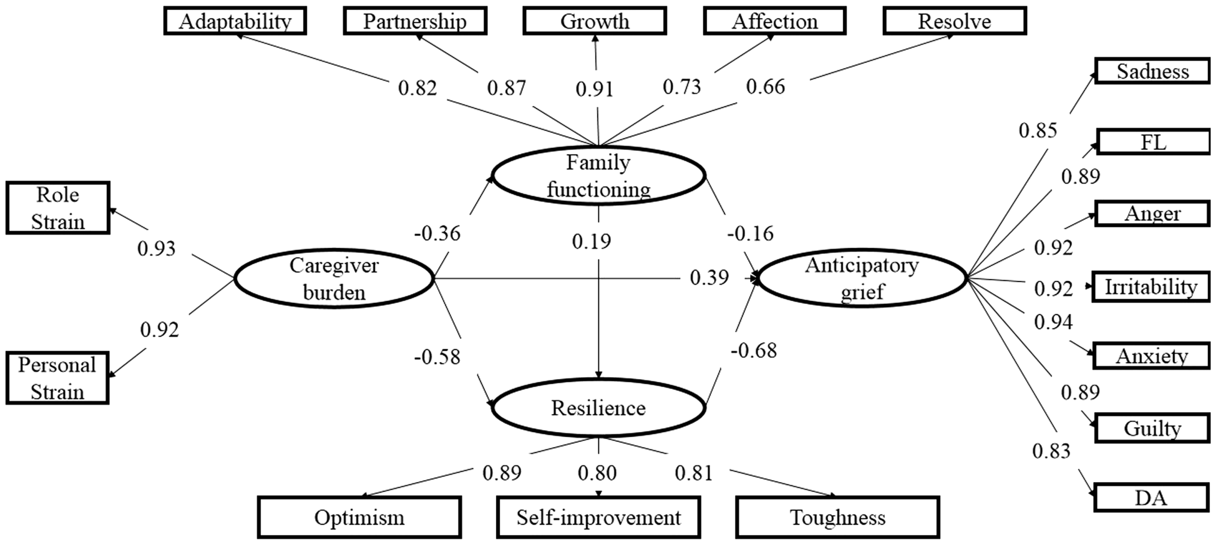

FIGURE 2
The Structural Equation Model linking caregiver burden and anticipatory grief through family functioning and resilience. Factors loadings are standardized. FL=feeling of loss, DA=decreased ability to function at usual tasks.

TABLE 4 Bootstrapping direct and indirect effects and 95% confidence intervals (CI) for the mediational model.

Model pathways	Estimated	95%CI	
		Lower	Upper
Caregiver burden → Anticipatory grief	0.39	0.30	0.50
Caregiver burden → Family functioning → Anticipatory grief	0.06	0.02	0.08
Caregiver burden → Resilience → Anticipatory grief	0.39	0.18	0.40
Caregiver burden → Family functioning → Resilience → Anticipatory grief	0.05	0.02	0.07

Chinese people tend to be self-confined when faced with problems, and they see family as an important source of social support (Yu et al., 2021). With the support of family members, caregivers of elderly cancer patients can maintain their social network and share the care responsibility, which may decrease their burden and improve emotional health (Steenfeldt et al., 2021). Caregivers of elderly cancer patients with high resilience are more likely to face caregiver burden with their toughness, and use a positive attitude to cope with the difficulties to reduce the impact of the caregiver burden (Bonanno, 2004). Therefore, when caregivers have higher family functioning and resilience, their caregiver burden and anticipatory grief would be alleviated.

In practice, nurses should develop policies and interventions to reduce caregiver burden and anticipatory grief. When an elderly cancer patient is diagnosed, nurses should provide support. Firstly, assessing caregivers who have the risk of burden, caring about their physiological, emotional, and social needs, and providing them personal psychological and financial support, and resilience skills (Baker et al., 2021). Secondly, nurses should counsel them that it is normal to feel sadness and grief, teach them how to deal with problems and manage stress, and help them access the available family support. Thirdly, nurses should guide caregivers to maintain health promotion-related behaviors, and maintain their physiological fitness to manage the caregiver burden. Finally, nurses should also participate in family activities, and encourage emotional communication among family members in these activities, so as to help them establish close relationships and improve family functioning (Kissane et al., 1998). In conclusion, nurses should pay full attention to the family functioning and resilience, and assist patients and caregivers in coping with cancer together, in order to promote caregivers' role adaptation and relieve their anticipatory grief.

Limitations and future directions

Some limitations of the present study should be acknowledged. Firstly, the study was conducted only in three hospitals in Western China, and only concerned the population of caregivers of elderly cancer patients, which may have caused a sampling bias and affected the representativeness of the findings. Secondly, whether participants had caregiving experience and different types of cancer of patients in sample selection was not adequately considered, which may also affect the level of clinical outcomes. Thirdly, the optimal cut-off values in this study were not confirmed. Finally, this study only focused on family functioning and resilience, while the demographic variables were not included in the structural equation modeling; therefore, additional variables should be considered in future research.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the School of Nursing, Lanzhou University in China. The patients/participants provided their written informed consent to participate in this study.

Author contributions

CL: writing and original draft preparation. HZ and NT: review and editing. QZ and TY: supervision. HZ: project administration. LY, XP, and JW: collecting information. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

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

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Better forbearance, lower depression: Evidence based on heart rate variability

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Background: The relationship between forbearance, a psychological resource, and depression has to date remained inconclusive. The present study investigated heart rate variability (HRV) reactivity to acute stressor tasks in participants with different levels of forbearance to discover how forbearance influences depressive emotions when facing adversity.

Method: The study examined the relationship between forbearance and depression, comparing HRV reactivity to stressor tasks in participants with different levels of forbearance. The levels of reported forbearance were assessed by the Forbearance Scale (FS). The Patient Health Questionnaire-9 (PHQ-9) was used to assessed depression severity. HRV reactivity was evaluated at five stages: baseline, the active stressor task, the period of recovery after the active stressor task, the passive stressor task, the period of recovery after the passive stressor task.

Results: FS scores had a significant negative correlation with PHQ-9 and a significant positive correlation with HRV; significant differences existed between the basal HRV in the higher and lower FS groups. In the passive stressor task and the period of recovery after the active stressor task, significantly different HRV responses were identified between the two groups.

Discussion: Forbearance was correlated with depression and HRV. The present research found differences in HRV among subjects with different levels of forbearance in the baseline as well as stressor and recovery periods, suggesting that self-regulation dysfunction may exist among persons with lower levels of forbearance. Because of the higher levels of forbearance, the negative emotions of individuals caused by adversity are mitigated.

KEYWORDS

forbearance, depression, positive psychological resource, heart rate variability, acute stress tasks

1. Introduction

Forbearance, which in Chinese culture refers to people regulating and controlling their emotions, attitudes, and behaviors, has received attention as a psychological resource. It is defined as a psychological quality whereby an individual can withstand desires, difficulties, and pressures; endure temporary unhappiness or humiliation in order to achieve their long-term interests or goals; handle conflict peacefully as well as being self-effacing; and regulate their emotions, attitudes, and behaviors (Yu and Xiao, 2020). It is also a virtue that can be defined in terms of the qualities of kindness and tolerance in Chinese philosophy (Han and Zhang, 2018). As a psychological resource, the levels of forbearance influence people's level of depression (Deng et al., 2019; Yu and Xiao, 2020; Deng and Xiao, 2022), and is a means of maintaining social and personal relationships in the face of provocation (Ho and Liang, 2021). Long-term forbearance is important for protect the general health and reduce the depression's onset tendency, whereas short-term forbearance is more beneficial for happiness (Aghababaei and Tabik, 2015). However, there are some negative interpretations of forbearance in Chinese culture; Chinese idioms such as "*To swallow an insult and humiliation silently*" and "*Take something (taunt, snub and so on) lying down*" indicate that forbearance also imply that individuals have to suppress their feelings of discomfort and control their behavior even when they do not want to do so. For instance, people have to tolerate the provocation of others when they themselves are defenseless or wronged because of the desire to accommodate others. These negative aspects suggest that forbearance perhaps predispose individuals to depression in certain environments, and some researchers consider forbearance as a negative coping strategy that increases the risk of depression and anxiety (Coiro et al., 2017). The conflicting findings of past research reveal the complexity of the psychology of forbearance. Nonetheless, the previous studies have concluded that forbearance is, to some extent, a positive psychological resource (Schnitker, 2012; Zahra Marhemati, 2017). Positive psychological resources refer to resources that individuals can use to positively cope with and respond to stress and adversity, and are increasingly recognized as associated with relief of depression (Celano et al., 2020; Shi et al., 2020). Self-regulation is an important positive psychological resource (Krkovic et al., 2018). Positive self-regulation enables individuals to better cope with the effects of negative emotions in the face of adversity (Ottenstein, 2020). Thus, further research was required to examine the relationship between forbearance and self-regulation in the context of a stressor, explaining the effect of forbearance on depressive symptoms. This would determine defining whether forbearance is a positive psychological resource and coping strategy.

The Psychophysiological Coherence Model theorizes that rhythmic activity in living systems can reflect the regulation of interconnected psychological, biological, and environmental networks (McCraty et al., 2009). Coherent and harmonious rhythms signify a stable and orderly living system associated with personal overall well-being, cognitive ability, socialization, and physical performance (McCraty and Childre, 2010). Heart rate variability (HRV) reflects one's heart rhythm, and is an important non-invasive indicator often used to investigate cardiac autonomic nervous system (ANS) activity (Thayer et al., 2012). Examining HRV can be used to assess a person's self-regulation ability in the face of stressors and is an indicator of psychological resilience and psychological flexibility (Visted et al., 2017; Lau et al., 2021). HRV analysis methods mainly focus on the time and frequency domains (TaskForce, 1996). Poor HRV is considered to be an indicator of many mental health problems (Kemp et al., 2014; Jiang et al., 2015; Guo et al., 2021); better emotional regulation, a lower perceived stress, and lower cognitive load are reflected by high HRV (Lischke et al., 2018; Dias et al., 2019).

The time and frequency domains are used to reflect the activity of the two branches of the ANS. Root mean square of R-R intervals (RMSSD) is one of the primary time-domain measures used to reflect the vagally mediated changes that occur in response to HRV. A lower RMSSD means that individuals are more likely to use maladaptive coping strategies in the face of stress (Machado et al., 2021). High-frequency power band (HF) can be used to evaluate the impact of parasympathetic nerves on the heart, and is highly correlated with respiratory sinus arrhythmia (RSA). RSA is a reliable biomarker of emotion regulation capacity in individuals (Beauchaine, 2015), which is thought to isolate the parasympathetic influence on the heart (Scott et al., 2021). A number of studies have confirmed that HF is an effective frequency domain measure of parasympathetic nerve activation (Balzarotti et al., 2017; Laborde et al., 2017; Kirk and Axelsen, 2020). Studies have found a negative relationship between HF and perceived emotional stress; reduced HF levels also reflect poor emotional inhibition (Gillie et al., 2014). Low-frequency power band (LF) with greater sympathetic sensitivity reflects baroreceptor activity (Shaffer et al., 2014; Pham et al., 2021), as well as the mixture of sympathetic and parasympathetic nerve contribution (Kidwell and Ellenbroek, 2018). Higher LF scores signify serious depression, anxiety, and perceived stress (Michels et al., 2013; Druzhkova et al., 2019). LF/HF is the ratio of LF to HF power; a high LF/HF ratio reflects greater sympathetic activity relative to parasympathetic activity (Thayer et al., 2012).

Acute laboratory stressors are used to elicit an immediate individuals' stress response immediately from individuals. They can be classified according to the different responses from the parasympathetic and sympathetic nerves. One broad category of acute stressors requires the participant to generate a behavioral response (e.g., solving math problems quickly, generating an impromptu speech, or receiving a cold-pressor test). It has been confirmed that these types of stressors invoke parasympathetic withdrawal, sympathetic activation, as well as an increase in heart rate (Jiang et al., 2017; Renna et al., 2022); furthermore, they contribute to a rejection of environmental stimuli and make the participant generate a defensive or escape response. These kinds of acute stressors have been labeled as "active" tasks and "sensory rejection" tasks by researchers (Lacey and Lacey, 1958). The other broad category of acute stressors requires the participant to be presented with visual, auditory, or tactile stimuli (e.g., watching videos or images featuring blood and injury). These types of acute stressors will invoke parasympathetic activation and a decreased heart rate, promoting enhanced cognitive processing of the threat stimuli by taking in the environmental stimuli (Watford et al., 2020). Researchers have termed these "passive" and "sensory intake" tasks (Lacey and Lacey, 1958).

Either type of acute stressors can elicit HRV reactivity. Rapid arithmetic or impromptu speech tasks in active stressors have been found to significantly reduce HF in HRV (Whited et al., 2014; Petrowski et al., 2017). In contrast, participants' HF response was found to significantly increase when they were asked to complete passive tasks such as watching a violent or bloody video compared to an emotionally neutral video (Shenhav and Mendes, 2014).

In this study, we aimed to discover the effects of forbearance on depression from an ANS perspective. The primary purpose of our study was to compare the HRV reactivity of participants with different levels of forbearance in acute stressors and hence investigate whether forbearance as a psychological resource can influence the emotional regulation and stress-coping ability of individuals in distress.

2. Materials and methods

2.1. Participants

Participants from Southern Medical University were recruited through flyers posted on campus and a website link providing recruitment information. The study was conducted from March 2021 to January 2022, and we received responses from 161 potential participants, who were all screened according to the following inclusion criteria: (1) no history of heart disease and mental illness, such as arrhythmia, coronary heart disease, diagnosed depression, anxiety, insomnia, and so on; (2) no history of medication, including cardiovascular medications, psychotropic medications, and the contraceptive pill; (3) no alcohol or tobacco addiction. A total of 130 participants were recruited based on the initial screening results.

As shown in Table 1, the mean age of the participants was 22.03 (*SD* = 2.04), while the average BMI was 20.40 (*SD* = 2.39). Participants reported moderate levels of caffeine consumption and engagement in sport. This study was approved by the Ethics Committee of the School of Public Health, Southern Medical University, and informed consent was given by all participants.

TABLE 1 Descriptive statistics of demographic data from higher and lower FS groups.

	Higher FS (*n* = 66)	Lower FS (*n* = 64)	Value of *p*
Age, year (mean ± *SD*)	21.94 ± 2.13	22.13 ± 1.95	0.606
BMI (mean ± *SD*)	20.64 ± 2.47	20.16 ± 2.30	0.262
Gender			0.491
Female (*n*, %)	48 (72.73%)	43 (67.19%)	
Exercise frequency per week (*n*, %)			0.380
0	16 (24.24%)	18 (28.13%)	
1–3	38 (57.58%)	29 (45.31%)	
3–5	8 (12.12%)	14 (21.88%)	
>5	4 (6.06%)	3 (4.68%)	
Caffeine consumption frequency per week (*n*, %)			0.371
Never	52 (78.78%)	47 (73.44%)	
Once per week	7 (10.61%)	5 (7.81%)	
A few times a week	5 (7.58%)	11 (17.19%)	
Once a day or more	2 (3.03%)	1 (1.56%)	
Total PHQ-9 score	6.29 ± 4.36	7.52 ± 3.60	0.083
Total FS score	80.89 ± 5.04	67.63 ± 5.05	**<0.001**

p-values in bold indicate significant difference ($p < 0.05$) between the two groups. BMI, Body Mass Index; PHQ-9, Patient Health Questionnaire-9; FS, Forbearance Scale.

2.2. Study procedure

Participants arrived at the lab to complete the informed consent form and questionnaires. Following this, an ECG (electrocardiograph) electrode was placed on each individual's sternum. After placement, participants were required to sit quietly for 15 min while the baseline ECG data were recorded. A stress induction was then given; participants were asked to complete the first stress task (active stressor, 6 min) and then to sit quietly for recovery (6 min). The second stressor was then administered (passive stressor, 6 min) followed by a recovery condition (6 min). Finally, participants were instructed to keep relaxed and sit quietly for 15 min while the post-ECG data were recorded. The order of stressor presentation shown to each participant was randomized. Throughout the experimental period, ECG data were recorded.

2.3. Study design

2.3.1. Baseline condition

Participants were instructed to avoid caffeine, alcohol, and exercise for 24 h before the experiment. They arrived at the lab at the appointed time (8:30 a.m. or 10:30 a.m.). After self-reported psychological measures were completed and the electrode was placed, each participant was asked to sit quietly for 15 min, while the baseline ECG data were recorded; the data were collected under a controlled temperature (24–26°C).

2.3.2. Active stressor

In this study, the math component of the Trier Social Stress Task (TSST) was used as an active stressor; it has been confirmed to significantly invoke an acute stress response in individuals, including an increase of salivary cortisol (Jiang et al., 2017), heart rate (Woody et al., 2017) and HRV responses

(Petrowski et al., 2017). All participants received the active stressor. In this stressor, participants were required to start at the number 1,022 and quickly subtract 13 consecutively in front of a committee (made up of one man and one woman); they were asked to restart this task from the beginning if they made any errors. The stressor duration was 6 min.

2.3.3. Passive stressor

An emotionally stressful video was used as the passive stressor. Videos containing violence, blood, or injury typically invoke parasympathetic activation and elicit a stress state (Brzozowski et al., 2018). Compared with a horror movie clip or a video of a car accident, a surgery video not only intuitively presents factors like trauma and blood, but also avoids other anxiety-inducing stimuli (Watford et al., 2020). Hence, a video of open-heart surgery was chosen to expose participants to blood and injury. The participants were randomly divided into a stress group and a control group according to a 3:1 ratio in order to ensure that this video did invoke acute stress in them (Aversano et al., 2012; Moher et al., 2012; Chandereng et al., 2020). Following randomization, subjects in the stress group were shown an edited video of a thoracotomy, while subjects in the control group were presented with an emotionally neutral clip about scenery. Both videos were played without sound to avoid the effect of background music on the experimental results. The stressor duration was 6 min.

2.3.4. Recovery condition

Participants were instructed to sit quietly for 6 min after each stressor condition ended. During this time, the ECG data were continuously recorded.

2.4. Measures

2.4.1. Heart rate variability

ECG data were recorded using a Holter monitor (Mobio® Portable Recorder, Chengdu Synwing Technology Co., Ltd., Chengdu, China). ECG analytics 2.0.2 software was used to analyze the recorded data and obtain time and frequency domain indices. Using ECG analytics 2.0.2 software, ECG signals were visually inspected and corrected for artifacts or signal noise. The time-domain index of HRV is RMSSD, which is one of the primary time-domain measures (Kidwell and Ellenbroek, 2018), and one of the more commonly used time-domain indices in short-term recording (Shaffer and Ginsberg, 2017; Saboul and Hautier, 2019). Frequency domain indices of HRV include HF, LF, and LF/HF ratio. HF is mainly regulated by parasympathetic activity (Shaffer et al., 2014), while LF is modulated by both sympathetic and parasympathetic activity (Xhyheri et al., 2012). The LF/HF ratio was computed as an index to reflect the sympathovagal balance (Pham et al., 2021). Absolute power was generated for HF and LF; the indices used in the current research were HF (n.u.) and LF (n.u.), which can be obtained accurately in a short-term measure (TaskForce, 1996; Shaffer and Ginsberg, 2017).

2.4.2. Forbearance scale

Levels of forbearance were assessed using the Forbearance Scale (FS; Yu and Xiao, 2020), which is based on the understanding of the word "*Ren-Nai* (Forbearance)" in Chinese traditional culture. It aims to measure the ability of individuals to adjust their emotions, attitudes, and behaviors in life events in accordance with Chinese cultural characteristics. The FS contains five factors: repressive avoidance, restraint and concession, patience and peace, delayed gratification, and positive cognition. It can reflect the forbearance characteristics of an individual in four aspects: cognition (positive cognition), behavior (repressive avoidance, restraint, and concession), motivation (delayed gratification), and personality (patience and peace). In the present study, the internal consistency of the FS was good ($\alpha = 0.866$). In a previous study, application of the FS to different social groups showed that FS scores were significantly negatively correlated with depression (Yu and Xiao, 2020; Deng and Xiao, 2022). The FS consists of 20 items, which are scored on a scale from 1 (totally inconsistent) to 5 (totally consistent). The total score on the scale is 20–100; higher total scores indicate a higher level of forbearance.

2.4.3. Patient health Questionnaire-9

Depression severity was assessed by the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 consists of nine items, scored on a scale from 0 (not at all) to 3 (nearly every day); the maximum score is 27. Higher total scores mean higher levels of depressive symptoms: a score of 0–4 indicates minimal depression, 5–9 indicates mild depression, 10–14 moderate depression, 15–19 moderately severe depression, and 20–27 serious depression. The Chinese version has good reliability and validity. The Cronbach's alpha score for the scale in this study was 0.844.

2.5. Statistical analysis

All participants were divided into higher FS and lower FS groups based on the mean FS scores. Demographic data were analyzed by descriptive analysis. The Kolmogorov–Smirnov test was applied to all study variables to determine whether the data were normally distributed, while a Spearman's rank correlation analysis was used to evaluate the relationship between FS and PHQ-9 scores. The relationship between FS scores and baseline HRV was also tested by Spearman's rank correlation analysis. A non-parametric test (Mann–Whitney *U*-test) and Student's *t*-test was used to compare the differences in HRV responses between the higher FS and lower FS groups at baseline, under different stressors, recovery conditions, and post-stressor period. All data calculations were performed using SPSS 26.0. A p-value < 0.05 was used to confirm statistical significance.

3. Results

3.1. Demographic data

The demographic data are presented in Table 1. The higher FS group and lower FS group did not differ in terms of age, BMI, gender ratio, exercise frequency per week, and caffeine consumption frequency per week.

3.2. Correlations between FS, depression, and heart rate variability at baseline

Correlations were analyzed between the FS items and PHQ-9 in order to verify the relationship between forbearance and depression, as shown in Table 2. The results showed a significant negative correlation between the total FS score and depressive symptoms ($r = -0.233$, $p = 0.008$). In addition, the results of the correlation analysis between individual FS items and depressive symptoms showed that higher levels of self-reported patience and calmness, delay of gratification, and positive identification with the concept of forbearance (items 3, 7, 8, 12, 13, 18, and 20) were significantly and negatively associated with depressive symptoms. In contrast, items related to suppressing negative emotions and evasive behavior in distress (items 1, 6) were significantly positively correlated with depression.

Correlation analysis was conducted to assess the degree of interdependence between FS and HRV. The results were as follows: RMSSD, $r = 0.301$, $p < 0.001$; HF, $r = 0.220$, $p = 0.012$; LF, $r = -0.219$, $p = 0.012$; LF/HF, $r = -0.190$, $p = 0.30$. These results indicate a relationship between FS and HRV.

3.3. Forbearance and heart rate variability at baseline

Table 3 shows data related to the baseline HRV indices for the higher FS and lower FS groups; the results show a significant difference in the baseline HRV in the two groups.

3.4. Forbearance and heart rate variability reactivity in stressor stages

3.4.1. Heart rate variability reactivity in passive stressor in stress and control groups

The Wilcoxon signed-rank test was used to investigate the difference between HRV at baseline and HRV at the passive stressor stage in the stress and control groups. Regarding HRV reactivity in the stress group, significant differences were found between the baseline and passive stressor stages (Table 4). In the control group, the results showed no significant differences between the two stages (Table 4). Hence, we can be certain that the

TABLE 2 Correlations between FS and PHQ-9.

FS item	*r*
1. A lot of times I wronged myself because of accommodating others	0.171*
2. I can tolerate the current unhappiness in order to the longer-term goal	−0.120
3. I am a patient person	−0.309**
4. I'd rather be compromised than haggle over every ounce with others	0.021
5. I think moderate be compromised is more conducive to success	−0.140
6. You must learn to swallow hard when your ability is insufficient	0.192*
7. I do not care about the immediate gains and losses, but about the future development	−0.290**
8. I can control my negative emotions very well	−0.350**
9. I try to avoid conflict with others	−0.088
10. I believe that people have to bear hardships and withstand hard work to have better development	−0.120
11. Sometimes forced by the situation, people should learn to compromise	−0.020
12. I am willing to restrain my current desires and needs for future development	−0.322**
13. I can control of my speech and behavior when I am upset or angry	−0.379**
14. I think I would rather make concessions to avoid trouble than tit for tat	−0.125
15. Forbearance is the embodiment of personal cultivation	−0.115
16. when we cannot get out of predicament, we should learn to accepting the adversity	0.098
17. I am willing to sacrifice my immediate interests for future gains	−0.055
18. I rarely vent my bad emotions to others	−0.173*
19. I rarely argue with others to get the Short-time upper hand	−0.122
20. People who are good at forbearance will have more opportunities for development	−0.279**
FS total	−0.233**

Items were reverse scored so that: 1 = Totally inconsistent, 2 = Partly inconsistent, 3 = Not sure, 4 = Partly consistent, 5 = Totally consistent. Thus, higher scores indicate higher levels of reported forbearance.

*$p < 0.05$, **$p < 0.01$.

thoracotomy video did cause stress in the subjects. Additionally, an interaction effect of 2 (higher/lower FS) × 2 (stress/control) was not significant.

3.4.2. Heart rate variability reactivity in stressor and recovery stages in the two groups

Significant differences were found in the passive stress task. The RMSSD and HF for the higher FS group were significantly higher than in the lower group, while the reverse results were found for the LF and LF/HF ratio (Table 5). Interestingly, regarding the HRV reactivity in the active stressor, no significant differences between the two groups were observed for all indices (all *p*-values > 0.05). However, regarding HRV reactivity in the higher FS and lower FS groups, there was a significant difference in the recovery period after the active stress task (Table 5).

3.5. RMSSD reactivity during the whole procedure

As the primary time-domain measure, the RMSSD is used to evaluate vagally mediated changes (Kidwell and Ellenbroek, 2018).

TABLE 3 Between-group comparisons at baseline HRV in higher FS group and lower FS group.

Index	Higher FS (*n*=66)	Lower FS (*n*=64)	Value of *p*
Baseline-RMSSD (ms)	36.30 (25.5–50.13)	27.00 (20.78–38.13)	**0.007**[b]
Baseline-HF (n.u.)	48.28 ± 16.79	41.98 ± 17.18	**0.036**[a]
Baseline-LF (n.u.)	47.02 ± 16.63	53.88 ± 17.39	**0.023**[a]
Baseline-LF/HF	0.99 (0.59–1.56)	1.31 (0.80–2.61)	**0.031**[b]
Baseline-HR, beat/min	74.85 ± 9.68	78.09 ± 9.37	0.061[a]

Mean values (±SE) for the indices of HF, LF and HR; Median values (Q1–Q3) for the indices of RMSSD and LF/HF. *p*-values in bold indicate significant difference ($p < 0.05$) between the two groups.

[a] Student's *t*-test.

[b] Mann–Whitney *U*-test.

The RMSSD of the higher and lower FS groups were compared at all stages (baseline, stressor, recovery, and post) using the Student's *t*-test or Mann–Whitney *U*-test. A significant difference in RMSSD was found between the two groups in both the baseline and post periods. As shown in Figure 1, in the active stressor stage, there was a non-significant difference in RMSSD between the two groups because of a rapid decrease in RMSSD in the higher FS group during this time (all *p*-values > 0.05). However, there was a significant RMSSD rebound in the subsequent recovery stage in the higher FS group, resulting in a significant difference again with the lower group. In the passive stressor stage, the RMSSD in the higher FS group was significantly higher than that in the lower FS group, and there was no significant difference in the subsequent recovery stage (all *p*-values > 0.05).

4. Discussion

The main findings of this study are as follows: (1) there was a significant negative correlation between the levels of forbearance and depressive symptoms; (2) there was a significant positive correlation between the levels of forbearance and HRV; (3) there were significant differences in HRV between subjects with higher and lower FS at baseline, in the passive stress task, and in the recovery stage after the active stressor.

The relationship between FS scores and PHQ-9 scores was found to be statistically significant. Specifically, individuals with higher FS scores had fewer depressive symptoms than those with lower FS scores. Additionally, the correlation analysis between each FS item and the total PHQ-9 scores showed that the positive components of forbearance, such as personal traits of being patient and peaceful in daily life, delaying gratification in order to achieve better goals, and positive identification with the concept of forbearance, were negatively related to depression severity. In contrast, negative components such as avoidance behavior in the face of difficult situations or suppressing painful emotions were positively related to depression. This finding shows that as a psychological resource, forbearance has both positive and negative aspects. A recent positive psychology emphasized a new approach to the study of life and meaning through a subtle appreciation of

TABLE 4 HRV indices before and after the passive stressor in the stress and control groups.

Index	Emotionally stressed group (*n*=100)		Value of *p*	Controls (*n*=30)		Value of *p*
	Baseline	Passive stress		Baseline	Passive stress	
RMSSD (ms)	32.50 (20.78–41.30)	38.05 (26.83–50.98) *	<0.001	35.80 (22.53–48.23)	34.25 (23.20–49.35)	0.376
HF (n.u.)	45.50 (33.63–59.60)	52.15 (39.70–67.83) *	<0.001	47.05 (33.43–53.20)	40.85 (29.75–55.38)	0.614
LF (n.u.)	49.75 (35.55–63.38)	42.55 (27.58–56.98) *	<0.001	47.50 (41.05–59.43)	52.45 (39.53–66.60)	0.517
LF/HF	1.09 (0.61–1.85)	0.81 (0.41–1.51)*	<0.001	0.99 (0.76–1.59)	1.39 (0.69–2.23)	0.504
HR, beats/min	76.00 (70.25–83.75)	73.00 (68.25–79.00) *	<0.001	72.50 (66.75–85.00)	72.50 (64.00–83.00)	0.205

Median values (Q1–Q3) for the indices of each group.

*$p < 0.05$ vs baseline.

TABLE 5 HRV indices between the recovery stage after the active stressor and the passive stressor in the higher and lower FS groups.

Index	Recovery stage after active stressor		Value of *p*	Passive stressor stage		Value of *p*
	Higher FS (*n*=66)	Lower FS (*n*=64)		Higher FS (*n*=49)	Lower FS (*n*=51)	
RMSSD (ms)	36.80 (28.20–48.75)	29.40 (23.80–37.80)	**0.005**[b]	46.93 ± 25.25	36.63 ± 15.98	**0.006**[a]
HF (n.u.)	27.40 (17.30–39.20)	22.90 (15.30–30.50)	**0.029**[b]	60.10 (44.75–73.70)	47.20 (34.50–65.60)	**0.010**[b]
LF (n.u.)	67.70 (53.35–79.15)	73.70 (67.10–81.70)	**0.050**[b]	41.31 ± 18.72	49.49 ± 18.70	**0.014**[a]
LF/HF	2.52 (1.36–4.56)	3.32 (2.22–5.16)	**0.028**[b]	0.59 (0.32–1.19)	0.98 (0.43–1.81)	**0.027**[b]
HR, beats/min	78.00 (72.00–84.50)	79.00 (74.00–86.00)	0.343[b]	72.00 (67.00–78.50)	74.00 (69.00–79.00)	0.274[b]

Mean values (±SE) for the indices of stressor stage RMSSD and LF; Median values (Q1–Q3) for the other indices. *p*-values in bold indicate significant difference ($p < 0.05$) between the two groups.

[a] Student's *t*-test.

[b] Mann–Whitney *U*-test.

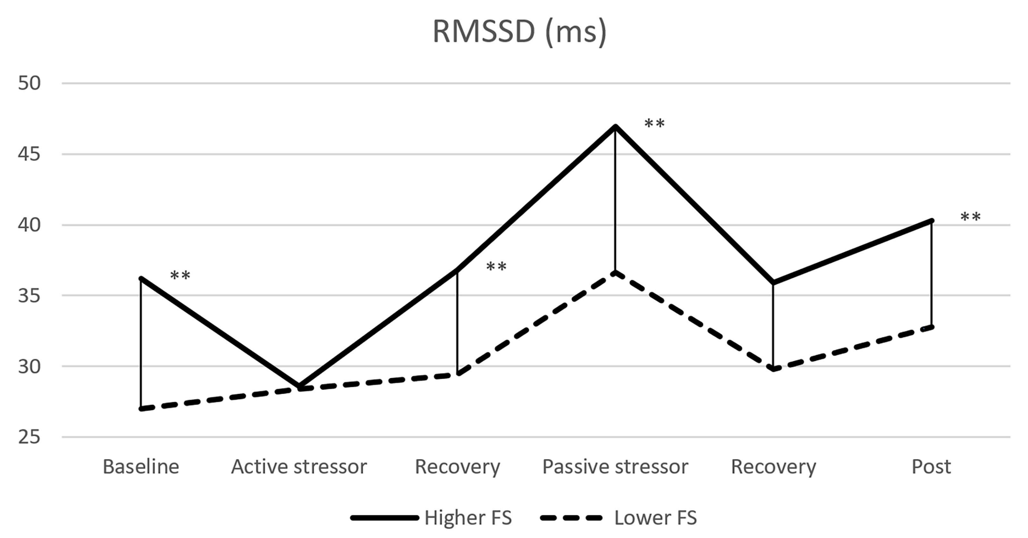

FIGURE 1
Comparisons of RMSSD reactivity in all stages between the higher and lower FS groups. **$p<0.01$.

the negative and positive sides of situations (Mayer and Vanderheiden, 2020). Forbearance has this exact same quality. Its positive side emphasizes the individual's initiative to regulate their emotions, attitudes, and behaviors for the long-term good, while its negative side emphasizes its role in our positive functioning and transformation (Ivtzan et al., 2015).

Participants with higher FS scores had a higher RMSSD and HF, and lower LF and LF/HF ratio. Specifically, higher FS scores mean greater parasympathetic activity, while lower FS scores mean increased sympathetic activation. According to a neurovisceral integration model, a higher resting HRV is associated with more flexible emotional response and better use of adaptive regulatory strategies (Balzarotti et al., 2017). The positive emotions brought about by the mentality of forbearance promote an orderly cardiac rhythm, which then increases parasympathetic activity (representing an increase in HRV), and this increased activity in turn enhances a person's positive emotions and experiences of well-being (McCraty et al., 2009). In contrast, lower levels of forbearance may create higher levels of depression, anger, anxiety, and worry. These negative feelings lead to cardiac rhythm disorder and ANS desynchronization, leading to a further decline in HRV and even affecting the activity of the prefrontal cortex, resulting in more emotional and cognitive dissonance (McCraty et al., 1995).

In the passive stressor (i.e., watching an emotionally stressful video), forbearance demonstrated an effect on mental health. Individuals with higher FS scores showed better HRV reactivity, as demonstrated by higher RMSSD and HF and lower LF and LF/HF. Although watching negative emotional films or images causes an increase in those indices (Shenhav and Mendes, 2014; Brzozowski et al., 2018), and the lower FS group also presented an upward trend, it is clear that subjects with higher FS scores had a larger increase in HF power. HF has been confirmed as being related to greater inhibitory control and more successful suppression of negative emotions; a person with higher HF is therefore less exposed to emotional stress (Gillie et al., 2014; Beauchaine, 2015). Additionally, the higher and lower FS groups presented the same trend of a decrease in LF power in the passive stressor. However, the lower FS group had a higher LF response, which may indicate that participants in the lower FS group felt more stress when viewing the stressful video. A higher LF response might imply parasympathetic blunting in individuals with low forbearance. In the face of a stressor, the baroreceptors generate action potentials that lead to sympathetic inhibition and parasympathetic activation *via* the medulla, thereby promoting the body's balance and recovery (Shaffer et al., 2014). However, the blunted parasympathetic nerves of a person with low forbearance are difficult to activate in time when receiving signals from the baroreceptors, resulting in an imbalance of the ANS, which makes it difficult to effectively regulate and adapt to emotional stress caused by adversity. The LF/HF ratio also presented the same reactivity; our findings showed that the LF/HF of lower FS individuals was higher than people with high FS scores in the passive stress task and this difference was shown throughout the experiment. A higher LF/HF indicates that sympathetic activity is higher than parasympathetic activity (Shaffer et al., 2014). These results confirm our previous interpretation: parasympathetic nerves are blunted, while sympathetic ones are dominant in the ANS of persons with low forbearance.

There was no significant difference in HRV reactivity between the higher and lower FS groups in the active stress task (i.e., solving math problems). As also found in most previous studies, all participants experienced a decrease in HF, increase in LF, and a rapid acceleration of heart rate while completing the active stress task. This suggests that the active stressor in the study is effective for stimulating sympathetic activation and parasympathetic withdrawal (Watford et al., 2020; Renna et al., 2022). Interestingly, the RMSSD of the higher FS group presented a substantial decrease under this stage, so that it was close to the value of the lower FS group; see Figure 1. Researchers have found that individuals who tend to use maladaptive coping strategies show a greater reduction in RMSSD during speech tasks, while people with good adaptive strategies maintain the magnitude of RMSSD when undergoing this stress (Machado et al., 2021). However, the current study found that participants with higher FS scores showed a more substantial decrease in RMSSD, whereas those with lower FS scores maintained it. As mentioned above, forbearance has both positive and negative connotations. People with high levels of forbearance tend to adopt an inward psychological defense mechanism when they are under the unfavorable evaluation of others or in a pressured environment, but people with lower levels of forbearance refuse this kind of withdrawing behavior and are more willing to use their own resistance to face these conditions. Participants were required to complete tasks such as solving math problems or making an impromptu speech when they are evaluated by others in the active stressor. Therefore, subjects with higher FS scores had a rapid decline in RMSSD in such stress tasks. This finding further clarifies some of the negative characteristics of forbearance, but raises the question of why did most previous studies suggest that forbearance is beneficial to an individual's mental health? Indeed, we found that although the higher FS group experienced a decrease in HRV during the stressor, a rapid compensation of HRV occurred in the subsequent recovery period, which again formed a significant difference with the lower FS group; see Figure 1. In short, the higher FS group had better HRV recovery performance after experiencing the active stressor. Let us associate this finding with the real-life context: people with higher levels of forbearance endure unhappiness and then move forward with high morale; people with lower levels of forbearance achieve staged victories through catharsis and resistance under stress, but cannot get rid of the negative effects of stressor. Interestingly, previous studies reported that higher HRV in the recovery stage is linked to behaviors of actively seeking social support (Geisler et al., 2013) and greater resilience to stress (An et al., 2020), while lower HRV in the rest stage is associated with anxiety, depression, and increased risk of cardiovascular disease (Chalmers et al., 2014). McCraty and Atkinson pointed out that individuals who are good at self-regulating their emotions have a faster recovery rate after experiencing stress (McCraty and Atkinson, 2012). Hence, although people with higher levels of forbearance use inappropriate behavioral responses when faced with active stressors, parasympathetic dominance after experiencing stress will help them to better recover from the stressor and reduce its negative effects.

5. Limitations of the study

Several limitations of this study must also be mentioned. First, the age range of the participants was between 18 and 29 years old; our study lacked exploration of adolescents, middle-aged, and elderly groups. Further studies should expand the age range of subjects to improve the external validity of the conclusions. Second, the current study did not measure participants' subjective reporting of stressfulness after each stress task. In future investigations, self-report data on stressfulness need to be collected. Third, the stress tasks used in our study were conducted under a condition of acute laboratory stress, which provides a good degree of control, but cannot completely cover all the stress experienced by individuals in reality. Chronic stressors are one of the sources that affect individuals' mental health. Therefore, future research could explore whether forbearance has an effect on chronic stressors (e.g., academic stress, parenting stress, etc.).

6. Conclusion

Forbearance is associated with autonomic responses represented by HRV. The study found a negative correlation between FS scores and depression, and a positive correlation with HRV. Participants with high levels of forbearance had a higher resting HRV and better HRV reactivity in the face of stressors. Although participants with high levels of forbearance had inappropriate behavioral responses to one of these stressors, the subsequent HRV rebound remained protective of mental health. As a significant part of Chinese culture, forbearance has an important influence on the Chinese. Our study confirmed the positive significance of forbearance in psychology, and clarified the role of forbearance in emotion regulation and relief of depressive symptoms.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the School of Public Health, Southern Medical University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

TS, XG, and ML collected and analyzed the data. TS and RX interpreted the data and wrote the first draft of the manuscript. ZX and TS generated the idea, designed the study, and wrote the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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Investigating the impact of written emotion disclosure on the level of occupational stress among intensive care nurses

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Objective: The present study was conducted with the aim of determining the impact of rewriting pleasant events on the level of occupational stress in Intensive Care Unit (ICU) nurses.

Methods: This is a quasi-experimental research conducted on nurses working in the intensive care units of Imam Khomeini and Golestan hospitals in Ahvaz, from July to November 2021. Seventy-six nurses were selected based on the inclusion criteria, and were then randomly assigned to the intervention and the control groups. The nurses' demographic information form and the Expanded Nursing Stress Scale (ENSS) were used to collect data. In the intervention group, the technique of rewriting pleasant events was used for 8weeks, at least once a week. The data was analyzed with SPSS V20.

Results: No significant difference in the demographic characteristics was observed between the intervention and the control groups ($p>0.05$). The pre-intervention occupational stress of the nurses in the intervention and the control groups were reported to be 173.86 ± 26.75 and 173.05 ± 24.47, respectively, showing no statistically significant difference ($p=0.89$). After the intervention, the occupational stress scores were 134.21 ± 16.09 and 172.36 ± 24.33, respectively, showing a significant difference between the two groups ($p<0.001$).

Conclusion: Considering the impact of rewriting pleasant events on the level of occupational stress of ICU nurses, it is recommended that nursing managers and nurses plan training programs for nurses in this area, and encourage other nurses to do so, too. It is also suggested to implement this intervention on the nurses of other wards as well.

KEYWORDS

occupational stress, nurses, rewriting, intensive care unit, emotion

Introduction

One of the most important stressors in every one's life is his/her job, and today, occupational stress has become a common and costly problem in the workplace (Alkhawaldeh et al., 2020). Occupational stress can be regarded as the accumulation of stressful factors and job-related conditions, upon the stressfulness of which most people agree (Hazavehei et al., 2017). Among different occupational groups, healthcare workers, especially those working in the hospital environment, experience higher occupational stress (Ribeiro et al., 2018), and among health care jobs, nursing is known for its high risk of fatigue and disease (Vahedian-Azimi et al., 2019).

The National Institute for Occupational Safety and Health of the United States has placed nursing at the top of the 40 professions with a high prevalence of stress-related diseases (Hazavehei et al., 2017).

The results of various studies show that job stress leads to leaving the job, conflicts among colleagues, health disorders, job dissatisfaction (Bonzini et al., 2015), reduced creativity, and job results decrease in the ability to make correct and timely decisions, feelings of incompetence and depression, disgust and fatigue from work, decrease in energy and work efficiency, and decrease in the quality of nursing care. Also, people with high work stress are more likely to have work accidents (Moayed et al., 2015). Despite the fact that nursing itself is stressful, in some wards, this stress is even multiplied (Torkaman et al., 2019). Close observation of health care conflicts, patients' pain and suffering, delays in clinical decision-making for end-of-life patients, and the inappropriate use of medical resources expose ICU nurses to the highest level of occupational stress (Torkaman et al., 2019). Nouroozi Kushali et al. (2013) reported ICU nurses' levels of stress, anxiety and depression as 33, 33.9, and 30.8%, respectively. Torkaman et al. (2019) describe this intensity from moderate to severe. If this stress is ignored, it will cause many problems for nurses, such as sleep disorders, digestive disorders, general health decline, decreased functioning, reduced quality of care, job burnout, and leaving the job (Poursadeghiyan et al., 2017).

In addition to the mentioned problems, today, with the spread of the epidemic of COVID-19 (Corona Virus Disease), a high point has been created in the aggravation of the mental problems of the medical staff, especially nurses, due to direct contact with the patients of COVID-19 (Fernandez et al., 2020; Zhang et al., 2021).

Previous researches have reported that during the outbreak of infectious diseases such as influenza and Ebola, a wide range of psychosocial effects were created on people at the individual, social and international levels, which at the individual level due to the high rate of death caused by these viruses, Psychological symptoms and problems, including job stress, increased (Boshra et al., 2020; Fernandez et al., 2020).

In order to reduce occupational stress, several actions and interventions have been recommended, including the use of food supplements such as zinc supplements (Baradari et al., 2013), educational programs and interventions based on appropriate theories and models of health education (Hazavehei et al., 2017), interventions based on emotion regulation (Hatamian, 2020), encouraging nurses to actively participate in clinical decision-making, developing supportive systems, providing opportunities for professional growth (Dolatshad et al., 2020), and creating a spirit of cooperation between physicians and nurses instead of authoritative and hierarchical relationships (Lloyd and Campion, 2017). Using psychological interventions focusing on emotion is also a useful approach, a simple way in which emotions are expressed through sharing and writing pleasant memories (Fadaei et al., 2020). Studies show that psychological debriefing is a proper method for preventing anxiety and mood disorders after accidents (Muosavi et al., 2013). In this regard, the results of the study by Keene et al., (2010) showed that debriefing sessions can be an effective approach to support health care providers in managing the grief caused by the death of a child. An appropriate approach toward implementing these potential interventions is written emotion disclosure (WED). This approach is a type of writing therapy, first introduced by Pennebaker and Beall in 1986. WED typically includes the participants who write down their experiences of a traumatic incident for 3–5 days later, 15 to 30 min a day (Riddle et al., 2016). In recent years, studies have been conducted to investigate the effects of expressing positive life experiences. The initial findings show that expressing positive and pleasant experiences can yield many benefits such as life satisfaction, and reducing health complaints (Wing et al., 2006; Burton and King, 2008). For example, Folkman argued that positive emotions create psychological *respite* from stressors and the related negative emotions (Folkman, 1997). Fredrikson's Broaden and Building Theory suggests that positive emotions expand people's thought-action repertoires, thus helping override thoughts and actions associated with negative stress-induced emotions such as depression and anxiety.

In this regard, a study was conducted by Mirzazadeh et al. (2015) which showed that holding debriefing sessions for describing stressful events can have a positive impact on nurses' moral distress. However, some studies reported different results, such as the study by Ebadi et al. (2021), where it was found emotion disclosure through writing increases the stress among the mothers of the children with autism. It should be noted that other studies had different target populations such as the mothers of autistic children, and the type of events had been different as well; Mirzazadeh's study investigated the expression of stressful incidents. On the other hand, there exists a limited number of similar studies, and further research is needed to develop approaches for reducing occupational stress among ICU nurses. Therefore, due to the importance of the quality of their performance, this research aims to evaluate the impact of written emotion disclosure on the occupational stress of ICU nurses. The hypothesis of this study is writing emotion disclosure reduces occupational stress in nurses working in intensive care units.

Materials and methods

This is a quasi-experimental intervention study whose population consists of nurses working in the ICUs and the Critical Care Units (CCUs) of Imam Khomeini and Ahvaz Golestan hospitals, from July to early November 2021. The samples size was calculated to be 38 subjects per group, based on the data obtained from the previous studies (Saedpanah et al., 2016), and $\alpha = 0.05$, power = 80% ($\beta = 0.8$), $d = 20.4$, $s = 28.5$, and taking into account a 15% attrition rate. The samples were selected based on the inclusion criteria such as working experience in ICU and CCU for at least 1 year, and holding at least a bachelor's degree in nursing. The exclusion criteria consisted of withdrawing from the research and the subjects' changing their workplace to another department.

The data collection tool consisted of a form for nurses' demographic data (age, gender, the level of education, clinical work experience, the type of employment, and working shifts), and the Expanded Nursing Stress Scale (ENSS). The ENSS was designed and validated by Gray-Toft and Anderson (1981) and includes 57 items on a 5-point Likert scale. This questionnaire examines the level of occupational stress in the research units.

There are 9 dimensions in this tool including death and dying (7 items), conflict with physicians (5 items), inadequate emotional preparation (3 items), peer-related problems (6 items), supervisor-related problems (7 items), workload (9 items), treatment uncertainty (9 items), patients and their families (8 items), and discrimination (3 items). The items are answered as I am not stressed at all (Alkhawaldeh et al., 2020), I am sometimes stressed (Hazavehei et al., 2017), I am stressed most of the time (Ribeiro et al., 2018), I am extremely stressed (Vahedian-Azimi et al., 2019), and this situation does not apply to my duties (Bonzini et al., 2015). If someone has not ever faced such a situation, he/she chooses 0. The scores range from 57 to 285, where a score of 57 to 114 indicates a low level of occupational stress among the target population, and a score between 114 and 228, a moderate occupational stress. A score above 228 shows a high level of occupational stress (Ghanei Gheshlagh et al., 2013; Shareinia et al., 2018). The ENSS is an international credible questionnaire whose validity and reliability has been examined many times in different parts of the world In Iran, the instrument was validated by Ghanei Gheshlagh et al. (2013). The Cronbach's alpha coefficient for the subscales ranged from $\alpha = 0.65$ (discrimination) to $\alpha = 0.88$ (conflict with nurses) (Shareinia et al., 2018).

After obtaining permission from the ethics committee and research assistant of Jundishapur University of Medical Sciences, Ahvaz, the researcher went to the research environment including ICUs and CCUs of Imam Khomeini and Golestan hospitals in Ahvaz and after introducing herself to the officials and presenting the letter of introduction and fully and accurately explaining the objectives of the research to them, she obtained the approval of the officials to conduct the research.

Then, the list of nurses who met the entry criteria was obtained from the head of the unit, and after introducing themselves and explaining the objectives of the research to the nurses, written informed consent was obtained from the eligible people willing to participate in the study.

It should be mentioned that in order to attract the attention of nurses, full explanations were provided regarding the way of conducting the study.

Then, the selected samples were allocated to intervention and control groups based on block classification. The people of the intervention group were divided into groups of 6 people and were trained in the conference room of the hospital departments.

At the beginning, the level of occupational stress in both intervention and control groups was measured using the ENSS. Then a short two-hour session was held to introduce research objectives and methods to the intervention group participants and teach them how to fill in the notebook. For 8 weeks, at least once a week, all the participants in the intervention group were asked to write down their thoughts and feelings about pleasant topics and positive events they had experienced at work in the provided notebooks, including the best working experiences, the best behaviors regarding patients, colleagues, doctors, supervisors, patients' relatives, and the service staff, regardless of the limitations of writing style, sentence structure or grammar (Ashley et al., 2011). They were also asked to try to write their notes in a peaceful place, while being alone, and then record the date and the time for each note, and give it to the researcher at the end. The notebook which was provided to the intervention group subjects contained 20 A5 papers. The first 4 pages of the notebook included the research objectives and method, a description of occupational stress, rewriting the events, and an example of these writings. The rest 16 blank pages were for writing the thoughts, feelings, and events experienced by the subjects. The intervention lasted for 8 weeks. At the end of the study, the ENSS was again filled out by both groups. In order to comply with ethical principles, at the end of the study, a workshop was held for the control group participants to teach them how to record their positive thoughts and feelings as well as their work experiences.

Data analysis was done using SPSS V20. The quantitative variables were reported using mean and standard deviation, and qualitative variables, using frequency (percentage). The normality of the distribution of quantitative variables was determined using the Shapiro–Wilk test. The comparison of qualitative variables was independently performed in the two groups, using Fisher's exact test and chi-square test. The quantitative variables in the two groups were compared using the paired *t*-test or its non-parametric equivalent (Mann–Whitney test). Univariate effects of intervention condition on posttest outcome measures were examined using between-subjects analysis of covariance (ANCOVA), adjusting for pretest scores.

The significance level of the tests was considered as 0.05. In order to comply with ethical principles, the research was approved by the Ethics committee of Ahvaz Jundishapur University under the code IR.AJUMS.REC.1400.154, and the necessary permits were obtained. The researcher also introduced the research team and the research objectives to the participants, and reminded them that participation was absolutely voluntarily, with no impact on their evaluation process, and that the subjects' data would remain confidential. It should be noted that because this study was conducted on nurses, it was not considered as a clinical trial and therefore did not need to receive the code "irct.ir."

Findings

Seventy-six nurses participated in this study, and none withdraw from the study or were excluded (Figure 1). Based on the results, no significant differences in gender ($p = 0.77$), marital status ($p = 0.64$) and the level of education ($p = 0.51$) were observed between the intervention and the control groups according to Fisher's exact test. No significant differences in employment status ($p = 0.81$) and work shift ($p = 0.35$) were observed between the groups according to chi-square test, and none was observed in nurses' age ($p = 0.74$) and working experience ($p = 0.73$) according to Mann–Whitney test, either (Table 1).

According to Table 2, the mean and the standard deviation of the total pre-intervention scores of nurses' occupational stress were 173.86 ± 26.75 and 173.05 ± 24.47 in the intervention and the control group, respectively, showing no statistically significant difference based on independent *t*-test ($p = 0.89$). After the intervention, the mean and the standard deviation of the total occupational stress scores reached 134.21 ± 16.09 in the intervention group, and 172.36 ± 24.33 in the control group, indicating a significant difference according to the independent *t*-test ($p < 0.001$). In addition, prior to the intervention, no significant difference between the dimensions was seen in both groups. However, after the intervention, in all the dimensions, except the dimension *conflict with physicians* ($p = 0.93$) the stress score decreased significantly in the intervention group ($p < 0.05$).

There was a statistically significant effect between two groups according to posttest outcome measures adjusting for pretest scores for all dimensions except for conflict with physician's dimension (Table 3).

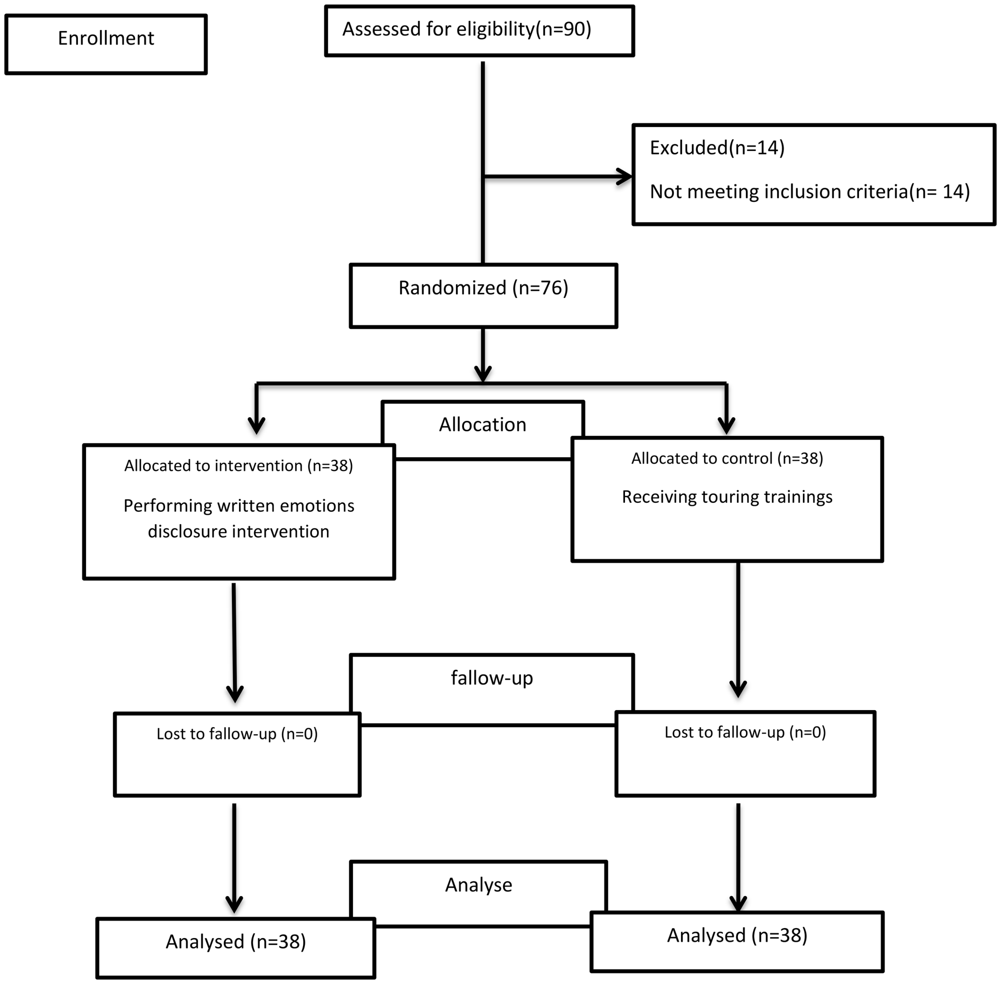

FIGURE 1
Flow diagram for participants included in study.

TABLE 1 Comparison of the absolute frequency and percentage of relative frequency of nurses according to demographic variables.

Variable	Categories	Intervention	Control	*p*-value
		N (%)	*N* (%)	
Sex	Male	9 (23.7)	7 (18.4)	0.77*
	Female	29 (76.3)	31 (81.6)	
Marital status	Single	17 (44.7)	14 (36.8)	0.64*
	Married	21 (55.3)	24 (63.2)	
Education level	BSN	31 (81.6)	34 (89.5)	0.51*
	MSc	7 (18.4)	4 (10.5)	
Employment status of nurses	Official nurse	27 (71.1)	24 (63.2)	0.81**
	Contractual nurse	5 (13.2)	5 (13.2)	
	Newly graduated nurse	2 (5.3)	4 (10.5)	
	Unemployed nurse	4 (10.5)	5 (13.2)	
Shift work	Morning	7 (18.4)	3 (7.9)	0.35**
	Evening	3 (7.9)	8 (21.1)	
	Night	2 (5.3)	1 (2.6)	
	Long day	6 (15.8)	3 (7.9)	
	Morning - evening	2 (5.3)	3 (7.9)	
	Rotation	18 (47.4)	20 (52.6)	
		M ± SD	*M* ± SD	
Age		35.81 ± 4.72	35.21 ± 5.09	0.74***
work experience		12.68 ± 4.24	12.52 ± 4.70	0.73***
work experience in ICU		5.92 ± 3.78	6.76 ± 4.20	0.57***
Number of night shifts		2.84 ± 2.49	3.21 ± 2.18	0.35***

*Fisher's exact test, **Chi-square test, ***Independent *t*-test.

Discussion

The present study was conducted with the aim of determining the effect of written emotion disclosure on the level of occupational stress in nurses working in intensive care units. According to the results of the study, the mean and the standard deviation of pre-intervention occupational stress scores were not significantly different in the two groups. However, after the intervention, this difference was significant, showing a significant decrease in the intervention group.

Various studies have reported that learning nursing ethics through a written narrative tailored to nurses' feelings helps to revive their thoughts and attitudes toward patients, and writing a narrative in nursing ethics education can lead to ethical performance (Tsuruwaka and Asahara, 2018).

Also, other studies have shown that both oral and written approaches are effective in reducing the care burden, stress and anxiety of family and youth caregivers and reducing the symptoms of depression, anxiety and stress of war wounded veterans who suffered from post-traumatic stress disorder. Meanwhile, the written approach of disclosing feelings has been more effective in reducing the burden of care and anxiety (Niles et al., 2013; Monazamitabar et al., 2015; Harvey et al., 2018).

The results of the studies by Ebadi et al. (2021) and Ashley et al. (2011) also showed that the disclosure of written emotions caused an increase in stress in caregivers or did not have an effect on reducing the psychological distress of informal caregivers, which is not in line with the present study. This difference can be interpreted in such a way that people deeply understand their problems by writing down their feelings, and with the disappearance of mental distractions, they are more affected and thus experience higher levels of stress (Ashley et al., 2011; Ebadi et al., 2021).

Also, the results of other studies showed that narrative writing had no effect on reducing the intensity and frequency of moral discomfort in intensive care nurses (Saidi et al.'s study), which according to the researcher, several factors can cause the different and inconsistent results of these studies compared to The present research will explain. The most important factors are: different target populations, time and place of research, research tools, number of samples, dependent variable and duration of briefing sessions (Saeedi et al., 2019).

Another result of the study was that after the intervention, the scores of all the dimensions of occupational stress, except conflict with physicians, decreased in the intervention group. The effectiveness of the written disclosure method in the overall

TABLE 2 Comparison of the average scores of total occupational stress and its dimensions in nurses before and after the intervention in two groups.

Variable	Time	Intervention	Control	*p*-value
		M±SD	*M*±SD	
Occupational stress	Pre-test	173.86 ± 26.75	173.05 ± 24.47	0.89
	Post-test	134.21 ± 16.09	172.36 ± 24.33	0.001
p-value		0.001	0.26	
Death and dying	Pre-test	21.57 ± 4.18	22.47 ± 4.01	0.34
	Post-test	17.02 ± 3.75	22.36 ± 3.19	0.001
p-value		0.001	0.16	
Conflict with physicians	Pre-test	13.00 ± 1.93	12.44 ± 3.08	0.35
	Post-test	12.26 ± 2.46	12.31 ± 3.11	0.93
p-value		0.056	0.16	
Inadequate emotional perception	Pre-test	10.18 ± 3.01	11.21 ± 2.70	0.12
	Post-test	6.39 ± 2.18	11.15 ± 2.68	0.001
p-value		0.001	0.32	
Problems with peers	Pre-test	18.07 ± 2.85	11.18 ± 1.82	0.10
	Post-test	12.10 ± 2.36	16.94 ± 1.64	0.001
p-value		0.001	0.095	
Problems with supervisors	Pre-test	19.84 ± 2.64	18.76 ± 3.61	0.14
	Post-test	16.65 ± 2.93	18.63 ± 3.79	0.013
p-value		0.001	0.65	
Workload	Pre-test	26.44 ± 5.44	25.10 ± 4.83	0.24
	Post-test	22.76 ± 3.92	25.28 ± 4.59	0.012
p-value		0.001	0.07	
Uncertainty concerning treatment	Pre-test	32.21 ± 7.50	33.68 ± 7.25	0.38
	Post-test	22.21 ± 4.62	33.76 ± 7.71	0.001
p-value		0.001	0.89	
Patients and family	Pre-test	22.39 ± 3.19	21.18 ± 3.54	0.12
	Post-test	19.34 ± 3.29	20.97 ± 3.68	0.04
p-value		0.001	0.14	
Discrimination	Pre-test	10.13 ± 2.86	11.00 ± 2.95	0.19
	Post-test	5.44 ± 1.98	10.92 ± 3.01	0.001
p-value		0.001	0.32	

scores of the occupational stress among intensive care unit nurses and most of its dimensions is an important finding, showing that this method can be used to reduce various aspects of stress. In regard with conflict with physicians, it seems that disclosing feelings does not reduce conflict with the physicians, the reasons of which are also different. Since this conflict is caused by reasons such as physicians' looking down on other medical workers, receiving organizational support, delegating their own duties to nurses, not fully implementing rules and regulations, and nurses and physicians' having misplaced expectations from each other, it seems that to solve this issue, interventions and programs other than this approach, i.e., written emotion disclosure, should be implemented.

The results of the studies by Mehrabi et al. (2021) and Mahmoodirad and Bagherian (2015) also showed that occupational stress scores did not decrease in some aspects such as conflicts with nurses and conflicts with doctors, responsibility and physical environment.

Occupational stress, as a whole, has numerous and various dimensions, each requiring attention. Since each of these dimensions alone can be an effective variable on nurses' lives, it is necessary to make appropriate and effective plans in regard with each. As the literature review yielded different results, it is not possible to say which dimensions depend on which interventions. It seems that the results are different based on the type of intervention, the type of research, the target population,

TABLE 3 Descriptive statistics and ANCOVA results for the outcome measures.

Outcome	Intervention	Control	*F*	*p*	Partial Eta-square
Death and dying			76.07	<0.0001	0.51
Baseline	21.57 ± 4.18	22.47 ± 4.01			
After intervention	17.02 ± 3.75	22.36 ± 3.91			
Conflict with physicians			1.99	0.162	0.02
Baseline	13.00 ± 1.93	12.44 ± 3.08			
After intervention	12.26 ± 2.46	12.31 ± 3.11			
Inadequate emotional preparation			109.52	<0.0001	0.6
Baseline	10.18 ± 3.01	11.21 ± 2.70			
After intervention	6.39 ± 2.18	11.15 ± 2.68			
Peer-related problems			184.79	<0.0001	0.71
Baseline	18.07 ± 2.85	17.18 ± 1.82			
After intervention	12.10 ± 2.36	16.94 ± 1.64			
Supervisor-related problems			24.05	<0.0001	0.24
Baseline	19.84 ± 2.64	18.76 ± 3.61			
After intervention	16.65 ± 2.93	18.63 ± 3.79			
Workload			47.87	<0.0001	0.39
Baseline	26.44 ± 5.04	25.10 ± 4.83			
After intervention	22.76 ± 3.92	25.28 ± 4.59			
Treatment uncertainty			144.1	<0.0001	0.66
Baseline	32.21 ± 7.50	33.68 ± 7.25			
After intervention	22.21 ± 4.62	33.76 ± 7.71			
Patients and their families			33.8	<0.0001	0.31
Baseline	22.39 ± 3.19	21.18 ± 3.54			
After intervention	19.34 ± 3.29	20.97 ± 3.68			
Discrimination			140.34	<0.0001	0.65
Baseline	10.13 ± 2.86	11.00 ± 2.95			
After intervention	5.44 ± 1.98	10.92 ± 3.01			

and the time and the place of the study, and everything should be planned according to each specific research or location. In fact, everything should be carried out in an organizational manner; in every organization and every job group, interventions should be developed according to the dimensions with lower scores, in which interventions have been effective.

Research limitations

One of the limitations of the current research was the outspread of COVID-19 pandemic which both increased nurses' stress levels and made the sampling process difficult and challenging. Another challenge was the presence of the intervention and the control groups' subjects in the same environment, which could have led to sample contamination; the control group subjects could probably become aware of the interventions performed in the intervention group.

The intervention was run for 8 weeks because the nurses of the ICU and CCU had very high workload due to a shortage of manpower, then prolonging the duration of the intervention due to current organizational constraints in hospitals, was perceived extra burden on nurses and therefore be considered one of the limitations of this study. Liao and Secemsky (2015) also referred to the local and systems factors and limited opportunities to engage in narrative medical writing among medical residents.

Study's strengths

One of the strengths of the study is the selection of two intervention and control groups and the block division of the subjects, and another strength is the pre-test in both intervention and control groups.

Final conclusion

The results showed that written emotion disclosure has an impact on the intensive care unit nurses' level of occupational stress and the related dimensions, including death and dying, inadequate emotional preparation, peer-related problems, supervisor-related problems, workload, treatment uncertainty, patients and their families, and discrimination, except for the dimension conflicts with physicians. This means that using this treatment plan can have many benefits as a simple, inexpensive, feasible, and effective non-pharmacological nursing intervention. As the nurses involved in patient care are sometimes ignored, whereas they provide permanent care for critically ill patients, especially in special care units, and constantly observe patients' pain, suffering, complications, and death, their level of stress increases; it is destructive and harmful to them. On the other hand, the coincidence of such stress in the work place with the stress caused by the COVID-19 pandemic has made the condition intolerable, making nursing interventions more necessary than ever. Therefore, the nurses working in intensive care units are recommended to get familiar with such approaches to contribute to self-help and improve the quality of nursing services in patient care.

The main finding of this research can be provided to the professors, nursing managers and health trustees of medical sciences universities, supervisors and nurses working in special care units and other medical staff of health and treatment centers in order to pay attention to nurses and their psychological problems, use interventions such as rewriting pleasant events to reduce them.

It is suggested that the present study should be conducted in other samples with different demographic characteristics and its effectiveness should be compared with other existing samples.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by ethics committee of Ahvaz Jundishapur University of Medical Sciences. The patients/participants provided their written informed consent to participate in this study.

Author contributions

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

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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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Effectiveness of mindfulness training on pregnancy stress and the hypothalamic–pituitary–adrenal axis in women in China: A multicenter randomized controlled trial

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Introduction: In the past two decades, mindfulness-based intervention programs have gradually become popular.Many studies have confirmed that these programs can effectively alleviate prenatal stress and negative emotion.The mindfulness-based stress-buffering hypothesis suggests that mindfulness training can induce changes in the levels of the cortisol secreted by the HPA axis, thereby reducing stress susceptibility. However, to date, only a few high-quality evidence-based medical studies have analyzed the effect of the mindfulness-based intervention in a maternal population. Thus, this study investigated the effects of a mindfulness-based psychosomatic intervention on pregnancy stress and the HYPERLINK "javascript:;" hypothalamic-pituitary-adrenal (HPA) axis of pregnant Chinese women.

Methods: Women experiencing first-time pregnancy (n = 117) were randomly allocated to the intervention group or parallel active control group, and data were collected at baseline and post-intervention periods. The participants completed questionnaires regarding mindfulness and pregnancy stress. Saliva samples was collected at the time of waking up, and 30, 45, and 60 min after waking up for analyzing the salivary cortisol levels. We analyzed differences between the two groups and changes within the same group before and after the intervention.

Results and discussion: A total of 95 participants completed the trial. Compared with the parallel active control group, the intervention group exhibited lower levels of stress after the intervention (P = 0.047). For HPA-axis-related indicators after the intervention, Delta value (P = 0.01) and AUCM value (P = 0.031) of the intervention group were significantly higher than that of the control group. Mindfulness-based interventions effectively reduced the level of pregnancy stress and adjusted the HPA axis function in pregnant women in China.

Clinical Trial Registration: https://www.chictr.org.cn, identifier ChiCTR 2000033149.

KEYWORDS

mindfulness, stress, HPA axis, randomized controlled trial, pregnant women, multicenter

1. Introduction

Stress refers to the adaptive physiological changes, which occur when an individual is challenged by internal or external stressors, to improve their chances of survival (Elder, 1998). The transition to motherhood is a unique phase that frequently necessitates immediate and significant changes in a woman's daily life, including her thinking and behavior. This shift in lifestyle may cause difficulties and stress for some women (Di Florio et al., 2013). A study of 1,522 pregnant women in the United States found that 78 and 6% of pregnant women experienced low to moderate and high levels of stress, respectively, during pregnancy (Woods et al., 2010). In a cross-sectional study, Mei et al. (2021) showed that the detection rate of stress in pregnant women in China was 69.39%. Stress during pregnancy has been associated with various health problems in women, including increased anxiety and postpartum depressive symptoms (Yim et al., 2015; Dunkel Schetter et al., 2016). In addition, stress during pregnancy increases negative maternal emotions, the risk of panic disorder, drug use, postpartum marital conflict, and multiple medical comorbidities (Sapolsky, 1998; Yim et al., 2015; Dunkel Schetter et al., 2016). Austin and Leader (2000) found that negative maternal emotions directly affect the fetus by altering the expression of related genes, causing changes in placental glucocorticoid signaling and, thus, increasing fetal exposure to cortisol. Austin et al. (2005) showed that the fetuses of pregnant women experiencing high stress levels had decreased fetal heart rate-movement coupling, which may indicate slower central nervous system development and more birth complications. Pregnancy stress has also been linked to adverse birth outcomes, such as preterm birth and low birthweight (Van den Bergh et al., 2020).

The activation of the hypothalamic-pituitary-adrenal (HPA) axis provides the body with the energy needed to cope with stress. However, over activation of the HPA axis can cause over-alertness in individuals (Lazarus and Folkman, 1984), and chronic dysregulation in biological stress-related systems is associated with adverse health outcomes (Chrousos, 2009). The end-product of the HPA axis is cortisol, which is released by the adrenal glands and is considered to be one of the main markers of the biological stress response (Fries et al., 2009; Caulfield and Cavigelli, 2020). Serum free cortisol levels peak at approximately 20–45 min after waking, and subsequently decline throughout the day. The dynamic pattern of cortisol, known as the cortisol arousal response (CAR), and indicators related to the CAR can be used to measure the physiological stress response function of the HPA axis (Pruessner et al., 1997; Chojnowska et al., 2021). A dramatic change in HPA axis regulation and cortisol secretion occurs during pregnancy, with cortisol levels rising throughout pregnancy and returning to pre-pregnancy levels after childbirth. This plays a key role in fetal organ development (Mastorakos and Ilias, 2003). Cortisol is associated with a heightened risk of stress-related health complications during pregnancy and postpartum (Zijlmans et al., 2015; Hodyl et al., 2017). Moreover, a blunted or flat CAR is correlated with an increased risk of postpartum depression (Scheyer and Urizar, 2016). Furthermore, flatter diurnal cortisol slopes (i.e., a smaller decrease in cortisol levels throughout the day) during pregnancy have been linked to increased anxiety and impaired sleep quality in mothers, as well as low birthweight in infants (Kivlighan et al., 2008; Bublitz et al., 2018).

Effective intervention measures are necessary to improve the physiological stress response function of the HPA axis and reduce stress during pregnancy. Pregnant women, especially first-time mothers, require organized antenatal education and preparation for birth. In the past two decades, mindfulness-based intervention programs have gradually become popular as a method of helping people improve their well-being. A mindfulness-based childbirth and parenting (MBCP) program (Hughes et al., 2009; Bardacke, 2012) was developed for pregnant women in the United States and adopted by Bardacke from the widely known and effective mindfulness-based stress reduction (MBSR) program developed by Kabat-Zinn (2003). The MBCP aims to teach pregnant women and their partners mindfulness skills to manage negative emotions and stress, during pregnancy and encourage sensitive parenting styles (Duncan and Bardacke, 2010; Duncan et al., 2017). Studies in several countries have confirmed that these MBCP programs can effectively alleviate prenatal stress and negative emotions (Vieten and Astin, 2008; Hofmann et al., 2010; Khoury et al., 2013). The mindfulness-based stress-buffering hypothesis suggests that mindfulness training can induce changes in the levels of the cortisol secreted by the HPA axis, thereby reducing stress susceptibility (Creswell et al., 2014). Some reviews suggest that mindfulness training may ameliorate stress-related diseases by decreasing the HPA axis response to acute stress (Creswell et al., 2019). However, to date, only a few high-quality evidence-based medical studies have analyzed the effect of the MBCP intervention in a maternal population, and no studies have explored the effect of the MBCP intervention on pregnancy stress and the HPA axis of Chinese pregnant women.

China has a unique traditional, cultural, and social background in maternal health care. In 2016, our team introduced the MBCP to China. We conducted a preliminary survey with Chinese pregnant women to determine the demand for the course and discovered that several pregnant women did not accept the traditional 9-week MBCP course because it was deemed too long. We increased the MBCP program's compatibility with Chinese culture and social context to meet the needs of pregnant women in China, thus, increasing the likelihood of maternal participation in the course. Our team modified the traditional MBCP curriculum in China (Bardacke, 2019) by changing the 9-week course to a “2-day on-site and 21-day online” curriculum model and simplifying parts of the curriculum. The present study explored the efficacy of the simplified version of the MBCP course in reducing pregnancy stress and improving HPA axis function in Chinese pregnant women.

2. Materials and methods

2.1. Study design and sample size

In this randomized controlled trial, we compared the efficacy of a simplified version of the MBCP intervention program in reducing stress and regulating salivary cortisol levels in pregnant women with that of a control group. Using statistical power analysis, we calculated the required sample size. The perceived stress scale (PSS) score was considered as a reference. The results of a previous MBCP study (Pan et al., 2019a,b) showed mean (and standard deviation [SD]) value of 11.64 (SD = 6.13) and 14.29 (SD = 5.23) on the PSS scale for the intervention group and control groups; and a statistical power of 0.90

was used to reject a null effect at a 0.05 level of significance. The minimum sample size was estimated to be 44 for each group (88 total). The target sample size was set as 110 participants after considering a possible attrition rate of 20%.

We generated random grouping sequences using SAS version 9.1 for Windows and assigned participants to the control or the intervention group (1:1 ratio) based on their time of enrollment. In our study, the participants were blinded and were not aware about the grouping.

2.2. Participants

This multicenter randomized controlled study was conducted from August 2021 to April 2022 at three hospitals: Shanxi Maternal and Child Health Hospital, Shandong Maternal and Child Health Hospital, and Shandong Provincial Hospital. The pregnant women were recruited from the three hospitals. Women who met the following criteria were invited to participate: singleton pregnancy between 20 and 32 weeks, able to communicate adequately in Chinese, had set up a registry at the target hospital, and planned to undergo prenatal examination, in-hospital delivery, and postnatal review at the hospital. Furthermore, the women had to have a minimum academic qualification of high school education. Otherwise eligible pregnant women were excluded if they had a history of psychiatric disturbances, epilepsy, multiple abortions, or premature birth, with serious pregnancy complications or diseases, such as severe pregnancy-induced hypertension or heart disease, which may prevent them from participating in the study. We initially selected 127 women to participate in the study (Figure 1).

2.3. Interventions

The intervention group received a 2-day on-site simplified version of the MBCP course over a weekend. The course lasted 6 h per day, including 3 h in the morning and 3 h in the afternoon, with a total on-site intervention time of 12 h. Two MBCP teachers, with extensive teaching experience, conducted the on-site course in small groups of approximately 30 people. The on-site course consisted primarily of raisin meditation, breathing awareness, body scan, mindful yoga and meditation, labor pain cognitive education, and pain management with ice holding exercises (Table 1). Within 21 days of a completion of the on-site course, the participants in the intervention group participated in the 21-day online course *via* the WeChat applet with recorded audio, which lasted for 5–35 min per day. The online course included formal practice, such as mindful breathing, body scan,

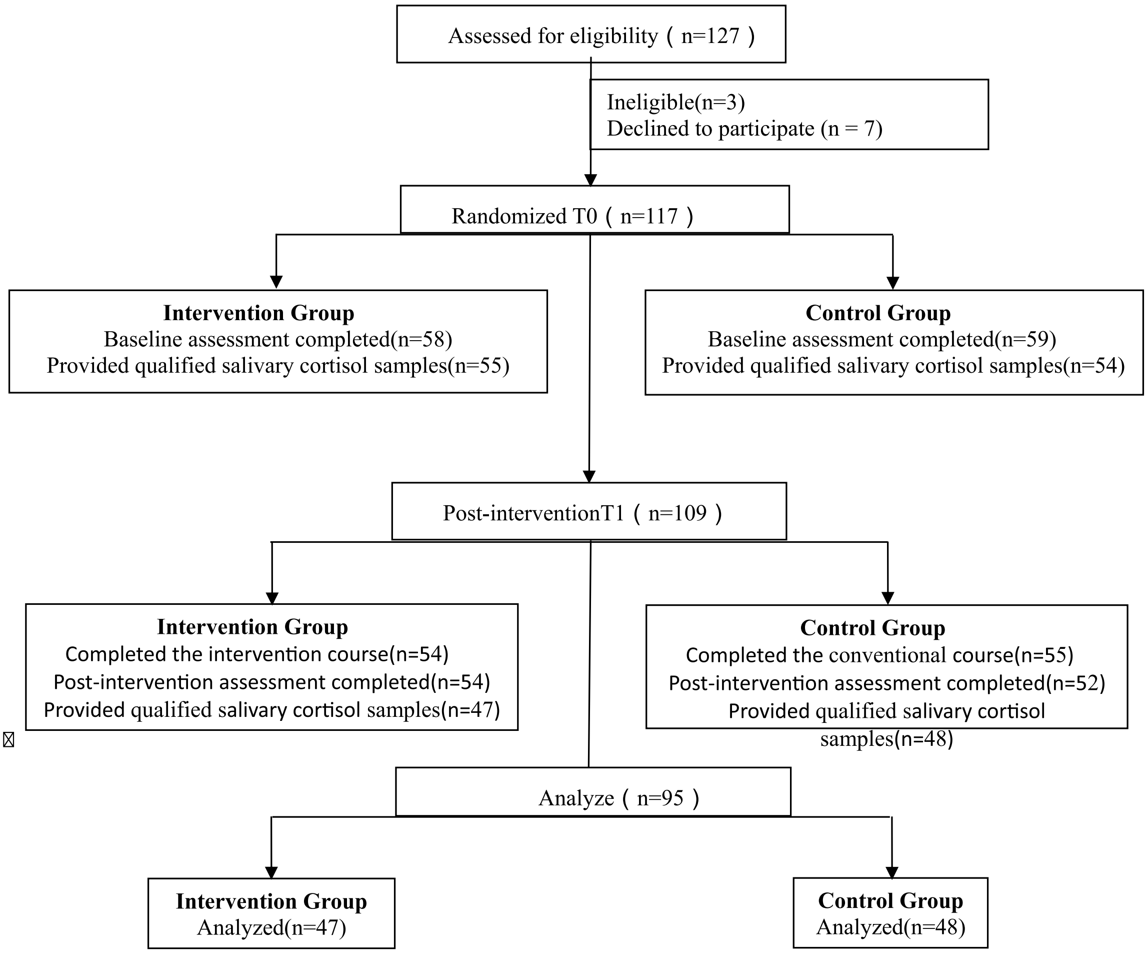

FIGURE 1
CONSORT diagram. Passage of participants through each trial stage.

TABLE 1 The main content of the 2-day on-site course.

Day 1	Introduction to mindfulness and introduction of the teacher and the participants. Practice: mindfully eating a raisin; awareness of breathing meditation; mindful yoga;
	Body scan meditation; mindful walking.
	Requesting; sharing among participants.
	Psycho-education: physiology of childbirth and pain from a body–mind perspective.
	Explanation of parenting knowledge: the neonatal sleep and diet rules.
	Practice: pain meditations using ice and a variety of pain-coping strategies;
	requesting, sharing among participants.
Day 2	Review of the course; encouragement to continue practicing mindfulness.

mindful yoga, and 3-min breathing space, as well as informal practice, such as mindful eating, mindful tooth brushing, mindful face washing, and other daily mindfulness practices. At the same time, the control group received an online pregnancy and childbirth education course with a recorded video *via* the WeChat applet for 21 days, which lasted approximately 5–10 min per day. This course covered physical and psychological knowledge related to pregnancy and self-care skills during pregnancy and postpartum.

Additionally, the participants in the intervention group received the same regular pregnancy and childbirth health education as the control group. While, the participants in the control group only received the regular pregnancy and childbirth health education for 21 days. We encouraged the partners of the participants in the intervention and control group to accompany and participate in the courses. Using the WeChat platform, we assisted and guided the two groups of participants in completing the relevant study and exercises. We arranged for physicians to respond to their pregnancy-and childbirth-related questions *via* the WeChat platform.

2.4. Data collection and measures

At the time of recruitment, all participants completed the demographic information questionnaire. In addition, we collected the Five Facet Mindfulness Questionnaire (FFMQ), PSS, and saliva samples from the two groups within 1 week before and after the intervention. Participants collected saliva samples by themselves at home at four time points in the morning: at awaking (AC_{0min}), and 30 min (AC_{30min}), 45 min (AC_{45min}), and 60 min (AC_{60min}) after awaking. At the post-intervention evaluation, participants in the intervention group completed the client satisfaction questionnaire (CSQ), designed by our team, to measure satisfaction with the course on a 10-point scale (1–10, with higher scores indicating greater satisfaction with the course). The participants received and completed the questionnaires in the presence of the investigators. The subjects read and filled the questionnaires by themselves. After the questionnaires were collected, we arranged two researchers to double input the questionnaire information into the database using the EpiData3.1 software.

2.4.1. Five facet mindfulness questionnaire

Mindfulness was assessed using the FFMQ. The scale is based on factor analysis and consists of 39 items, yielding subscale scores that measure five elements of mindfulness: observing, describing, acting with awareness, being non-judgmental of inner experience, and being non-reactive to inner experience. Responses were scored using a 5-point Likert-type scale, with 1 representing "never or very rarely true" and 5 representing "very often or always true" (Baer et al., 2006). In our study, the Cronbach's alpha ranged from 0.79 to 0.88.

2.4.2. Perceived stress scale

The PSS was used to assess stress. Chen created the scale in 1983 and revised it in 1989 to measure the psychological stress level of women during pregnancy. The scale contains 30 items and 4 subscales: stress from ensuring the health and safety of the mother and child (PSS1), validating a parent's role (PSS2), altering body structure and function (PSS3), and other factors (worried about taking care of the baby, worried about not being able to maintain a good spousal relationship after having a baby, and worried about not being able to provide good living conditions for the baby). For each question, 0 to 4 points are awarded; the higher the score, the greater is the pregnancy stress. The reliability coefficient of the table containing the total quantity is 0.90. The coefficients of internal consistency for the three subscales ranged from 0.79 to 0.89 (Cohen et al., 1983; Chen et al., 1989). In our study, the Cronbach's alpha ranged from 0.82 to 0.88.

2.4.3. Salivary cortisol level

To control diurnal hormonal changes, participants were asked to avoid caffeine, alcohol, or engage in aerobic exercise the day before collecting the saliva samples. They were given a saliva collection kit containing four commercially available saliva collection tubes, ice packs, thermal insulation bags, and other tools for collecting and transporting saliva samples at low temperatures. They were also given a collection log to record the dates and times of saliva collection. At enrollment, the participants were individually instructed on how to collect saliva. If necessary, the participants could practice collecting saliva in the presence of researchers, who would answer any pertinent questions on-site to improve protocol adherence. The participants collected saliva samples on their own using the saliva collection tubes at four time points on each collection day (immediately upon waking up, and 30, 45, and 60 min after waking). We asked all the participants to store each tube of saliva specimen in a 4°C refrigerator immediately after collection. On the day of collection, the participants themselves brought the saliva samples to the hospital using ice packs and thermal insulation bags, and handed them to the researchers. Subsequently, the researchers stored the specimens in a refrigerator at −80°C. After collecting all the specimens, they were transported, using dry ice and a bio-safety transport box, to the laboratory for centralized testing. After the saliva was thawed at room temperature, the collected saliva was centrifuged at 3000 rpm for 15 min, and the subnatant was collected for biochemical analysis. The salivary cortisol level was quantified using an ezymelinked immunosorbent assay (ELISA) kit (Cat. Number: SLV-2930, DRG, Germany). Centralized testing was performed within 20 days.

2.5. Ethical considerations

The study protocol was approved by the Ethics Review Committee of the National Center for Women and Children (Chinese Center for Disease Control and Prevention, Beijing, China; approval no. FY2020-10). Before recruitment, we explained our study's purpose, significance, benefits, and potential risks in detail to every pregnant woman interested in participating. In addition, we explained to the participants what they needed to do in our study and follow-up to gain their cooperation and understanding. The participants provided written informed consent. In addition, to keep the data confidential, all the data collected were anonymous and prohibited for use outside of our study. We informed the participants that they had the right to withdraw from participation at any time during the study period, without consequences.

2.6. Data analysis

SPSS version 24.0 for Windows was used for data analysis. Demographic characteristics are presented as mean (standard deviation [SD]) for measurement data and as frequency counts (percentages) for categorical variables. Chi-square and Fisher's exact test were used to compare the demographic variables of the two groups (education level, marital status, and family income). *t*-test was used to analyze rank scores and measurement data, including scale baselines and cortisol-related indicators. We compared the differences in questionnaire scores and cortisol-related indicators between the two groups using analysis of covariance (ANCOVA) and the generalized estimate equation (GEE) before and after the intervention, respectively.

Three cortisol-related indicators were computed: Delta, which measures the acute rise in cortisol typically seen after waking in the morning (Dedovic and Ngiam, 2015); the area under the curve with respect to the ground (AUC_G), which measures the overall amount of cortisol secreted within 1 h after awakening (Pruessner et al., 2003); and the area under the curve with respect to increase (AUC_M), which measures the increase in cortisol within 1 h of waking relative to the minimum of four time points (AC_{min}) (Grossi et al., 2005). All the scores were calculated and used as indices of the HPA function.

$$Delta = \left(AC_{30\,\text{min}} - AC_{0\,\text{min}}\right) \div AC_{0\,\text{min}} \times 100$$

$$AUC_G = \left(AC_{0\,\text{min}} + AC_{30\,\text{min}}\right) \times 30/2 + \left(AC_{30\,\text{min}} + AC_{45\,\text{min}}\right) \times 15/2 + \left(AC_{45\,\text{min}} + AC_{60\,\text{min}}\right) \times 15/2$$

$$AUC_M = AUC_G - AC_{\text{min}} \times 60$$

3. Results

In total, 127 participants were interviewed. We eliminated the research participants with premature birth, stillbirth, and other cases of premature termination of pregnancy during the intervention process. We also excluded participants who did not complete the course (for the intervention group: participants who were absent from the on-site courses or attended fewer than 16 online courses; for the control group: participants who attended fewer than 16 online regular health education sessions). Moreover, we eliminated the cortisol data due to delay of the first sample collection by more than 5 min after awakening, an insufficient amount of saliva collected at any of the four time points, and outlier cortisol values (>3 SD from the mean). Among the 127 participants, 3 were eliminated because they did not meet the criteria for inclusion, 7 pregnant women withdrew from participation prior to the intervention, and 22 participants were excluded from further analysis because of follow-up failure or failure to provide satisfactory saliva samples. Of the 22 participants excluded from further analysis, 11 belonged to the intervention group and 11 belonged to the control group; the attrition rate was 18.8%. Finally, 95 participants were included in the data analysis, including 47 and 48 in the intervention and control group, respectively (Figure 1).

The differences between the intervention ($n = 47$) and control groups ($n = 48$) were not statistically significant for age, the infant's gestational age, body weight, education level, census register, marital status, household income, parity, pregnancy method, and pregnancy complications. We also compared the general information between the participants who did ($n = 95$) and did not ($n = 22$) complete the entire experiment and found no statistical differences ($p > 0.10$). We compared the baseline data of the psychological questionnaires and cortisol levels prior to intervention between the two groups and found a statistically significant difference between the two groups in the dimension of ensuring maternal and child health and safety of PSS1 ($p < 0.05$), but no significant differences in cortisol levels and the other questionnaires (Table 2). At the post-intervention evaluation, 93.62% of the intervention group participants scored 8 or higher on the CSQ questionnaire, indicating that they were satisfied with the course.

We compared the differences in questionnaire scores in one group before and after intervention. The result showed that the total score of the FFMQ and the dimension of observing after the intervention were significantly higher than that before the intervention ($p = 0.001$, $p = 0.013$). The other dimensions of the FFMQ also improved after the intervention compared with those before the intervention, but the difference was not statistically significant. The total score of the PSS and dimension of PPS3 in the intervention group were significantly lower after the intervention ($p = 0.03$, $p = 0.004$) than that before the intervention. The dimensions of PSS1 and PSS2 also decreased after the intervention, but the differences were not statistically significant. In the control group, the dimension of acting with awareness (FFMQ) was significantly lower after the intervention ($p = 0.04$), but there were no significant differences in the total score and other dimensions of the FFMQ before and after the intervention. The dimensions of PSS2 and PSS-others were significantly higher after the intervention than that before the intervention ($p = 0.04$, $p = 0.01$). There were no significant differences in the total score and other dimensions of the PSS before and after the intervention.

We compared the differences in questionnaire scores between the two groups before and after the intervention using an ANCOVA. The total score of the FFMQ and its five dimensions were higher in the intervention group than that in the control group after intervention; however, the difference was not statistically significant. The difference in the FFMQ total scores between the two groups was marginally significant ($p = 0.057$). Meanwhile, the total score of the PSS questionnaire in the intervention group was significantly lower than that in the control group after intervention ($p = 0.047$). The dimension "body shape and change" of the PSS was significantly lower in the intervention group than that in the control group ($p = 0.018$). The

TABLE 2 Comparison of general information and the baseline data between the two groups [$\bar{x} \pm s$, *n*(%)].

Characteristics	Intervention group (47)	Control group (48)	Statistics	*P*
Age (M ± SD)	30.43 ± 2.96	30.42 ± 3.02	0.01	0.99[a]
Gestational age of infant (M ± SD)	24.17 ± 4.23	25.71 ± 3.53	−1.93	0.16[a]
Body weight(M ± SD)	67.50 ± 11.44	65.07 ± 13.2	0.96	0.34[a]
Level of education			0.70	0.4[b]
Junior college or below	12	16		
University or above	35	32		
Marital status			<0.001	1[c]
Married	46	47		
Not married	1	1		
Income			0.84	0.66[b]
Less than ¥100,000	10	9		
¥100,000–¥200,000	28	26		
More than ¥200,000	9	13		
Parity			0.44	0.51[b]
No prior births	37	35		
1 or more prior births	10	13		
Pregnancy way			0.001	1[c]
Pregnancy by nature	44	45		
Pregnancy by medicine	3	3		
Pregnancy complications			0.15	0.74[c]
No	42	44		
Yes	5	4		
Waking time [hour:minutes (minutes)]	7:10 (±0:11)	7:36(±0:12)	1.22	0.12[a]
FFMQ	124.13 ± 7.81	126.13 ± 9.65	−1.11	0.27[a]
FFMQ-observing	23.52 ± 4.59	23.29 ± 4.44	0.24	0.81[a]
FFMQ-describing	27.47 ± 4.52	27.19 ± 4.62	0.31	0.76[a]
FFMQ-acting with awareness	29.45 ± 3.74	30.85 ± 4.07	−1.75	0.08[a]
FFMQ-non-judgmental	24.23 ± 4.53	24.38 ± 3.86	−0.17	0.87[a]
FFMQ-non-reactive	19.46 ± 2.66	20.42 ± 3.20	−1.59	0.12[a]
PSS	21.72 ± 10.70	17.92 ± 10.09	1.78	0.08[a]
PSS1	6.51 ± 4.36	6.09 ± 4.89	0.44	0.66[a]
PSS2	8.81 ± 5.00	6.70 ± 3.15	2.46	0.02[a]*
PSS3	4.17 ± 2.70	3.33 ± 2.81	1.48	0.14[a]
PSS-others	2.23 ± 1.36	1.87 ± 1.70	1.15	0.25[a]
AC				
AC_{0min}	10.98 ± 4.27	11.23 ± 4.19	−0.29	0.77[a]
AC_{30min}	16.85 ± 7.46	19.45 ± 7.43	−1.70	0.09[a]
AC_{45min}	14.38 ± 5.78	16.66 ± 6.05	−1.88	0.06[a]
AC_{60min}	13.67 ± 6.42	14.54 ± 5.10	−0.73	0.47[a]
Delta	64.51 ± 79.05	91.53 ± 91.43	−1.54	0.13[a]
AUC_{M}	272.14 ± 183.98	352.51 ± 209.84	−1.98	0.05[a]
AUC_{G}	862.06 ± 314.52	964.96 ± 303.88	−1.62	0.11[a]

[a] *t*-test; [b] Chi-square test, X^2; [c] Fisher's exact test; *$p < 0.05$. FFMQ, the five facet mindfulness questionnaire; PSS, the perceived stress scale; PSS1, stress from ensuring the health and safety of the mother and child; PSS2, stress from validating a parent's role; PSS3, stress from altering body structure and body function; PSS-others, stress from the others; AC, awaking cortisol level; AC_{0min}, cortisol level at awaking; AC_{30min}, cortisol level at 30 min after awaking; AC_{45min}, cortisol level at 45 min after awaking; AC_{60min}, cortisol level at 60 min after awaking; Delta, the acute rise in cortisol after waking in the morning; AUC_{M}, area under the curve with respect to increase, measures the increase in cortisol within 1 h of waking relative to minimum of four time points; AUC_{G}, area under the curve with respect to ground, measures the overall amount of cortisol secreted within 1 h after awakening.

TABLE 3 Mean and standard deviation of questionnaire scores for both groups and comparison of the scores before and after intervention in one group ($\bar{x} \pm s$).

Questionnaire	Intervention group (47)		*t*	*P*	Control group (48)		*t*	*P*
	Before intervention	After intervention			Before intervention	After intervention		
FFMQ	124.13 ± 7.81	130.65 ± 10.73	−3.37	0.001*	126.13 ± 9.65	126.49 ± 9.36	−0.19	0.85
FFMQ-observing	23.52 ± 4.59	26.14 ± 5.40	−2.54	0.013*	23.29 ± 4.44	25.00 ± 4.58	−1.88	0.06
FFMQ-describing	27.47 ± 4.52	28.61 ± 3.54	−1.36	0.18	27.19 ± 4.62	27.74 ± 3.70	0.64	0.52
FFMQ-actingwith awareness	29.45 ± 3.74	30.00 ± 4.48	−0.65	0.52	30.85 ± 4.07	29.02 ± 4.36	0.86	0.04*
FFMQ-nonjudgmental	24.23 ± 4.53	25.55 ± 3.83	−1.54	0.13	24.38 ± 3.86	25.00 ± 3.82	−0.79	0.43
FFMQ-non-reactive	19.46 ± 2.66	20.34 ± 3.34	−0.62	0.16	20.42 ± 3.20	19.73 ± 2.15	1.24	0.22
PSS	21.72 ± 10.70	16.89 ± 10.64	2.19	0.03*	17.92 ± 10.09	22.21 ± 13.38	−1.78	0.08
PSS1	6.51 ± 4.36	5.40 ± 3.93	1.30	0.20	6.09 ± 4.89	6.33 ± 4.83	−0.24	0.81
PSS2	8.81 ± 5.00	6.93 ± 3.64	2.08	0.40	6.70 ± 3.15	8.33 ± 4.54	−2.04	0.04*
PSS3	4.17 ± 2.70	2.70 ± 2.11	2.94	0.004*	3.33 ± 2.81	3.98 ± 2.81	−1.13	0.26
PSS-others	2.23 ± 1.36	1.97 ± 1.77	0.80	0.43	1.87 ± 1.70	2.79 ± 1.88	−2.52	0.01*

**p* < 0.05.

TABLE 4 Results of covariance analysis.

Questionnaire	Adjusted mean and standard deviation		F	*P*	*d*	CI
	Intervention group (47)	Control group (48)				
FFMQ	130.58 ± 1.49	126.56 ± 1.46	3.70	0.057	4.01	[−0.13,8.16]
FFMQ-observing	26.14 ± 0.73	25.01 ± 0.73	1.21	0.275	1.13	[−0.92,3.18]
FFMQ-describing	28.62 ± 0.53	27.74 ± 0.53	1.39	0.241	0.88	[−0.60,2.36]
FFMQ-acting with awareness	30.05 ± 0.65	28.97 ± 0.65	1.37	0.244	1.08	[−0.75,2.92]
FFMQ-non-judgmental	25.54 ± 0.56	25.00 ± 0.55	0.48	0.492	0.54	[−1.02,2.11]
FFMQ-non-reactive	20.29 ± 0.41	19.79 ± 0.41	0.72	0.397	0.41	[−0.66,1.65]
PSS	17.00 ± 1.79	22.10 ± 1.77	4.05	0.047*	−5.10	[−10.14,−0.07]
PSS1	5.44 ± 0.63	6.28 ± 0.62	0.90	0.345	−0.84	[−2.60,0.92]
PSS2	6.82 ± 0.61	8.44 ± 0.61	3.43	0.067	−1.62	[−3.35,0.12]
PSS3	2.72 ± 0.37	3.97 ± 0.36	5.76	0.018*	−1.25	[−2.28,−0.22]
PSS-others	1.96 ± 0.27	2.80 ± 0.27	4.87	0.030*	−0.84	[−1.59,−0.08]

**p* < 0.05.

dimension "others" of the PSS was significantly lower in the intervention group than that in the control group ($p = 0.03$). Meanwhile, the dimensions "identify with parental roles" and "health and safety of mother and child" were lower in the intervention group than those in the control group, but the differences were not statistically significant (Tables 3, 4).

We compared the differences in cortisol levels and related indicators between the two groups before and after the intervention using the GEE. In the analysis, grouping was considered as the main effect, whereas time was considered as a covariate. For Delta, $\beta_1 = -100.35$, $p = 0.009$; that is, cortisol levels in the intervention group decreased by an average of 100.35 relative to those in the control group after intervention, and the difference was statistically significant. Meanwhile, the difference in Delta before and after the intervention was not statistically significant ($\beta_2 = 8.09$, $p = 0.624$). Finally, the difference in the magnitude of change between the two groups before and after the intervention was statistically significant ($\beta_3 = 73.33$, $p = 0.01$). For AUC_M, $\beta_1 = -183.43$, $p = 0.014$; that is, cortisol levels in the intervention group decreased by an average of 183.43 relative to those in the control group after intervention, and the difference was statistically significant. Meanwhile, the difference in AUC_M before and after the intervention was not statistically significant ($\beta_2 = -25.62$, $p = 0.415$). The difference in the magnitude of change between the two groups before and after the intervention was statistically significant ($\beta_3 = 103.05$, $p = 0.031$). AC_{0min}, AC_{30min}, AC_{45min}, AC_{60min}, and AUC_G exhibited no significant difference between the two groups. For AC_{0min},

AC_{30min}, and AC_{60min}, the differences in cortisol levels before and after the intervention were significant. After the intervention, the cortisol levels decreased by an average of 1.72, 2.59, and 1.91, respectively, compared with those before the intervention. For AUC_G, the difference in cortisol total output before and after the intervention was significant. After the intervention, the cortisol total output decreased by an average of 109.85 compared with that before the intervention (Figures 2–4; Table 5).

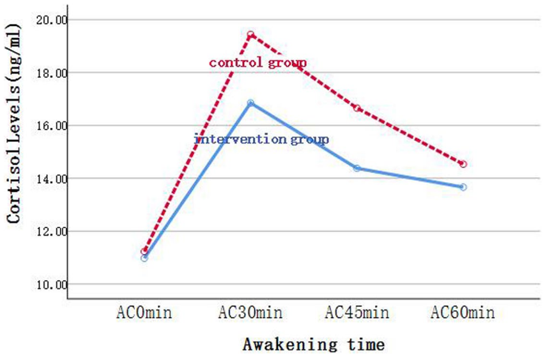

FIGURE 2
Changes of cortisol levels in saliva samples of the two groups at each time point before intervention.

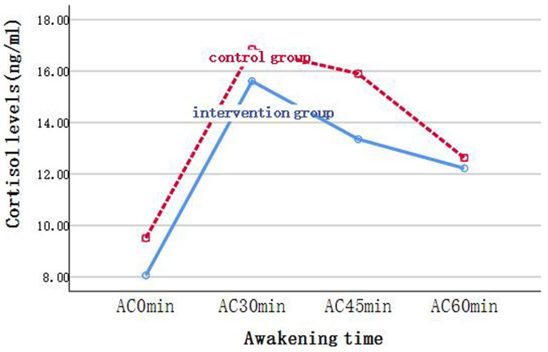

FIGURE 3
Changes of cortisol levels in saliva samples of the two groups at each time point after intervention.

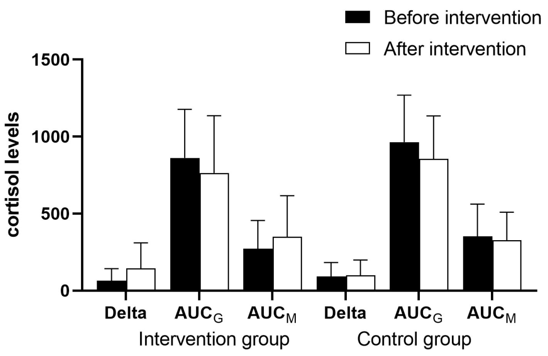

FIGURE 4
Comparison of cortisol levels (Delta, AUCG, and AUCM) of the intervention and control group before and after the intervention.

4. Discussion

This randomized controlled trial aimed to examine the effects of the simplified version of the MBCP course on reducing pregnancy stress and regulating the CAR in pregnant Chinese women during pregnancy compared with the active control group. A total of 95 pregnant women completed the study. The demographic characteristics and baseline cortisol-related indicators were not statistically significantly different between the intervention and control group before the intervention. However, after the intervention, the level of pregnancy stress was significantly reduced, whereas the levels of Delta and $AUC_{M,}$ were significantly increased in the intervention group compared with that in the control group.

In terms of mindfulness intervention for pregnancy stress, the conclusion of this study is consistent with the conclusions of most previous studies (Krusche et al., 2018; Warriner et al., 2018; Pan et al., 2019a,b; Lönnberg et al., 2020), but the effect was different. Warriner et al. (2018) of Oxford University conducted a single-arm study involving 86 pregnant women. In this study, the participants received a 4-week mindfulness intervention, and their stress levels were compared before and after the intervention to evaluate the intervention effect of the course. Their results showed that the stress level was 4.13 points lower after intervention. Meanwhile, in our study, the stress level of the participants in the intervention group decreased by 4.83 points, which was slightly higher than Warriner et al. (2018). However, the baseline level of pregnancy stress (19.19 ± 7.03) among pregnant women in the previous study was slightly lower than that of participants in the intervention group (21.72 ± 10.07) of our study. Participants with a higher level of stress may be more sensitive to the intervention. In addition, the study by Warrine et al. had a high rate of loss to follow-up (41.9%) and did not include a control group; these factors may lead to bias. Moreover, Krusche et al. (2018), also from Oxford University, conducted a randomized controlled study to evaluate the effect of an online mindfulness intervention course on pregnancy stress. Their study included 185 pregnant women, and the baseline level of pregnancy stress (21.65 ± 8.02) was similar to that in our study. In the intervention group, the level of pregnancy stress decreased by 4.47 points more than that in the control group. Meanwhile, in our study, the stress level of participants in the control group showed an upward trend after intervention, whereas the stress level of pregnant women in the intervention group decreased by 9.12 points more than that in the control group after intervention. However, Krusche et al. (2018) reported a high attrition rate (61.08%). Beattie et al. (2017) conducted a pilot randomized trial with 48 pregnant Australian women who were 24–28 weeks pregnant to evaluate the effects of an 8-week mindfulness intervention program on pregnancy stress and other adverse psychological conditions. In contrast to our research, this study measured stress using PSS-10. After the intervention, the reduction in pregnancy stress score in the intervention group was 24.28%, which is slightly higher than the reduction in our study (22.23%). Nevertheless, the attrition rate in their study (58.33%) was significantly higher than that in our study (18.8%). On the one hand, the 8-week intervention course with a longer class may have a greater intervention effect; on the other hand,

TABLE 5 Results of GEE analysis.

Cortisol related indicators	Variables	β	SE	Wald X^2	P
AC_{0min}	(Intercept)	12.96	1.11	137.29	0
	Intervention group	0.95	1.64	0.33	0.56
	Control group	0	–	–	–
	Time	−1.72	0.66	6.75	0.009*
	Time*Intervention group	−1.20	1.00	1.44	0.23
	Time*Control group	0			
AC_{30min}	(Intercept)	22.04	2.12	108.17	0
	Intervention group	−3.95	3.10	1.62	0.20
	Control group	0	–	–	–
	Time	−2.59	1.27	4.18	0.041*
	Time*Intervention group	1.35	1.96	0.48	0.49
	Time*Control group	0			
AC_{45min}	(Intercept)	17.42	1.60	119.27	0
	Intervention group	−2.01	2.29	0.77	0.38
	Control group	0	–	–	–
	Time	−0.76	0.94	0.66	0.42
	Time*Intervention group	−0.27	1.45	0.03	0.85
	Time*Control group	0			
AC_{60min}	(Intercept)	16.45	1.26	170.50	0
	Intervention group	−1.33	2.10	0.40	0.53
	Control group	0	–	–	–
	time	−1.91	0.68	7.83	0.005*
	Time*Intervention group	0.46	1.22	0.15	0.70
	Time*Control group	0			
Delta	(Intercept)	83.45	26.09	10.23	0.001
	Intervention group	−100.35	38.24	6.89	0.009*
	Control group	0	–	–	–
	Time	8.09	16.50	0.24	0.62
	Time*Intervention group	73.33	28.54	6.60	0.01*
	Time*Control group	0			
AUC_M	(Intercept)	378.14	55.67	46.14	0
	Intervention group	−183.43	74.90	6.00	0.014*
	Control group	0	–	–	–
	Time	−25.62	31.45	0.66	0.42
	Time*Intervention group	103.05	47.80	4.65	0.031*
	Time*Control group	0			
AUC_G	Intercept	1074.82	76.91	195.28	0
	Intervention group	−114.84	118.22	0.94	0.33
	Control group	0	–	–	–
	Time	−109.85	43.24	6.46	0.011*
	Time*Intervention group	11.93	72.61	0.03	0.87
	Time*Control group	0			

*$p < 0.05$.

the longer class may make it challenging for participants to adhere to it. Lönnberg et al. (2020) conducted a randomized controlled study involving 193 pregnant women with high stress levels. The participants were 15–22 weeks pregnant, and the intervention group received 8 weeks of MBCP training; the PSS was used to measure the level of stress. The baseline level of maternal stress was significantly higher in the intervention group (26.82 ± 7.76) than that in our study (21.72 ± 10.07). The results showed that the reduction in stress levels in the intervention group was 6.11 points greater than that in our study (4.83). Lonnberg selected pregnant women with a high stress level, and the effect of mindfulness training may be more pronounced in those with mood disorders. In conclusion, our intervention model is effective and has unique advantages for pregnancy stress. The attrition rate in our study is lower than most similar studies, especially the study with an 8-week intervention course model. In addition, our course may prove more effective intervention for pregnant women with high stress levels. In the future, it is necessary to further test the intervention effect of our course in a high-stress population.

After intervention, the Delta and AUC_M values of the intervention group were significantly higher than those of the control group, whereas there were no statistically significant differences in the cortisol level at awakening, and 30, 45, and 60 min after awakening. Moreover, the total amount of cortisol secreted within 1 h after awakening (AUC_G) showed no significant difference between the two groups. Khoury et al. (2015) revealed that "total cortisol output" and "change in cortisol levels" were the two most important cortisol indicator components. Stalder et al. (2016) proposed that AUC_M was a sensitive indicator of the cortisol awakening response (CAR). Delta and AUC_M were both sensitive indicators of the CAR in our study. Few studies have been conducted on the effects of mindfulness intervention targeting the HPA axis in pregnant women. However, the results of this study are consistent with those of similar studies conducted on the non-pregnant population. For instance, Harris A R (2016) conducted a randomized controlled study of 64 educators and found that after mindfulness intervention, the CAR levels in the intervention group were significantly higher than those in the control group, whereas AUC_G levels did not differ significantly between the two groups. Meanwhile, Matousek et al. (2011) analyzed changes in CAR-related indicators before and after intervention in 33 women who underwent a mindfulness-based stress reduction (MBSR) program after breast cancer drug therapy. They discovered that CAR increased significantly after intervention. When they subdivided the sample further, they found that those with higher initial cortisol levels experienced a decline over time, whereas those with lower initial levels experienced an increase. Furthermore, a randomized controlled study of 114 police officers conducted by Grupe et al. (2021) drew different conclusions. They found that mindfulness training improved the mental health and sleep quality and reduced the CAR of police officers. In conclusion, mindfulness training may have a bidirectional effect on the CAR, which varies depending on the psychosomatic health level of the participants. In a study by Matousek et al. (2011) on cancer patients with poor physical functioning, CAR was negatively correlated with fatigue, and the patients had lower cortisol levels than healthy people (Chida and Steptoe, 2009). By increasing CAR, mindfulness training may have increased physical vitality. While the police force is dominated by young and middle-aged males who are physically fit and face more work pressure, CAR is relatively higher in the general population, and chronically high CAR levels are associated with overreaction, worry, burnout, and depression (Schlotz et al., 2004; Fries et al., 2009). A moderate reduction in cortisol levels is beneficial for police officers' physical and mental health. O'Leary et al. (2016) explored the effect of mindfulness on cortisol through a meta-analysis. The idea of changes in cortisol flexibility is supported when interpreting inconsistencies in the results of assorted studies. Dedovic et al. (2010) showed that the flexibility of CAR reflects the coping abilities of the individual.

According to the arousal response hypothesis, CAR allows organisms to respond to the stress of the upcoming day, and increased cortisol levels in the morning may reflect an increase in energy demand (Schulz et al., 1998). Powell and Schlotz (2012) hypothesized that CAR was an adaptive anticipatory response for the upcoming day. When participants showed increased CAR, they experienced less distress in response to daily stress. Moreover, the increase in CAR in healthy pregnant women is lower than that in non-pregnant women (Clow et al., 2004; Shea et al., 2007; Entringer et al., 2010). This difference may result from physiological adaptations that protect the mother and fetus from overexposure to stress hormones (Christian, 2012). However, with the rapid increase in cortisol levels in pregnant women, the CAR of pregnant women decreases with an increase in gestational weeks (De Weerth and Buitelaar, 2005; Entringer et al., 2010). Thayer et al. (2018) studied 741 women who were not pregnant, who were in various stages of pregnancy, and had given birth. The results showed that the CAR of pregnant women decreased significantly in the second trimester. The trend of continuous weakening may have different effects on pregnant women's physical and psychological outcomes at different stages of pregnancy. Meanwhile, Scheyer and Urizar (2016) found that a smaller arousal response was significantly associated with postpartum depressive symptoms in the first and second trimesters. Most of the pregnant women selected in this study were in the middle of pregnancy; therefore, it is beneficial to improve their CAR to protect the pregnant women and fetuses. A review suggested that reduced CAR may be associated with individual psychosomatic disorders, such as chronic pain or sleep disorders (Fries et al., 2009). Several studies have confirmed that the reduction in AUC_M, an indicator of arousal increase, is associated with the aggravation of subclinical symptoms (Dedovic et al., 2010; Mangold et al., 2012; Dedovic and Ngiam, 2015). The increase of AUC_M, an indicator of increased CAR, has great potential to improve pregnant women's physical and mental health. Therefore, mindfulness training may be one of the effective ways to help pregnant women enhance their CAR and improve their physical and mental health.

Based on the dual effects of mindfulness training on psychological status and CAR levels, it is hypothesized that the underlying mechanism of mindfulness intervention is the mutual influence of psychological symptoms and physiological stress response, to improve the health level of the body (McEwen, 2004; Wintermann et al., 2016). In their review, Creswell et al. (2019) proposed the effect of the stress-buffering framework of mindfulness training on physical health. This suggests that both the peripheral physiological response and subjective experience, that is, the co-regulation of inflammation and additional physiological responses and health behaviors, are coping resources of the body. In the framework, psychological symptoms and HPA axis response are bidirectional. The present study found that mindfulness training may have simultaneous effects on mental health and the HPA axis, thereby verifying the framework's hypothesis. According to the 2021 China Statistical Yearbook, 10.62 million babies were born in China in 2021 (National Burea of Statistics of China, 2021). Thus, there is an urgent need for innovative and accessible interventions to alleviate pregnancy stress, and MBCP courses localized in China provide Chinese women with a new option to alleviate pregnancy stress and improve their mental health. Our study provides a theoretical reference for promoting and applying localized MBCP courses for pregnant women in China.

4.1. Limitations

This study has the following limitations. First, the participants were primarily pregnant women with a high level of education. In the intervention group, 74.47% of participants held a bachelor's degree or higher, compared to 66.65% in the control group. We hypothesized that the effect of the mindfulness course may be related to the level of education of the participants; those with a higher level of education may comprehend the course material better and, therefore, be more responsive to the intervention. We are unsure whether the "2-day onsite and 21-day online" simplified version of the MBCP course would have the same effect if the participants were pregnant women with a lower level of education. Second, the inclusion criteria were limited to primiparas. Pregnancy stress levels have been found to be higher in primiparas (Wheeler et al., 2018), and those with higher stress may be more sensitive to mindfulness interventions. We are unsure whether the simplified version of the MBCP course would have the same effect for nonprimiparas. These two aspects of the study limit the extrapolation of the results. Third, the sample size of this study was relatively small, and the differences in the magnitude of changes in some dimensions of stress levels and mindfulness levels between the two groups after the intervention were not well demonstrated.

5. Conclusion

Our findings indicate that mindfulness training during pregnancy can effectively relieve stress and improve the physiological stress response function of the HPA axis in pregnant women. The "2-day on-site and 21-day online" simplified version of the MBCP course localized for pregnant women in China appears to be an acceptable and effective intervention for maternal mental health. However, health economics must still determine whether the program can be widely promoted among pregnant women in China.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Review Committee of the National Center for Women and Children (Chinese Center for Disease Control and Prevention, Beijing, China; approval no. FY2020-10). The patients/participants provided their written informed consent to participate in this study.

Author contributions

RZ and FS conceived the research. SW, MS, and CZ designed the survey. RZ, SW, MS, CZ, DZ, JW, YL, and KL conducted the survey. SW and CZ conducted the statistical analyses. SW wrote the primary draft and prepared advanced drafts for publication. SW, CZ, and MS finalized the report. TX and XP supervised the writing of the report. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1073494/full#supplementary-material

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Living with migraine: A meta-synthesis of qualitative studies

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Introduction: Migraine is one of the top ten causes of disability worldwide. However, migraine is still underrated in society, and the quality of care for this disease is scant. Qualitative research allows for giving voice to people and understanding the impact of their disease through their experience of it. This study aims at synthesising the state of the art of qualitative studies focused on how people with migraine experience their life and pathology.

Methods: MEDLINE *via* PubMed, EMBASE, CINAHL, PsycINFO, and Cochrane Library were consulted up to November 2021 for qualitative studies. Studies to be eligible had to focus on adults (age $>$ 18 years) with a diagnosis of primary episodic or chronic migraine following the International Classification of Headache. The quality of the study was analysed using the CASP (Critical Appraisal Skills Programme) tool. The synthesis was done through a thematic analysis. CERQual (Confidence in Evidence from Reviews of Qualitative research) approach was used to assess the confidence in retrieved evidence.

Results: Ten studies were included, counting 262 people with migraine. Our synthesis produced four main themes. (1) "Negative impact of migraine symptoms on overall life" as migraine negatively impacts people's whole life. (2) "Impact of migraine on family, work and social relationship" as migraine reduces the possibility to focus at work and interact with people. (3) "Impact of migraine on emotional health" as people with migraine experience psychological distress. (4) "Coping strategies to deal with migraine" such as keep on living one's own life, no matter the symptoms.

Conclusions: Migraine negatively impacts people's whole life, from private to social and work sphere. People with migraine feel stigmatised as others struggle with understanding their condition. Hence, it is necessary to improve awareness among society of this disabling condition, and the quality of care of these people, tackling this disease from a social and health-policy point of view.

KEYWORDS

headache, quality of life, disease management, patient participation, decision making, rehabilitation

1. Introduction

Migraine is a primary headache characterised by a throbbing pain on one side of the head, whose aetiology cannot be found in a specific structural alteration but in a combination of genetic and environmental factors (Burstein et al., 2015; Puledda et al., 2017). Migraine is the third most prevalent disorder worldwide and the second and third cause of disability and years of healthy life lost due to disability, respectively (Steiner et al., 2015, 2016, 2020). Moreover, it is one of the most common causes of absenteeism at work, and people with migraine experience a broad array of psychological distress due to their disease (Antonaci et al., 2011; Gandolfi et al., 2019; Donisi et al., 2020). Nevertheless, migraine is still underrated in society [World Health Organisation (WHO), 2011]. This underestimation of migraine disability is probably a result of a lack of education and knowledge of this disease among the general population and healthcare professionals [World Health Organisation (WHO), 2011; Guerrero et al., 2021; Pace et al., 2021].

The management of migraine is daunting as there is no definitive cure for this pathology, but symptoms-related management. People with migraine must learn how to coexist and cope with their disease. Recommendations for the treatment of acute migraine revolve around the importance of an early diagnosis and treatment, with the latter characterised by a personalised pharmacological intervention as first-line treatment (May and Schulte, 2016; Oskoui et al., 2019; Battista et al., 2021; Vanderpluym et al., 2021). Moreover, people with migraine should be educated on the lifestyle factors that can trigger or improve migraine attacks and the use of non-pharmacological treatments (e.g., muscular and relaxing techniques) (May and Schulte, 2016; Meyer et al., 2016; Falsiroli Maistrello et al., 2018; Garrigós-Pedrón et al., 2018). These treatments aim at reducing migraine frequency, duration and intensity. However, adherence to guidelines for the attack treatment of migraine is poor (Hepp et al., 2014; Olesen et al., 2022).

Considering the high impact of this disease, how underrated it is, and its difficult management, qualitative studies are needed to understand and give voice to people with migraine to understand their experience. By doing so, they allow for understanding people with different diseases, helping them in their therapeutic process, and improving their clinical management, influencing consultation behaviour and people's preferences (Peters et al., 2002; Noyes et al., 2018a). In 2002, Peters et al. stated that "few studies have been conducted on the patients' perspective on headache" (Peters et al., 2002). Since that moment, different qualitative studies have been published, leading to different systematic reviews. Nichols et al. analysed qualitative studies about the experience of different chronic headaches, including migraine (Nichols et al., 2017). However, migraine symptoms may overlap with other types of headaches, and chronic and episodic migraine might lead to different experiences worth exploring. Minen et al. conducted a meta-synthesis of qualitative studies on migraine management and patients' attitude to treatments and physicians (Minen et al., 2018). However, they did not take into account how people experience and live with this disease. In line with that, this study aims at filling the knowledge gap in the literature about people's perception of migraine (either episodic or chronic) and their implications on their life by synthetising qualitative studies on this topic.

2. Methods

A meta-synthesis is a systematic review and integration of findings from qualitative studies (Lachal et al., 2017). Meta-syntheses are concerned with understanding and describing key points, issues, and recurring themes within a research area of interest. Specifically, our meta-synthesis focuses on people's perception of a phenomenon (migraine) to offer different interpretations that might help the development of healthcare settings (Lachal et al., 2017). For this reason, the meta-synthesis approach suits the aim of this study, whose research question is: "How do people with migraine experience and manage their life?" The reporting of this meta-synthesis follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA) 2020 (Page et al., 2021).

2.1. Eligibility criteria

2.1.1. Types of study

We included qualitative studies written in English and published in the last 21 years (2000–2021) that adopted different approaches (e.g., phenomenological analysis and grounded theory) and data collection methods (e.g., interviews and focus groups). Instead, we excluded studies in languages other than English that adopted quantitative designs such as systematic reviews, case reports, case series, and randomised-controlled trials (RCTs).

2.1.2. Participants

We considered eligible all the studies that included adults (age > 18 years) with a diagnosis of primary episodic or chronic migraine following the criteria of the International Classification of Headache Disorders (ICHD), with or without aura,[1] excluding people with a headache not classified as primary migraine headaches. We did not impose any restrictions on the sex and gender of participants.

2.1.3. Types of evaluation

In this meta-synthesis, the focus is on people's experience of migraine. Thus, we included qualitative studies that focused on people with migraine. Instead, we excluded studies that concentrated only on caregivers or physicians.

2.2. Information sources

The research was conducted on MEDLINE *via* Pubmed, EMBASE, Cochrane Library, CINAHL, and PsycINFO. Since there is no consensus about which databases should be used for meta-synthesis, we adopted the recommendations from the "Cochrane Handbook for Systematic Reviews for Interventions" (Higgins et al., 2021). In their book, the Cochrane group suggested using MEDLINE *via* Pubmed, EMBASE, and Cochrane Library as the bare minimum requirement and adopted other sources based on the specific topic of the review. Therefore, we also adopted CINAHL and PsycINFO as they are preeminent databases for qualitative and psychological primary studies. We consulted these databases up to November 2021.

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[1] The International Classification of Headache Disorders - ICHD-3. Available online at: https://ichd-3.org/ (accessed July 20, 2022).

2.3. Search strategy

The search strategy adopted is the SPIDER tool used for qualitative evidence synthesis: Sample, Phenomenon of Interest, Design, Evaluation, and Research type (Cooke et al., 2012). The search strings used for all database is reported as Supplementary material 1. SB and AL conducted the search strategies with the help of a librarian from Lund University.

2.4. Selection process

Articles obtained from the research were uploaded to the Rayyan website after duplicate removal. Afterwards, two independent authors (AL and LFM) selected the studies applying the inclusion and exclusion criteria to titles and abstracts. In case of disagreement, a third author was consulted (SB). The full texts were read, and the final selection was decided through discussion by two authors (AL and SB). In addition to the inclusion and exclusion criteria, researchers evaluated the sample characteristics to include or not a study. The final purpose of this synthesis is to collect the experiences of a wide range of people with migraine, so if two studies had the same sample and similar settings, only one was included.

2.5. Data collection process

Two authors (AL and IC) independently extracted data from each study following the Cochrane indications (Noyes et al., 2018b) and using standardised Excel templates: author (year), title, country, setting, study design, objective, strengths and weaknesses, the total number of participants, sample characteristics, pathology of interest, frequency of migraine, and onset/years with migraine and disability rating scale. Then the two authors independently collected themes and subthemes from primary studies in a second Excel template. Disagreements in the data collection were resolved by either a consensus process or consultation with a third author (SB).

2.6. Methodological quality of the studies

Following Cochrane Qualitative and Implementation Group's recommendations, the studies were assessed for critical appraisal with the Critical Appraisal Skills Programme (CASP) tool by two authors independently (AL and IC) (Noyes et al., 2018b). CASP is the most common tool adopted for quality appraisal in health-related qualitative syntheses. The tool is made of ten questions that span from the use of appropriate methodology to the value of the results. Researchers can answer "yes", "no", or "can't tell" to each question. Each question has "comments" boxes to report why certain answers were given, and it is accompanied by suggested "hints" that help the researchers to reason upon the correct answer.

2.7. Data synthesis

A data-driven thematic analysis was used to synthesise the data with a descriptive approach (Dixon-Woods et al., 2005). Thematic analysis is a flexible method that identifies main or recurring themes from the included studies, summarising them under thematic headings. Specifically, data synthesis was divided into two phases. In the first one, two authors (AL and IC) thoroughly read the primary studies identifying their themes and subthemes independently. Then, they selected only those themes and subthemes that answered our research question, synthetising them based on their core meaning. In the second one, they discussed together their summarised themes and subthemes to reach a final consensus. In case of disagreement in the second phase, a third author (SB) was consulted.

2.8. Certainty of evidence

The Confidence in Evidence from Reviews of Qualitative research (CERQual) approach was used to assess the certainty of findings as either high, moderate, low or very low: it included the methodological limitations, relevance, coherence, and adequacy of data (Lewin et al., 2015). The methodological limitations of included studies were the result of the assessment made by the CASP tool. The relevance was the extent to which the setting or the inclusion criteria from the primary studies supporting review findings applied to the context specified in the review question (Lewin et al., 2015). The coherence assessed data consistency within and across all studies. The adequacy of data was an overall determination of the degree of richness and quantity of data supporting a review finding (Lewin et al., 2015).

3. Results

3.1. Study selection

The research conducted on databases yielded 917 articles after the removal of duplicates. After the first screening selection of titles and abstracts, we excluded 905 studies. We read the full text of the remaining twelve articles. We excluded two studies as one did not declare a diagnosis of migraine following ICHD criteria (Leiper et al., 2006), and the other study (Moloney et al., 2004) presented the same sample (perimenopausal women) of a more recent study written by the same author included in this synthesis. Therefore, the final synthesis included ten articles (Cottrell et al., 2002; Ruiz De Velasco et al., 2003; Belam et al., 2005; Peters et al., 2005; Moloney et al., 2006; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017; Scaratti et al., 2018; Estave et al., 2021) (Figure 1; PRISMA flow diagram).

3.2. Study characteristics

The ten studies included in the research counted 262 participants with a diagnosis of migraine headache (either episodic or chronic) according to ICHD criteria. Table 1 includes all study

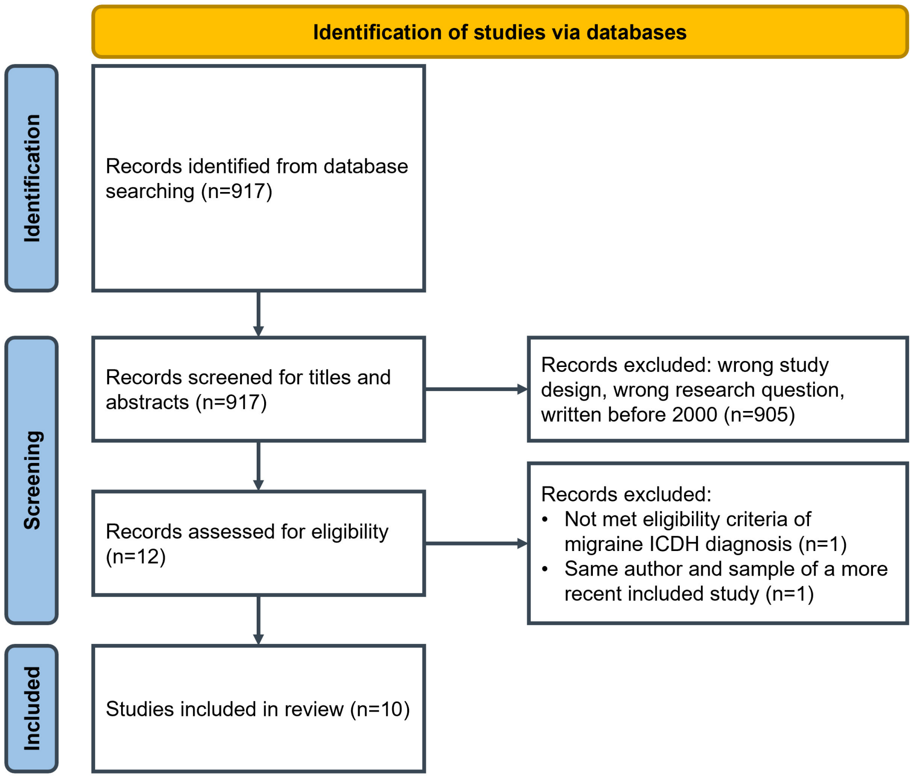

FIGURE 1
PRISMA 2020 flow diagram.

characteristics and the different themes and subthemes extracted by the authors of the articles.

3.3. Methodological quality of the studies

The overall evaluations of CASP are collected in Table 2. The single answers with respective explanations for all the studies are reported in Table 3.

3.4. Results of the synthesis

The synthesis produced four main themes, as shown in Table 4. Every main theme was examined in some subthemes to explain more clearly the various life aspects affected by migraine.

3.4.1. Theme 1: Negative impact of migraine symptoms on overall life

The first theme was present in most studies (Ruiz De Velasco et al., 2003; Belam et al., 2005; Peters et al., 2005; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017; Estave et al., 2021). It deals with how migraine affects patients' lives through physical symptoms, pain and the consequent inability to function at their best. This was the first theme that came to light because it explained how migraine negatively affected the lives of people with it and represented the underlying cause of the most negative experiences that emerged in the following subthemes.

3.4.1.1. Subtheme 1A: Everything is about pain

The participants described the pain as routine using a vivid range of metaphors to explain how impactful migraine was on them:

> "A freight train coming through", "A storm entering my head", "As if my head would explode" (Ramsey, 2012).

> "It's like somebody's put a knife through my head. The pain is so intense that for several seconds I don't even open my eyes, in the hope that I'm just dreaming about it" (Peters et al., 2005).

3.4.1.2. Subtheme 1B: Disabling symptoms and physical impact

Participants also experienced physical and disabling symptoms such as nausea, vomiting, and visual or auditory impairment (aura). Aura did not affect all people with migraine, but it was considered one of the most disabling symptoms.

TABLE 1 Summary of findings.

References	Country	Study design and analysis	Sampling strategy	Population	Migraine and clinical characteristics	Themes and subthemes
Estave et al. (2021), "Learning the full impact of migraine through patient voices: A qualitative study."	United States of America	Semi-structured qualitative interviews analysed following a grounded theory	Participants were recruited from a pilot study and a RCT on the effect of a mindfulness-based stress reduction protocol in adults with migraine.	**Number:** 81 **Age:** Average 45–46 year (y) **Sex:** 90% female (F) **Ethnicity:** Caucasian **Pathology:** Migraine	- **Migraine onset:** Not available (N.A.) - **Years with migraine:** Pilot study and RCT: 26 - **Days with migraine (month):** - Pilot study: 4.2 RCT: 7.45 - **Frequency migraine attacks:** N.A. - **Days with use of symptomatic medication:** N.A. - **MIDAS** (Migraine Disability Assessment) - 1 months: Pilot study: 12.5 RCT: 13.7/10.0 - **HIT – 6** (Headache Impact Test 6): Pilot study and RCT: 63.0 - **Beck Depression Inventory, second edition (BDI-II):** N.A. - **State-Trait Anxiety Inventory (STAI):** N.A.	1. **Global negative impact on overall life:** (a) controls life; (b) makes life difficult; (c) causes disability during attacks; (d) lack of control over migraine attacks; (e) attempts to push through despite migraine. 2. **Migraine impact on emotional health:** (a) isolation; (b) anxiety; (c) frustration/anger; (d) guilt; (e) mood changes/irritability; (f) depression/hopelessness. 3. **Migraine impact on cognitive function:** (a) concentration difficulties, (b) communication challenges. 4. **Migraine impact on specific domains of life with resulting reactions:** (a) work/career: guilt, change of job status, presenteeism, financial impact, school impact; (b) family life: frustration, guilt, disrupted time; (c) social life: irritability, altered plans, communication. 5. **Fear and avoidance:** (a) pain catastrophising, (b) anticipatory anxiety, (c) avoidance behaviour. 6. **Stigma surrounding migraine:** (a) externalised stigma, (b) internalised stigma.
Palacios-Ceña et al. (2017), "Living with chronic migraine: qualitative study on female patients' perspectives from a specialised headache clinic in Spain."	Spain	In-depth unstructured and semi-structured interviews and patients' drawings analysed following a phenomenological approach.	Patients were recruited at their first visit to the headache clinic at the Hospital Clinico San Carlos (Madrid) neurology department. Sampling continued until redundant information from data analysis was achieved.	**Number:** 20 **Age:** mean age ± standard deviation (SD) 38.65 ± 13.85 **Sex:** 100% F **Ethnicity:** Caucasian **Pathology:** Chronic migraine	- **Migraine onset**: N.A. - **Years with migraine**: 20.2 (SD 13,23) - **Days with migraine** (month): 12.85 (SD 6.03) - **Frequency migraine attacks (month)**: 24.6 (SD 4.7) - **Days with use of symptomatic medication** (month): 14.1 (SD 8.91). - **MIDAS**: N.A. - **HIT – 6**: N.A. - **BDI-II:** five patients had mild depression and three had moderate depression. - **STAI:** fourteen patients with some degree of anxiety (moderate to severe).	**1. The shame of suffering from an invisible condition;** 2. **Treatment: between need, scepticism and fear;** 3. **Looking for physicians' support and sincerity and fighting misconceptions;** 4. **Limiting the impact on daily life through self-control;** 5. **Family and work: between understanding and disbelief.**

(Continued)

TABLE 1 (Continued)

References	Country	Study design and analysis	Sampling strategy	Population	Migraine and clinical characteristics	Themes and subthemes
Rutberg and Öhrling (2012), "Migraine – more than a headache: women's experiences of living with migraine."	Sweden	In-depth interviews and drawings following a Hermeneutic phenomenological method.	Letters describing the purpose of the study were sent to all 24 members of Swedish Migraine Association. Those who showed interest were contacted by phone, and they all gave written informed consent.	**Number:** 10 **Age** (range): between 37 and 69 **Sex:** 100% F **Ethnicity:** Caucasian **Pathology:** Migraine	• **Migraine onset (age):** eight women migraine started in their late teens or their early twenties. Two women migraine started in menopause. • **Years with migraine:** N.A. • **Days with migraine (month):** N.A. • **Frequency migraine attacks (number):** One-two attack(s) per year for two women, one-four attacks per month for six women and 10-20 attacks per month for two women • **Days with use of symptomatic medication (month):** N.A. • **MIDAS**: N.A. • **HIT – 6:** N.A. • **BDI-II:** N.A. • **STAI:** fourteen patients with some degree of anxiety (moderate to severe).	1. **Being besieged by an attack:** (a) being temporarily incapacitated; (b) feeling involuntarily isolated from life. 2. **Struggling in a life characterised by uncertainty:** (a) being in a state of constant readiness; (b) worrying about the use of medication. 3. **Living with an invisible disorder:** (a) living with the fear of not being believed; (b) struggling to avoid being doubted.
Ramsey (2012), "Living with migraine headache: a phenomenological study of women's experiences."	United States of America	Hermeneutic Phenomenological inquiry and storey theory with interviews.	Women who held an account at a mid-Atlantic university received an illustrative e-mail. More than 100 women wanted to participate, but the researcher contacted the first 12 who supplied a phone number. The authors decided that redundancy was evident in the eight participant storey.	**Number:** eight **Age:** Average 35,9 y **Sex:** 100% F **Ethnicity:** Caucasian **Pathology:** Migraine	• **Migraine onset (age):** average 20,5 y • **Years with migraine:** N.A. • **Days with migraine (month):** N.A. • **Frequency migraine attacks (number):** N.A. • **Days with use of symptomatic medication (month):** N.A. • **MIDAS:** N.A. • **HIT – 6:** N.A. • **BDI-II:** N.A. • **STAI:** N.A.	**1. Recalling the significant experience that reshaped life;** **2. Experiencing self as vulnerable, with unmet expectations, unfulfilled relationship, and regrets;** **3. Being overcome by unrelenting, torturous pain magnified by intrusion from the outside world;** **4. Pushing through to hold self together to do what needs to be done despite tortuous pain;** **5. Surrendering to the compelling call to focus on self in order to relieve the torturous pain;** **6. Making the most of pain-free time to get on with life and navigate the aftermath of the headache experience;** **7. Being on guard against an unpredictable attack and yet hopeful that it is possible to outsmart the next attack**.

(Continued)

TABLE 1 (Continued)

References	Country	Study design and analysis	Sampling strategy	Population	Migraine and clinical characteristics	Themes and subthemes
Peters et al. (2005), "The patients' perceptions of migraine and chronic daily headache: a qualitative study."	United Kingdom	Semi-structured interviews analysed following grounded theory methodology.	Participants were recruited in Surrey (UK) by personal contact, posters in two local supermarkets and letters to 20 members of the Migraine Action Association.	**Number:** 13 **Age:** average 42,7 y **Sex: nine** male (M) and four female. **Ethnicity:** Caucasian **Pathology:** Migraine, five participants also had chronic daily headache (CDH) with >15 attacks per month and nine had tension-type headache (TTH).	- **Migraine onset (age):** N.A. - **Years with migraine:** N.A. - **Days with migraine (month):** N.A. - **Frequency migraine attacks (number): five** participants had >15 attacks per month. - **Days with use of symptomatic medication (month):** N.A. - **MIDAS:** four participants minimal; one mild; six moderate (three with migraine and three with CDH), two severe disability (CDH). - **HIT – 6:** N.A. - **BDI-II:** N.A. - **STAI:** N.A.	1. **Headaches:** (a) pain and other symptoms; (b) differentiating between different types of headache; (c) perceptions of headaches as barriers and facilitators to care. 2. **Headache impact.** 3. **Headache as a health issue.**
Scaratti et al. (2018), "A qualitative study on patients with chronic migraine with medication overuse headache: comparing frequent and non-frequent relapsers."	Italy	In-person interviews analysed following thematic analysis and a narrative approach.	Participants were consecutively recruited during structured withdrawal treatments at the Headaches Centre of the Neurological Institute C. Besta in Milan between November 2015 and June 2016. Inclusion criteria: >18 years old, diagnosis of chronic migraine and medication overuse.	**Number:** 16 **Age:** mean age 53 y **Sex:** 13 F, 3 M **Ethnicity:** Caucasian **Pathology:** Chronic migraine and medication overuse headache (MOH). Seven participants were classified as frequent re relapsers (FRs) and nine as non-frequent relapsers (NFRs). Patients had both psychiatric (depression or anxiety) and physical comorbidities.	- **Migraine onset (age):** N.A. - **Years with migraine:** FRs 18 years; NFRs 13 years. - **Days with migraine (month):** average 21-22 - **Frequency migraine attacks (number):** N.A. - **Days with use of symptomatic medication (month):** N.A. - **MIDAS:** N.A. - **HIT – 6:** N.A. - **BDI-II:** N.A. - **STAI:** N.A.	1. **Disclosing or concealing headache and the dilemma of isolation;** 2. **Medication addiction;** 3. **Anxiety;** 4. **Use of non-pharmacological therapies.**
Cottrell et al. (2002), "Perceptions and needs of patients with migraine: a focus group study."	United States of America	Focus groups analysed following thematic analysis.	Names of potential participants were obtained from a list of people recruited for a separate headache study conducted by two of the authors; telephone screening.	**Number:** 24 **Age:** range between 25 and 49 y **Sex:** 100% F **Ethnicity:** Caucasian **Pathology:** Migraine, two participants had also occasional tension type headache (TTH).	- **Migraine onset (age):** N.A. - **Years with migraine:** Authors included patients who had experienced migraine for at least six months. - **Days with migraine (month):** one-two. - **Frequency migraine attacks (number):** two third of sample had one to three per month. - **Days with use of symptomatic medication (month):** N.A. - **MIDAS:** N.A. - **HIT – 6:** N.A. - **BDI-II:** N.A. - **STAI:** N.A.	1. **Effect on social functioning;** 2. **Effect on family functioning;** 3. **Effect on work;** 4. **Effect on relationships;** 5. **Issues related to physician care;** 6. **Problems with insurance and drug companies.**

(Continued)

References	Country	Study design and analysis	Sampling strategy	Population	Migraine and clinical characteristics	Themes and subthemes
Moloney et al. (2006), "The experiences of midlife women with migraines."	United States of America	Data were collected in two consecutive multi-method studies: the first one used qualitative interviews, focus group, paper-and-pencil questionnaire (HHQ, Migraine-Specific QoL, SF-36) and six-month daily diaries. The second study was internet-based with both in-person and phone interviews, similar quantitative questionnaires and virtual focus groups (online discussion boards). The interpretative hermeneutic approach was used for analysis.	Ten participants in the first study were recruited from a health maintenance organisation. Forty-three participants in the second study were recruited from a university setting, the local community and the internet.	**Number:** 53 **Age:** range between 40 and 55. **Sex:** 100% F (perimenopausal women). **Ethnicity:** 44 Caucasian, eight African American, one English Indian. **Pathology:** Migraine.	• **Migraine onset (age):** N.A. • **Years with migraine:** N.A. • **Days with migraine (month):** N.A. • **Frequency migraine attacks (number):** two/three • **Days with use of symptomatic medication (month):** N.A. • **MIDAS:** N.A. • **HIT – 6:** N.A. • **BDI-II:** N.A. • **STAI:** N.A.	1. **Shifting headache patterns:** (a) headaches patterns; (b) looking for an answer; 2. **Predicting, preventing, and controlling headaches:** (a) is this a migraine or something else?; (b) identifying triggers; (c) course of headache: the lurking migraine; (d) medications; (e) I might try…: self-care interventions; 3. **Keeping on the move:** (a) working through headache; (b) desperation; (c) keeping my arsenal of medicine; (d) having a dirty secret.
Belam et al. (2005), "A qualitative study of migraine involving patient researchers."	United Kingdom	Qualitative interviews analysed following a grounded theory.	Patient researchers were recruited from a local intermediate care headache clinic, advertised through the local press, word of mouth and an organisation for people with migraine. Study participants were recruited from a local headache clinic.	**Number:** eight **Age:** average 47,6 **Sex:** six F and 2 M **Ethnicity:** Caucasian **Pathology:** Migraine	• **Migraine onset (age):** N.A. • **Years with migraine:** N.A. • **Days with migraine (month):** N.A. • **Frequency migraine attacks (number):** two/three • **Days with use of symptomatic medication (month):** N.A. • **MIDAS:** N.A. • **HIT – 6:** average 70,5 (all results were over 56 that means substantial impact) • **BDI-II:** N.A. • **STAI:** N.A.	1. **Impact on life (everyone is different):** (a) physical and psychological impact; (b) impact on family and social life; (c) impact on career. 2. **Making sense of the problem; Putting up with it;** 3. **Doing something about it:** (a) self-help; (b) professional help.
Ruiz De Velasco et al. (2003), "Quality of life in migraine patients: a qualitative study."	Spain	Six focus groups and nine personal interviews. The method used for the analysis was described by Krueger: the researcher offers brief descriptions based on direct data followed by an illustrative example.	Participants were divided in six groups: in the first, second and third groups, patients were recruited from the Department of Neurology of Hospital de Galdakao, Spain. In the fourth group, participants were selected by pharmacists; the fifth group included healthcare professionals (nurses and physicians); the last group included relatives of patients with migraine.	**Number:** 41 (29 migraine suffers) **Age (average):** first group: 35, 43; second group: 37, 66; third group: 34, 13; fourth group: 48, 5. **Sex:** 30 F overall (27 F and 2 M migraine suffers). **Ethnicity:** Caucasian **Pathology:** Migraine with or without aura.	• **Migraine onset (age):** N.A. • **Years with migraine:** N.A. • **Days with migraine (month):** N.A. • **Frequency migraine attacks (number):** first group: 3,4 (range 2-6); second group: 5,3 (range 2-11); third group: 6,7 (range 2-12); fourth group 3 (range 2-9). • **Days with use of symptomatic medication (month):** N.A. First group used prophylaxis (nadolol 70%, amitriptyline 20%, flunarizine 10%). • **MIDAS:** N.A. • **HIT – 6:** N.A. • **BDI-II:** N.A. • **STAI:** N.A.	1. **Symptomatic aspects; Social aspects:** (a) work and studies; (b) family relationships; (c) social relationships; 2. **Emotional aspects**.

TABLE 2 Evaluations of methodological quality of the studies—CASP checklist.

Question	Yes (Number of studies)	Can't tell (Number of studies)	No (Number of studies)
1. Was there a clear statement of the aims of the research?	10	0	0
2. Is a qualitative methodology appropriate?	10	0	0
3. Was the research design appropriate to address the aims of the research?	6	4	0
4. Was the recruitment strategy appropriate to the aims of the research?	8	1	1
5. Was the data collected in a way that addressed the research issue?	7	3	0
6. Has the relationship between researchers and participants been adequately considered?	5	5	0
7. Have ethical issues been taken into consideration?	4	6	0
8. Was the data analysis sufficiently rigorous?	10	0	0
9. Is there a clear statement of findings?	10	0	0
10. How valuable is the research?	10	0	0

> "Hearing that all day would kill me", "A stereo that someone just keeps turning the volume up in my head", "As echoing through my head", "As fingernails on a chalkboard" (Ramsey, 2012).

> "And your eyes begin to close because your whole body hurts and you feel pain when there is any kind of noise, light, anything at all" (Ruiz De Velasco et al., 2003).

3.4.1.3. Subtheme 1C: Migraine involves day-to-day life

People with migraine reported that their disease affected their life and hindered their ability to live it.

> "I am losing a day of my life", "Attacks make doing day-to-day things a lot more difficult. [...] It makes day-to-day living harder" (Estave et al., 2021).

> "You lose your life for a moment" (Rutberg and Öhrling, 2012).

3.4.1.4. Subtheme 1D: Inability to carry out activities with pleasure (want to but not able to)

Migraine symptoms also cause a loss of pleasure in daily activities.

> "I have to stop doing things that I like to do, and I can't enjoy things I like to do", "I never felt real joy because of always having this in the back of my mind" (Estave et al., 2021).

3.4.2. Theme 2: Impact of migraine on family, social, and work relationships

The second theme focused on how migraine affects people's relationships (Cottrell et al., 2002; Ruiz De Velasco et al., 2003; Belam et al., 2005; Peters et al., 2005; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017; Scaratti et al., 2018; Estave et al., 2021). They explained how others considered them and how difficult it is to get along with social life. Participants voiced a problematic concept of not being understood by others, especially in the workplace where there could be consequences on their career up until the loss of their job. This problem sometimes emerged among friends and family. People with migraine perceived a certain sense of disbelief from others while they explained their situation as it is an "invisible condition". The theme of failing to take care of children was recurrent in the studies (Cottrell et al., 2002; Belam et al., 2005; Ramsey, 2012; Estave et al., 2021). Moreover, a few participants expressed the negative impact on sexual relations voicing a common discomfort that was not often mentioned because of shame.

3.4.2.1. Subtheme 2A: Migraine affects cognitive function (loss of concentration/memory) at work and people feel they have to change their job or they even lose it

The participants complained about the effect of migraine on their work. This conception was recurring among the studies because migraine attacks also involved cognitive functions, and participants underlined the consequences of work.

> "I've been fired from a job before because of my migraine attacks" (Estave et al., 2021).

> "When I've got a migraine, I know that I can't give 100%, and that bothers me" (Ramsey, 2012).

> "I try to look productive, but I'm only doing half" (Cottrell et al., 2002).

> "It affects my career choice" (Belam et al., 2005).

> "It's hard to concentrate"; "It affects memory" (Rutberg and Öhrling, 2012).

TABLE 3 Answers explanations of CASP.

References	1. Was there a clear statement of the aims of the research?	2. Is a qualitative methodology appropriate?	3. Was the research design appropriate to address the aims of the research?	4. Was the recruitment strategy appropriate to the aims of the research?	5. Was the data collected in a way that addressed the research issue?	6. Has the relationship between researchers and participants been adequately considered?	7. Have ethical issues been taken into consideration?	8. Was the data analysis sufficiently rigorous?	9. Is there a clear statement of findings?	10. How valuable is the research?
Estave et al. (2021), "Learning the full impact of migraine through patient voices: A qualitative study."	Yes	Yes	Can't tell (it does not explain why they use grounded theory, even if the results seem coherent with the approach)	Can't tell (participants take part in two RCTs and the recruitment strategy is explained in another paper)	Can't tell (it does not explain why they use grounded theory, even if the results seem coherent with the approach)	Yes	Yes	Yes	Yes	The authors specific in the paragraph "strengths and limitations" the contribution of their study to the existing knowledge and its limitations, such as selection bias and the difficulty of transferring the findings to other populations.
Palacios-Ceña et al. (2017), "Living with chronic migraine: a qualitative study on female patients' perspectives from a specialised headache clinic in Spain."	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	The authors discussed the strengths and limitations of the study in the paragraph "Discussion." A limitation is the low generalisability due to the women sample. The authors discuss the contributions to existing knowledge explaining that their study is the first to treat chronic migraine and compare their findings with ones in current literature.
Rutberg and Öhrling (2012), "Migraine – more than a headache: women's experiences of living with migraine."	Yes	Yes	Yes	Yes	Yes	Can't tell (because the considerations explained in the paragraph "*Justification of the study*" are not enough to understand the relationship between researchers and participants)	Yes	Yes	Yes	The authors declare the strengths and limitations of the study in the paragraph "Methodological considerations." A limitation is the sample of only women that do not allow for generalising the data to other genders. The authors compare their findings to the current literature in the paragraph "Discussion."

(Continued)

TABLE 3 (Continued)

References	1. Was there a clear statement of the aims of the research?	2. Is a qualitative methodology appropriate?	3. Was the research design appropriate to address the aims of the research?	4. Was the recruitment strategy appropriate to the aims of the research?	5. Was the data collected in a way that addressed the research issue?	6. Has the relationship between researchers and participants been adequately considered?	7. Have ethical issues been taken into consideration?	8. Was the data analysis sufficiently rigorous?	9. Is there a clear statement of findings?	10. How valuable is the research?
Ramsey (2012), "Living with migraine headache: a phenomenological study of women's experiences."	Yes	Yes	Yes	No (Because the paragraph "*Data collection*" did not explain why they contacted only the first 12 volunteers, which does not justify their relevance in responding to the research question).	Yes	Yes	Can't tell (There is no code or date of approval).	Yes	Yes	The authors discuss the generalisability of their findings and the implications of practise in the paragraph "Implications for holistic nursing practise."
Peters et al. (2005), "The patients' perceptions of migraine and chronic daily headache: a qualitative study."	Yes	Yes	Can't tell (it is explained in another paper and the authors do not explain why they use this research design to answer the research question)	Yes	Yes	Can't tell (problem on reporting)	Can't tell (Ethical approval was obtained from the University of Surrey Ethics Committee, but there is no code)	Yes	Yes	In the paragraph "Discussion" is presented the information this study adds to current literature and which are the further step to investigate. The author discuss the limitations to the generalisability of findings due to the small sample size and the nature of the qualitative analysis.
Scaratti et al. (2018), "A qualitative study on patients with chronic migraine with medication overuse headache: comparing frequent and non-frequent relapsers."	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell (the ethical committee of the Institute approved the study, but there is neither a code nor the date of approval)	Yes	Yes	In the paragraph "Discussion" the authors explained the value of their approach that was "data-driven" and underlined the limitations such as the not precise definition of FR and the low applicability due to the

(Continued)

TABLE 3 (Continued)

References	1. Was there a clear statement of the aims of the research?	2. Is a qualitative methodology appropriate?	3. Was the research design appropriate to address the aims of the research?	4. Was the recruitment strategy appropriate to the aims of the research?	5. Was the data collected in a way that addressed the research issue?	6. Has the relationship between researchers and participants been adequately considered?	7. Have ethical issues been taken into consideration?	8. Was the data analysis sufficiently rigorous?	9. Is there a clear statement of findings?	10. How valuable is the research?
										limited number of participants. The authors explain in the paragraph “Conclusion” the implications for the clinical practise such as considering some relevant psychological aspects of patients.
Cottrell et al. (2002), “Perceptions and needs of patients with migraine: a focus group study.”	Yes	Yes	Can’t tell (the authors do not explain why they use this research design to answer the research question).	Yes	Can’t tell (it is not specified why they chose the focus group).	Can’t tell (the relationship between researchers and participants is not reported and explained).	Can’t tell (there is neither a code nor a date of approval)	Yes	Yes	The authors underline the limitations of the study in the paragraph “Discussion” such as the small sample size and the characteristics of participants that are not generalisable. Authors compare their findings to the current literature and suggest implications for practise lie in need for more general information about migraines and their management.
Moloney et al. (2006), “The experiences of midlife women with migraines.”	Yes	Yes	Can’t tell (the authors don’t specify why they use the hermeneutic approach)	Yes	Can’t tell (the research issue is not adequately explained)	Can’t tell (the relationship between researchers and participants is not reported and explained).	Can’t tell (there is neither a code nor date of approval)	Yes	Yes	The authors discuss their findings compared to current literature in the paragraph “Discussion.” A paragraph is dedicate to “Implications for research, practise and education.”

(Continued)

TABLE 3 (Continued)

References	1. Was there a clear statement of the aims of the research?	2. Is a qualitative methodology appropriate?	3. Was the research design appropriate to address the aims of the research?	4. Was the recruitment strategy appropriate to the aims of the research?	5. Was the data collected in a way that addressed the research issue?	6. Has the relationship between researchers and participants been adequately considered?	7. Have ethical issues been taken into consideration?	8. Was the data analysis sufficiently rigorous?	9. Is there a clear statement of findings?	10. How valuable is the research?
Belam et al. (2005), "A qualitative study of migraine involving patient researchers."	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	The authors accepted a lack of rigor because the perspective is more influenced by action research, but underlined the different insights into the investigations that resulted in a practical approach. The authors discussed strengths and weaknesses in the paragraph "Strengths and limitations of this study."
Ruiz De Velasco et al. (2003), "Quality of life in migraine patients: a qualitative study."	Yes	Yes	Yes	Yes	Yes	Can't tell (the relationship between researchers and participants is not adequately reported and explained)	Can't tell (there is neither a code nor date of approval)	Yes	Yes	The authors explain strengths and limitations in the paragraph "Discussion" and discuss the contribution to existing knowledge: the perspective of self-medicated patients, family relatives and healthcare professionals.

TABLE 4 Final themes and subthemes.

Themes	Subthemes
1. Negative impact of migraine symptoms on overall life	- Everything is about pain - Disabling symptoms and physical impact - Migraine involves day-to-day life - Inability to carry out activities with pleasure (want to but not able to)
2. Impact of migraine on family, social and work relationships	- Migraine affects cognitive function (loss of concentration/memory) at work to the point where it may result in a need to change or lose the job - People with migraine are often not understood by their bosses or friends (it is not even considered serious) - Migraine affects the ability to take care of children - Negative impact on the relationship with partner (including sexual relation) - Migraine affects social life (leisure activities, sports, holidays)
3. Impact of migraine on emotional health	- Migraine involves psychological distress (avoidance behaviour, anticipatory anxiety, depression) - Migraine affects intrapersonal emotions (frustration, desperation, irritability, mood changes and hopelessness) - Consequences of social and family aspects on emotional health (isolated, guilty)
4. Coping strategies to deal with migraine	- Self-efficacy before and during an attack (focus on self) - Take advantage of pain-free time - Share experiences - Balance the demands of life

> "There is this fear that if I get (a migraine) I'm gonna have to dive off (work), and I won't be able to fulfil duties" (Peters et al., 2005).

In most studies, participants voiced the theme of not being understood at work and its consequences on their work experiences.

> "They thought it was a joke because nobody takes it seriously and nobody knows what migraine is", "They've never had it they just think it's a headache, and it's not just a headache" (Estave et al., 2021).

> "My workmate told my bosses that if I had a headache, I should take a pill and that it was no excuse not to go to work" (Palacios-Ceña et al., 2017).

3.4.2.2. Subtheme 2B: Migraine affects the ability to take care of children

Migraine often made childcare difficult, according to participants, who expressed it this way:

> "I feel like I can't take care of him (18-month-old)" (Estave et al., 2021).

> "It's very difficult to think that there are times when you can't take care of your child" (Ramsey, 2012).

> "Mummy just can't deal with them [games] or do any housework or do anything" (Peters et al., 2005).

> "I'm not the mom I wanted to be" (Cottrell et al., 2002).

> "My son is only 11 and he has never known me any different" (Belam et al., 2005).

3.4.2.3. Subtheme 2C: Negative impact on the relationship with partner (including sexual relation)

The consequences of migraine attacks were also reported in the relationship with the partner, as the participants explained:

> "It affects my husband because it puts more on him when I have one" (Estave et al., 2021).

> "It's changing my life even in our sexual relations because since I began to have this pain, I haven't felt any kind of sexual arousal" (Ruiz De Velasco et al., 2003).

3.4.2.4. Subtheme 2D: Migraine affects social life (leisure activities, sports, holidays)

Participants' experience of migraine also involved social life.

> "You can't lead a normal life, you can't go out dancing, to dinner, to the cinema. It changes the way you live.", "It limits the time I can spend with my friends and even the desire to do sport" (Palacios-Ceña et al., 2017).

> "Social life is affected a lot…I no longer have any relationship with them (friends)… the others, after a while, got tired of me" (Scaratti et al., 2018).

Moreover, participants reported their friends and acquaintances do not completely understand their situation. They struggle with legitimising it.

> "I think people look like—yeah, right, everybody has headaches. They're not that bad, just get a grip and keep going" (Cottrell et al., 2002).

> "The others don't understand because it is a sharp pain, and if you haven't experienced it, you can't imagine what it's like" (Ruiz De Velasco et al., 2003).

3.4.3. Theme 3: Impact of migraine on emotional health

The third theme dealt with emotional features that followed migraine and affected participants' lives even from a psychological aspect. Migraine involves psychological distress (avoidance behaviour, anticipatory anxiety, and depression). Psychological distress was common among participants, who suffered a lot and often presented themselves as overwhelmed by this condition (Ruiz De Velasco et al., 2003; Belam et al., 2005; Moloney et al., 2006; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017; Scaratti et al., 2018; Estave et al., 2021).

3.4.3.1. Subtheme 3A: Migraine involves intrapersonal emotions (frustration, desperation, irritability, mood changes, depression, anxiety, and hopelessness)

Participants expressed their emotions, such as frustration and desperation, with condition that was difficult to explain and face. Emotions such as irritability and mood changes also affected the social relation triggering a vicious circle of discomfort.

> "I'm more irritable and don't want to be around a lot of people" (Estave et al., 2021).

> "Desperation is definitely part of the day" (Moloney et al., 2006).

> "You are always in a bad mood, and besides" (Ruiz De Velasco et al., 2003).

> "I get in such a bad mood that I can't stand anyone, you're irritable, you do not anyone talk to you, no-one to tell you anything" (Palacios-Ceña et al., 2017).

Among the different feelings, depression and anxiety were the most reported ones:

> "[Attacks] cause a lot of anxiety because I don't know when I'm going to have one and I'm fearful. And when I have one, I'm fearful it's not going away" (Estave et al., 2021).

> "I feel a little depressed. [...] I can't react anymore, I'm tired of my headache" (Scaratti et al., 2018).

3.4.3.2. Subtheme 3B: Consequences of social and family aspects on emotional health (isolated, guilty)

Participants of Estave's study explained that physical and psychological symptoms led to feelings of isolation and guilty about time away from social engagement and family duties:

> "I'm sorry it affects me because it takes me away from my family, my kids", "My daughters, my husband and everybody ... they just stopped including me in everything, so I felt like I was observing them live, but I wasn't really living" (Estave et al., 2021).

Participants of the studies by Palacios-Ceña et al. (2017) and Scaratti et al. (2018) explained the feeling of isolation:

> "I am isolated from almost all of the people I know, except from my family of origin and from some friends...but I no longer have any relationship with them...the others, after a while, got tired of me" (Scaratti et al., 2018).

> "It cuts you off from being with others; it separates you from everyone else" (Palacios-Ceña et al., 2017).

3.4.4. Theme 4: Coping strategies to deal with migraine

The last theme underlined the coping strategies that participants adopt to deal with their migraine. Participants voiced concern about the implications of migraine on every aspect of life, and, in most cases, it was hard to take on. However, they shared the strategies they adopted against the disability caused by attacks to cope with migraine.

3.4.4.1. Subtheme 4A: Self-efficacy as a support to manage migraine

Participants expressed their willingness not to be overwhelmed by pain. Therefore, they lived trying to go through the attack, managing it (Palacios-Ceña et al., 2017). They explained their will to keep on doing their activities, no matter the symptoms, to meet their expectations in a social or work context (Ramsey, 2012). However, they also showed to be aware of when taking care of themselves (Ramsey, 2012). Belam et al., in their study, talked about how people adopted self-help strategies to cope with attacks and look for remedies (Belam et al., 2005). The participants in Moloney et al. study added that it was essential to focus on causes and triggers to increase prediction and control (Moloney et al., 2006).

> "You try not to let it affect you, to control everything, to deal with it, to be conscious of everything that might cause pain." "I try to tolerate the pain as much as I can" (Palacios-Ceña et al., 2017).

> " [...] you just have to go on through it" (Ramsey, 2012).

3.4.4.2. Subtheme 4B: Take advantage of pain-free time

Another strategy voiced by participants was using time devoid of pain to engage in activities like exercise and stress reduction to prevent other attacks and reduce the frequency.

> "The good things are certainly that you don't have headache, but sometimes during the inactive phase you're actually getting over another one, and so you're trying to recoup, and sometimes redo things that you have done halfway [...]. I try to take those inactive times to really enjoy life" (Ramsey, 2012).

3.4.4.3. Subtheme 4C: Share experiences

Participants voiced their need to share experiences, talk to others and explore meaning as they want to understand their condition and adjust it in the context of their lives.

> "It was very helpful to be able to talk to and listen to other people who suffer from migraine", "When you realise that other members of the family have migraine, you feel the battle is over—you understand why you get them" (Belam et al., 2005).

3.4.4.4. Subtheme 4D: Balance the demands of life

Living with migraine was a constantly evolving process that required constant attention and vigilance. This process included the ability to balance the demands of life.

> "You learn to live with it, and you do not know what life would be without it, but it is like permanently wearing a backpack, which is though, you must always consider the possibility of not being able to do things" (Rutberg and Öhrling, 2012).

Participants voiced that they lived in a constant state of readiness to avoid triggers and control the attack. They described migraine with this metaphor:

> "It's though that I am forced to live with somebody who always interrupts and decides what I should or should not do" (Rutberg and Öhrling, 2012).

3.5. Certainty of evidence

Table 5 reports the certainty of quality evidence (CerQual approach). None of the study findings was evaluated to be higher certainty because of weaknesses in relevance and minor methodology limitations of included studies. All the study findings were assessed as moderate confidence, which meant a good level of certainty because of minor concerns regarding the coherence and adequacy of data within and across all studies included.

4. Discussion

This is the first meta-synthesis that focuses exclusively on the life experiences of people with migraine (either episodic or chronic). From our synthesis, four main themes were brought to the forefront: "Negative impact of migraine symptoms on overall life"; "Impact of migraine on family, work and social relationships"; "Impact of migraine on emotional health"; and "Coping strategies to deal with migraine". Our findings are in line with the ones from the meta-synthesis of Nichols et al. on chronic headaches (Nichols et al., 2017). People with chronic headaches from different genesis share a detrimental experience akin to the participants of the studies in our review. This shared experience stemmed from a similar sense of suffering, difficulties in Organising work and household chores, blaming one's own situation and other psychological distress such as anxiety. Our themes can also overlap with the ones retrieved from two qualitative studies on adolescents with migraine (Donovan et al., 2013; Walter, 2017), which were excluded from this meta-synthesis as we focused only on adults. Nevertheless, the experience of overwhelming pain and a sense of isolation caused by migraine are present regardless the age. However, the need to share experiences and social support is more evident among adolescents than in our sample (Donovan et al., 2013; Walter, 2017).

The first theme, "Negative impact of migraine symptoms on overall life", showed that migraine symptoms are disabling and affect everyday life. This is in line with the current quantitative literature about the quality of life of people with migraine (Blumenfeld et al., 2011; Haywood et al., 2018; Buse et al., 2019). These studies suggest that people with migraine experience high levels of disability that impact their health-related quality of life. The qualitative data from this meta-synthesis delve into the quantitative ones, explaining where the disability has its greatest impact. For example, Estave et al. explained how people with migraine experienced doing things without pleasure or wanting to do something, but their disease hindered this attempt (Estave et al., 2021).

However, the most significant burden of people with migraine emerges in the work and social fields, as we explained in the second theme, "Impact of migraine on family, work and social relationship". This theme focused on how people with migraine perceived their disease to impact different spheres of life, namely, family, work and social relationships. When it comes to family and work, people with migraine reported these spheres to be hindered by migraine attacks. This is in line with a study by Buse et al., where the authors reported migraine harmed people's careers and the feeling of being "good parents" in one-third of their population (Stewart et al., 2010; Buse et al., 2019). Thus, quantitative data underlines the prevalence of negative impact on jobs, whereas qualitative data sheds some light on where these problems are. In particular, people with migraine reported the loss of cognitive function (concentration and memory) while at work due to their symptoms. This sense of discomfort is further worsened by the lack of understanding from their bosses. When it comes to intimate relationships, Buse et al. underlined the difficulty of people with migraine in establishing and maintaining a relationship, ending up breaking up with their partner because of the recurrence of attacks that affect the ability to do things together (Buse et al., 2019). Ruiz De Velasco et al. highlighted that migraine could also impact the sexual sphere because of the pain of migraine attacks and its negative consequences on sexual arousal (Ruiz De Velasco et al., 2003). Problems in sexual spheres for these people can be underrated by a general sense of embarrassment, stigma and cultural taboo. People during focus groups felt embarrassed to talk about this topic, while they felt more at ease during individual interviews. Talking about sex is a challenge in healthcare (Brandenburg and Bitzer, 2009).

TABLE 5 Certainty of evidence (CerQual).

Review finding	Studies contributing to the review finding	Assessment of methodological limitations	Assessment of relevance	Assessment of coherence	Assessment of adequacy of data	Overall CerQual assessment of confidence	Explanation of judgement
Negative impact of migraine symptoms on overall life	Ruiz De Velasco et al., 2003; Belam et al., 2005; Peters et al., 2005; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017; Estave et al., 2021	Minor methodological limitations (two studies with no limitations, one with minor limitations on research design, recruitment strategy and data collections, one study with moderate methodological limitations on recruitment strategy and the other studies have minor methodological limitations)	Substantial concerns about relevance (all the studies included only Caucasian people)	Minor concerns about coherence (data reasonably consistent within and across all studies)	Minor concerns about adequacy (seven studies that offered together moderately rich data overall)	Moderate confidence	This finding was graded as moderate confidence because of minor concerns regarding methodological limitations, coherence and adequacy; though substantial concerns about relevance.
Impact of migraine on family, work and social relationships	Cottrell et al., 2002; Ruiz De Velasco et al., 2003; Belam et al., 2005; Peters et al., 2005; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017; Scaratti et al., 2018; Estave et al., 2021	Minor methodological limitations (two studies with no limitations, one study with concerns on research design and data collection, one study with concerns with research design, recruitment strategy and data collection, one with moderate concern on recruitment strategy and the other studies have minor methodological limitations)	Substantial concerns about relevance (all the studies included only Caucasian people)	Minor concerns about coherence (data reasonably consistent within and across all studies)	Minor concerns about adequacy (nine studies that offered together moderately rich data overall)	Moderate confidence	This finding was graded as moderate confidence because of minor concerns regarding methodological limitations, coherence and adequacy; though substantial concerns about relevance.
Impact of migraine on emotional health	Ruiz De Velasco et al., 2003; Belam et al., 2005; Moloney et al., 2006; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017; Scaratti et al., 2018; Estave et al., 2021	Minor methodological limitations (two studies with no limitations, one study with concern on research design, recruitment strategy and data collection, one study with minor concern on research design and data collection, one study with moderate concern on recruitment strategy and the other studies have minor methodological limitations)	Substantial concerns about relevance (all the studies included only Caucasian people)	Minor concerns about coherence (data reasonably consistent within and across all studies)	Minor concerns about adequacy (eight studies that offered together moderately rich data overall)	Moderate confidence	This finding was graded as moderate confidence because of minor concerns regarding methodological limitations, coherence and adequacy; though substantial concerns about relevance.
Coping strategies to deal with migraine	Belam et al., 2005; Moloney et al., 2006; Ramsey, 2012; Rutberg and Öhrling, 2012; Palacios-Ceña et al., 2017	Minor methodological limitations (two studies with no limitations, one study with minor concerns, one with concerns on research design and data collection and one with moderate concerns on recruitment strategy)	Substantial concerns about relevance (all the studies included only Caucasian people)	Minor concerns about coherence (data reasonably consistent within and across all studies)	Minor concerns about adequacy (eight studies that offered together moderately rich data overall)	Moderate confidence	This finding was graded as moderate confidence because of minor concerns regarding methodological limitations, coherence and adequacy; though substantial concerns about relevance.

However, for some people, sexuality is an essential yet complex phenomenon to feel ashamed about. This aspect must be taken into account during the care process for people with migraine to offer them multidisciplinary support that tackles this disease from different perspectives.

The third theme, "Impact of migraine on emotional health," underlines the effects of migraine on emotional health. In the studies retrieved in our meta-synthesis, people with migraine reported a general sense of guilt. One participant stated, "It's my brain. It's my fault" (Estave et al., 2021). This sense of guilt was reported by other participants, and it is an overarching theme that was recently pointed out as one of the elements that contribute to the migraine burden (Estave et al., 2021). Rutberg and Moloney highlighted that participants' guilt might also stem from the lack of awareness and understanding of this disease in society (Moloney et al., 2006; Rutberg and Öhrling, 2012). As regards the issue of not being understood by others, which could lead to isolation, Estave explained that improving knowledge and awareness of migraine in the general public could reduce emotional disorders in people with migraine (Estave et al., 2021). These burdensome feelings can be one of the reasons behind the high prevalence of psychological distress among people with migraine. To previous evidence, 23.1% of people with migraine experience psychological distress (Korkmaz et al., 2019; Donisi et al., 2020). The study by Chu et al. found that the severity of depression and anxiety are related to migraine frequency and can alter the perception of pain (Chu et al., 2018). Therefore, it is fundamental to consider also the psychological sphere when taking charge of people with migraine.

The final theme dealt with the "Coping Strategies to deal with migraine" that people with migraine brought to the forefront to deal with their disease. These strategies included the importance of self-efficacy, taking advantage of pain-free time, sharing experiences and balancing the demands of life. Palacios Ceña et al. underlined that their study participants wanted to go and live through the attacks, managing them (Palacios-Ceña et al., 2017). Believing in the ability to produce specific performance attainments in their available capacity is called "self-efficacy" (Gandolfi et al., 2019; Donisi et al., 2020). High levels of self-efficacy were reported as a key factor in preventing attacks and adaptation to pain (Gandolfi et al., 2019; Donisi et al., 2020). However, as written by Ramsey et al., they can push people to deal with pain and also to meet their and others' expectations, levering external motivation (Ramsey, 2012). The participants from our studies were aware of the importance of adopting different strategies to manage their disease. Some of them were more symptoms-related, like taking medications, going to a cold dark room to eliminate all external stimuli and resting as much as needed (Ramsey, 2012). Other strategies were more part of a more systemic management of the disease, such as sharing experiences to understand their conditions, and seeking social support from healthcare professionals, other people with migraine, friends, relatives and acquaintances (Belam et al., 2005). The benefit of this need is also confirmed by quantitative studies where higher perceived social support was positively correlated with lower migraine intensity and psychological distress (Gandolfi et al., 2019; Donisi et al., 2020). Moreover, pain-free time is essential to reduce triggers and control migraine attacks. Ramsey and Moloney explained that some of their participants used their pain-free time to do exercise and stress reduction activities (Moloney et al., 2006; Ramsey, 2012). Thus, multimodal management should be considered where these and other adaptative coping strategies are offered and shared with patients to handle their symptoms once there, increase their levels of self-efficacy and take the most out of their pain-free time.

Several limitations of this study need to be addressed. This meta-synthesis has a sample made mostly of Caucasian people. The participants in our meta-synthesis came mainly from America and Europe. Moreover, most of the participants were women. However, this is in line with the worldwide prevalence of migraine, which is more common in women than men. We included both episodic and chronic migraine, which could be limiting in understanding the perception of these two types of migraine. Nevertheless, the meta-synthesis by Nichols et al. (2017) on chronic headaches underlined similar themes. Finally, our studies drew their results upon different theoretical under-pinning, ranging from interpretative phenomenological analysis to grounded theory. This is a common challenge in the synthesis of qualitative research (Rahimi et al., 2009). In line with that, we tried to adopt different strategies to be as rigorous as possible. First, we created a well and focused research question. Then, we selected the studies following specific criteria deemed as meaningful to answer our research question. Moreover, our research team was composed of different professionals (e.g., physiotherapists and psychologists) to take into account the particular aspects of the primary studies. Finally, the primary studies highlighted a shared experience of the disease by people with migraine, no matter the adopted approaches. The strengths of these studies are the rigorous and sensitive research we performed with the help of a librarian and the fact that we included only participants with migraine diagnoses (ICHD criteria). Moreover, we use the CerQual to assess the certainty of the evidence of our findings.

5. Conclusions

This study synthetised the available evidence on the experience of people with migraine. Several spheres of quality of life are jeopardised, namely, work, social life, and sexual and emotional health. People with migraine felt to be unseen and stigmatised at work and during their social life as others struggle with understanding their condition. There is a need to tackle this disease from a social and health-policy point of view by educating people with migraine and those around them about this condition, making this disease more "visible" to society.

Data availability statement

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

Author contributions

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

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Conflict of interest

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

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Tracking perceived stress, anxiety, and depression in daily life: a double-downward spiral process

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Introduction: Previous studies using retrospective questionnaires have suggested a complex relationship between perceived stress and related negative emotions and emphasized their importance in mental health. However, how daily perceived stress, anxiety, and depression interact dynamically in a natural context remains largely unexplored.

Methods: This study conducted a longitudinal survey that applied experience sampling methodology to data from 141 Chinese college students (58% women, mean age = 20.1 ± 1.63 years).

Results: The hierarchical linear models confirmed that daily perceived stress and negative emotions (i.e., perceived depression and anxiety) could reciprocally reinforce one another with the characteristic dynamics of a cognitive–emotional downward spiral. Additionally, anxiety and depression could further circularly aggravate each other imminently. These two intertwined downward-spiral processes constitute a double-downward-spiral model.

Discussion: The findings contribute to a better understanding of the interactive mechanisms underlying perceived stress and its related negative emotions in everyday life and highlight the significance of early emotion regulation and stress relief in healthy people.

KEYWORDS

perceived stress, anxiety, depression, experience sampling methodology (ESM), downward spiral model

Introduction

Negative emotions are a general dimension of subjective distress and unpleasurable activation that subsumes various aversive mood states (Watson et al., 1988). From an evolutionary psychology perspective, negative emotions have adaptive functions, such as helping people identify threats and dangers (Nesse, 1990). In contrast, from the mental health standpoint, negative emotions are more likely to cause a range of dysfunctional reactions and detrimental outcomes, such as impairment of an individual's thought–activity sequence and chronic burnout of social responsibilities, and predict various forms of psychopathology, particularly mood disorders (Fredrickson and Branigan, 2005; Lapid Pickman et al., 2021; Liu M. et al., 2021). Many studies have proposed that anxiety and perceived depression are the most damaging negative states of mind. They are prevalent in people's daily lives and lead to serious mental health problems over time without valid interventions (Ren et al., 2016; Monzonís-Carda et al., 2021; Casey et al., 2022).

However, the question remains how seemingly unavoidable negative emotions in daily life gradually deteriorate, resulting in emotional problems or obstacles for healthy individuals. Previous studies, mostly based on cross-sectional and cross-lag longitudinal methodologies, have indicated that perceived stress, anxiety, and perceived depression are potential antecedents of mood disorders (Asmundson et al., 2020; García-Mieres et al., 2020; Armon et al., 2021), and show close associations with each other (Levine et al., 2019; Huang et al., 2021). However, studies have focused only on the effect of major stress events and serious negative emotions, and these variables have rarely been proposed in short-term longitudinal cycles as a potential risk for mood disorders in daily life. In reality, it is the neglected daily trifles that shape our long-term psychological states. For example, daily chores better predict stress-related health issues than major life events (Miller et al., 2008). The accumulation of negative reactions to minor stresses will likely cause health problems and psychological disorders (Miller et al., 2008; Johnsson et al., 2015). Therefore, it is necessary to explore the dynamic internal interaction, mediation, and moderation mechanisms between daily perceived stress and related perceived negative emotions (i.e., anxiety and depression) in a natural context. This study examined a double-downward-spiral process model of daily perceived stress, anxiety, and perceived depression to determine how minor stresses and negative emotions in everyday life gradually become serious and why they lead to mental health problems.

Perceived stress is an individual's cognitive assessment of the threat posed by stressors and their ability to cope with these threats (Liu Z. et al., 2021). In the process of coping with stressful events, individuals are prone to produce a series of negative emotions such as anxiety, depression, anger, and pain (Pereira-Morales et al., 2019; Huang et al., 2021; Clayborne et al., 2022). For example, Israeli et al. (2018) triggered participants' perceived stress through an impromptu speech task and found that induced stress promoted a more severe state of anxiety in participants. In addition, a recent experience sampling study also supported that perceived stress at a certain moment in daily life could positively predict imminent anxiety (Du and Xu, 2019). Anxiety can also play a role in perceived stress. Anxiety is often closely related to negative cognitive styles such as rumination (Brosschot et al., 2006), which leads to higher levels of physical and psychological arousal in individuals, causing them to become hyper-focused on future stressors, further exacerbating their subjective experience of stress (Yang and Liu, 2016).

Perceived stress is suggested to predict depression positively. The diathesis–stress theory proposes that specific life stress is essential for triggering depression (Monroe and Simons, 1991). Consistent with this theory, studies have also shown that perceived stress has a stable positive relationship with perceived depression, even in different time windows (Xu et al., 2018; Levine et al., 2019). Individuals in stressful situations may have different evaluation and coping styles to outside stimuli; therefore, they may adopt negative cognitive styles that could worsen depression (Rodríguez-Naranjo and Caño, 2016). However, persistent perceived depression can lead to increased stress. According to the cognitive resource theory (Kahneman, 1973), processing depressed emotions might deplete or divert the resources needed to perform control functions. This diversion of resources leaves individuals with insufficient cognitive resources to cope with environmental events, leading them to perceive more stress (Padmala et al., 2011; Bui et al., 2021). A recent study supported the finding that depressed mothers raising children perceived more parenting stress than healthy mothers (Ma et al., 2019).

TABLE 1 Descriptive statistics: means, standard deviations, and ICCs.

Variables	*N*	Mean	*SD*	*ICC(1)*	*ICC(2)*
Daily perceived stress$_{(t+2)}$	4015	37.64	25.07	0.685	0.984
Depression$_{(t+2)}$	4015	15.27	21.96	0.606	0.977
Anxiety$_{(t+2)}$	4015	32.78	28.08	0.566	0.973

Moreover, it is well known that depression and anxiety are highly interdependent, meaning that individuals with high levels of depression (anxiety) tend to have severe anxiety (depression) (Chavira et al., 2004; González-Mesa et al., 2020). Despite the high co-occurrence of depression and anxiety, these disorders differ in nature. According to the tripartite model of anxiety and depression, anxiety is simply a high level of negative emotion, whereas depression combines low levels of positive emotion with high levels of negative emotion. Anxiety is associated with high physical arousal, whereas depression is not (Anderson and Hope, 2008). Thus, in addition to exploring the bidirectional cognitive–emotional facilitation relationship between perceived stress and negative emotions (anxiety and depression), we also examined whether there was mutual reinforcement between anxiety and depression as two distinct emotional states to provide an explanation for their co-occurrence (Kuppens and Verduyn, 2017).

Emotions are not self-generated but are caused by changes in the internal or external (usually social) environment (Kuppens and Verduyn, 2017). Because of constant changes in individuals' internal and external environments, temporary emotions fluctuate dynamically. Perceived stress is another dynamic variable that can easily change with time, the environment, and other factors (Henderson et al., 2016; Ekuni et al., 2022). However, most previous horizontal and vertical studies have tended to treat stress and negative emotions as relatively "stable" states. Retrospective questionnaires have been widely used to measure stress, anxiety, and depression. However, this approach might have a "memory–experience bias" and fail to sensitively capture the dynamic changes of these variables in daily life because perceived stress and emotions can be situational (Ellison et al., 2020). Therefore, previous results have mostly been based on observations over relatively long periods in different groups. How do individuals' perceived stress, depression, and anxiety change dynamically and affect each other? This question has not yet been answered well. To answer it, we needed to use a dynamic assessment method to conduct intensive tracking measurements of perceived stress, perceived depression, and anxiety in daily life.

The experience sampling method (ESM) repeatedly collects and records individuals' instantaneous assessments of daily life in a short period and has been validated by numerous studies (Francis et al., 2021; Parsons and Young, 2022). It can be used effectively to study the trajectory of individual variables over time and context and their related influencing factors. For example, Du et al. (2019) administered five surveys to 100 university students every day for a single week to collect real-time data on their mindful state and positive emotions at each time point. They found that a mindful state and positive emotions could reciprocally enhance each other in a dynamic upward spiral. Compared with

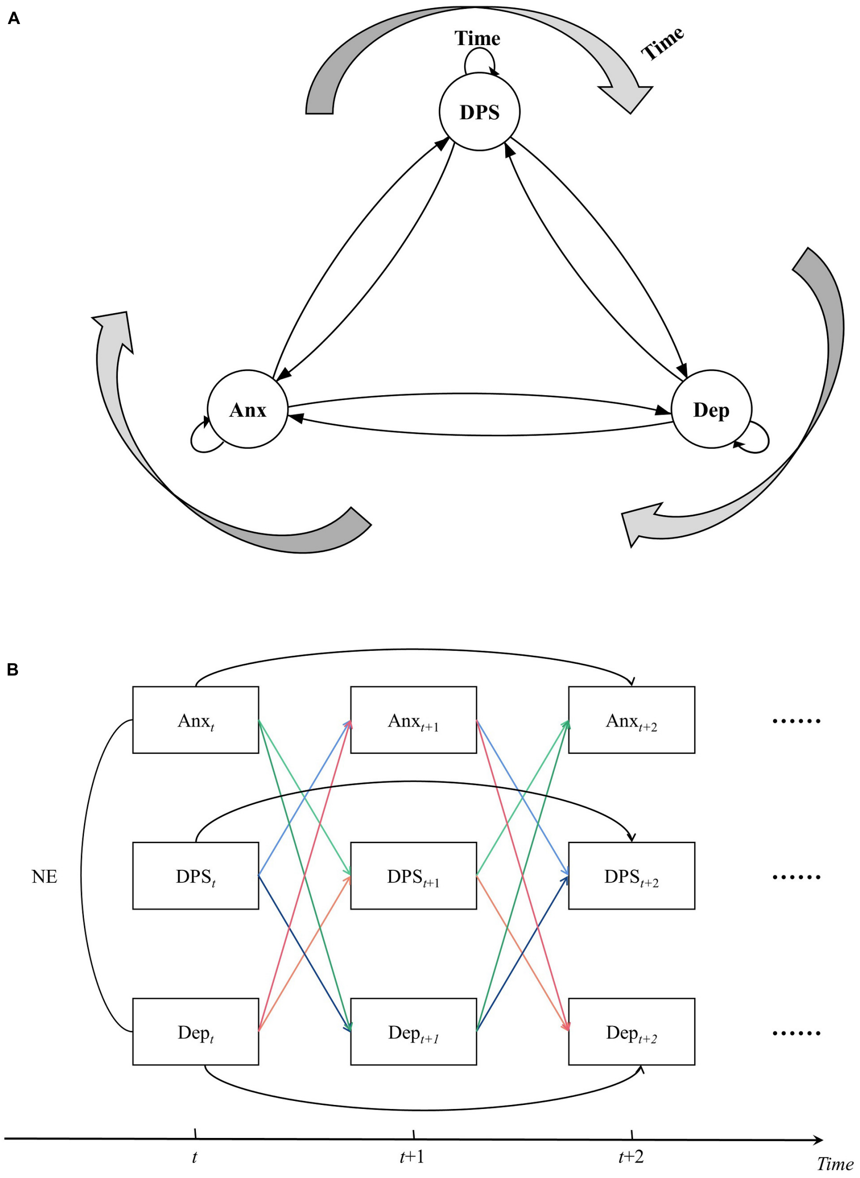

FIGURE 1
(A) A downward-spiral model, presenting a trajectory of change of daily perceived stress, anxiety and depression. DPS, daily perceived stress; Anx, anxiety; Dep, depression. **(B)** The paths of the downward spiral model. DPSt, daily perceived stress at *t*; Anxt, anxiety at *t*; Dept, depression at *t*; NE, negative emotion.

TABLE 2 Step 1 and Step 3 in mediating analysis of Anxiety$_t$, DPS$_{t+1}$, and Anxiety$_{t+2}$ are outside the parentheses; mediating analysis of Depression$_t$, DPS$_{t+1}$, and Depression$_{t+2}$ are inside the parentheses.

Negative emotion (dependent variable)	Step 1. Independent variable			Step 3. Independent variableand mediating variable					
	Anxiety$_t$ (Depression$_t$)			Anxiety$_t$ (Depression$_t$)			DPS $_{t+1}$		
	B	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
Anxiety$_{t+2}$ (Depression$_{t+2}$)	0.146 (0.121)	0.037 (0.034)	< 0.001 (<0.001)	0.086 (0.109)	0.028 (0.035)	< 0.01 (<0.01)	0.260 (0.072)	0.036 (0.028)	< 0.001 (<0.05)

retrospective questionnaires, ESM allows us to acquire "immediate" information that reflects participants' current state and reduces the bias between memory and experience (Ellison et al., 2020). This study used ESM to track individuals' real-time perceived stress, depression, and anxiety in daily life to explore their mutually reinforcing developmental trajectories because ESM is a realistic and accurate way to draw conclusions generalizable to everyday life.

The above discussion implies that perceived stress, depression, and anxiety can exist in a mutually promoting process, leading to a gradual deterioration in mental health. We refer to this process as a "downward-spiral process of negative emotion." The downward spiral of stress sensitization theory provides initial evidence to support this process. It has been proposed that daily stressors might not evoke a significant mood episode but instead progressively and covertly lower affective thresholds, leading people to become more sensitive to stress and prone to negative emotions and full-blown episodes of perceived stress and depressive symptoms (Post, 2007). In addition, a previous cross-lag study investigated the downward-spiral model between perceived stress and depressive symptoms. Levine et al. (2019) tested 658 first-year students using stress, depressive, and perfectionism questionnaires four times every 2–3 months. The results showed that freshmen experienced increased stress and depressive symptoms that contributed to each other longitudinally in a circular and additive manner; this was moderated by self-critical perfectionism (Levine et al., 2019). However, few studies have used a more sensitive and realistic method, such as ESM, to explore the interaction effect model of perceived stress, anxiety, and depression in healthy people's daily lives. Therefore, we constructed and examined a double-downward-spiral model with two parts: (1) a cognitive–emotional downward-spiral process of perceived stress and negative emotions (anxiety and depression) and (2) an emotional–emotional downward-spiral process of anxiety and perceived depression.

This study aimed to provide evidence of the dynamic reciprocal or mediating link between perceived stress, anxiety, and depression in normal daily life. We conducted ESM study to provide new insights into the dynamically perceived stress, anxiety, and depression experienced by individuals over time in diverse everyday contexts. Our hypotheses were as follows:

> H1: Perceived stress at time $t + 1$ mediates the positive prediction of negative emotions (i.e., anxiety and depression) at time t on negative emotions (i.e., anxiety and depression) at time $t + 2$, and, in turn, negative emotions (i.e., anxiety and depression) at time $t + 1$ mediate between perceived stress at time t and time $t + 2$. This is an examination of the cognitive–emotional downward-spiral model.

> H2: Anxiety at time t predicts higher anxiety at time $t + 2$ through more perceived depression at time $t + 1$ and vice versa, and perceived depression at time t predicts perceived depression at time $t + 2$ through more anxiety at time $t + 1$. This is an examination of the emotion–emotion downward-spiral model.

Figures 1A, B illustrate the theoretical double-downward-spiral model.

TABLE 3 Step 2 in mediating analysis of Anxiety$_t$, DPS$_{t+1}$, and Anxiety$_{t+2}$ and mediating analysis of Depression$_t$, DPS$_{t+1}$, and Depression$_{t+2}$.

Step 2. Independent variable	DPS$_{t+1}$ (Mediating variable)		
	B	*SE*	*p*
Anxiety$_t$	0.229	0.026	<0.001
Depression$_t$	0.168	0.033	<0.001

Materials and methods

Participants and procedures

We recruited all the study participants through social media (WeChat and QQ, two popular communication platforms in China) and posters at a Chinese university. The initial sample consisted of 172 participants, but we excluded 31 participants with completion rates below 75%. The final sample comprised 141 students (58% women and 42% men) with a mean age of 20.1 years ($SD = 1.63$) (except for five participants for whom demographic information was unavailable).

First, we invited all the participants to join a group on the social networking platform WeChat, informing them of the research details and securing written informed consent. Over the next 12 consecutive days (19–30 October 2020), they had to complete a brief questionnaire three times daily (at 9:30, 15:30, and 22:30), assessing their perceived stress, subjective depression, and anxiety levels. Thus, each participant completed 36 questionnaires. According to Bolger et al.'s (2012) power simulations curve, power is improved more by increasing sample size than time points, and a power of 80% can be achieved with under 120 samples while keeping the time points to nine. Our study's sample size was 141, and the number of time points was 36. Therefore, our study's power was suitable.

The participants accessed the questionnaire each time by responding to a web link we sent to their cell phones via WeChat. We asked all the participants to allow new message notifications from WeChat and to complete the questionnaire within one hour of receiving the link. We offered each participant RMB2–3 (about US$ 0.30–0.45) per completed questionnaire. The university's ethics committee approved this study, and all participants declared they had no history of mental disorders.

Measures

Daily perceived stress (DPS)

Following previous experience sampling studies (Xu et al., 2018), we used three items to measure perceived stress, all derived from the Perceived Stress Scale (Cohen et al., 1983): (1) feeling unable to control important things in one's life; (2) feeling nervous and stressed; and (3) constantly thinking that things must be done by oneself. The rating score ranged from 0 (not at all) to 100 (extremely). The higher the mean score for these three items, the greater the perceived stress. The Cronbach's alpha for the study sample was 0.83.

Perceived depression and anxiety

Many previous studies have used dynamic assessment methods to test emotions, primarily through single self-scripted items whose effectiveness has been verified (Xu et al., 2018; Pawluk et al., 2021). We used a single self-administered questionnaire to measure negative emotions (i.e., perceived anxiety and depression). Referring to a previous study (Xu et al., 2018), we used the specifically compiled item "Are you anxious at this moment" to measure perceived anxiety and the item "Are you depressed at the moment" to measure perceived

TABLE 4 Step 1 and Step 3 in mediating analysis of DPS$_t$, Anxiety$_{t+1}$, and DPS$_{t+2}$ and mediating analysis of DPS$_t$, Depression$_{t+1}$, and DPS$_{t+2}$.

Dependent variable	Step 1. Independent variable			Step 3. Independent variable and mediating variable											
	DPS$_t$			DPS$_t$→Anxiety$_{t+1}$→DPS$_{t+2}$						DPS$_t$→Depression$_{t+1}$→DPS$_{t+2}$					
				DPS$_t$			Anxiety$_{t+1}$			DPS$_t$			Depression$_{t+1}$		
	B	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
DPS$_{t+2}$	0.255	0.030	< 0.001	0.203	0.024	<0.001	0.174	0.022	<0.001	0.240	0.028	<0.001	0.135	0.027	<0.001

depression. The rating score ranged from 0 (not at all) to 100 (extremely), with higher scores indicating more severe anxiety or depression. We also used the hierarchical linear model (HLM 7.0) to analyze the reliability estimates for anxiety and perceived depression. The reliability estimates for anxiety and perceived depression were 0.970 and 0.975, respectively.

Analysis using hierarchical linear models

Because we needed to examine both the relationships within individuals and between individuals, we used HLM7.0 to construct a 1-1-1 mediated hierarchical linear model since all variables in the model were measured at Level 1 (within individuals). Following Du and Xu (2019), we tested the mediation process via CWC(M) (centered within the context of the reintroduction of the subtracted means at Level 2) (Zhang et al., 2009) following these analysis steps:

Step 1. We established an equation between the independent variable (negative emotions at *t*) and the dependent variable (negative emotions at *t* + 2) in Level 1. We calculated the average stress measured by each participant over 12 days and added that to Level 2 to create Model 1:

MODEL 1

Level 1:

$$Neg_{(t+2)i} = \pi_{0i} + \pi_{1i} * \left(Neg_{ti}\right) + e_{ti}$$

Level 2:

$$\pi_{0i} = b_{00} + b_{01} * \left(M_{i}\_Neg\right) + u_{0i}$$

$$\pi_{1i} = b_{10}$$

where *t* represents the moment, and *i* represents the individual. Neg$_{(t+2)i}$ represents the negative emotions of the *i*th participant at *t* + 2 and Neg$_{(t)i}$ represents the perceived stress of the *i*th participant at *t*. M$_i$_Neg is the average of all negative emotions measured by the *i*th participant, which represents the total negative emotions of the participant. The intercept π_{0i} represents the mean value of negative emotions measured by the *i*th participant. e_{ti} denotes the residual. b_{10} represents the predictive degree of negative emotions at *t* to negative emotions at *t* + 2 and b_{01} represents the predictive effect of overall negative emotions on negative emotions at *t* + 2.

Step 2. We established the relationship between the independent variable (negative emotions at *t*) and mediating variable (daily perceived stress at *t* + 1) at Level 1. Then, the negative emotions of each individual are averaged and put into Level 2 in the equation, as follows:

MODEL 2

Level 1:

$$DPS_{(t+1)i} = \pi_{0i} + \pi_{1i} * \left(Neg_{ti}\right) + e_{ti}$$

Level 2:

$$\pi_{0i} = b_{00} + b_{01} * \left(M_{i}\_Neg\right) + u_{0i}$$

$$\pi_{1i} = b_{10}$$

Similar to the first equation, DPS$_{(t+1)i}$ represents the *i*th participants' daily perceived stress at *t* + 1. In this model, b_{10} represents the prediction degree of negative emotions at one moment to daily perceived stress at the next moment, and b_{01} represents the predictive effect of overall negative emotions on daily perceived stress at *t* + 1.

Step 3. We tested the relationship between the independent variable (negative emotions at *t*), mediating variable (daily perceived stress at *t* + 1), and dependent variable (negative emotions at *t* + 2) at Level 1. The means of the independent variable (negative emotions at *t*) and mediating variable (daily perceived stress at *t* + 1) for each participant were calculated and placed in Level 2, as seen in Model 3.

MODEL 3

Level 1:

$$Neg_{(t+2)i} = \pi_{0i} + \pi_{1i} * \left(DPS_{(t+1)i}\right) + \pi_{2i} * \left(Neg_{ti}\right) + e_{ti}$$

Level 2:

$$\pi_{0i} = b_{00} + b_{01} * \left(M_{i}\_DPS\right) + b_{02} * \left(M_{i}\_Neg\right) + u_{0i}I$$

$$\pi_{1i} = b_{10}$$

$$\pi_{2i} = b_{20}$$

Many of the symbols in this equation are similar to those above. Mi_DPS, which has not appeared before, represents all participants' overall daily perceived stress. In this equation, b_{10} and b_{20} represent the predictive effect of negative emotions at t and daily perceived stress at *t* + 1 on negative emotions at *t* + 2, respectively, and b_{01} and b_{02} represent the extent to which overall negative emotions and daily perceived stress could predict negative emotions at *t* + 2.

Using the same procedure described above, we analyzed the mediation model among daily perceived stress at *t* (the independent variable), negative emotions at *t* + 1 (the mediating variables), and daily perceived stress at *t* + 2 (the dependent variable). As above, we analyzed the mediation effect among anxiety at *t* (the independent variable), perceived depression at *t* + 1 (the mediating variable), and anxiety at *t* + 2 (the dependent variable). Then, we examined the mediating role of anxiety at *t* + 1 in the dynamic association between perceived depression at t and perceived depression at *t* + 2.

Results

We excluded 31 participants with completion rates below 75%, leaving us with 4,015 valid responses from 141 participants (>75% completion) for analysis. The excluded participants' stress and anxiety assessments did not differ significantly from those of the included participants ($t_{stress} = -0.640$, $p = 0.523$; $t_{anxiety} = -0.292$, $p = 0.771$); however, their perceived depression levels were significantly higher than those of the included participants ($t_{depression} = 2.411$, $p = 0.017$).

Each included participant responded 28.48 times on average. We deleted missing data at Level 1 when making an MDM file in HLM 7.0. We used the Level 1 data to examine the temporal association among the variables. Table 1 shows the primary variables, including means, standard deviations, and intraclass correlation coefficients (ICCs). ICC (1) is the ratio of between-group variance to the total variance, and ICC (2) is the group mean reliability (Castro, 2002). The null models showed that the ICC (1) values of daily perceived stress, depression, and anxiety were 0.685, 0.606, and 0.566, respectively, indicating that 68.5, 60.6, and 56.6% of the variances were due to inter-individual factors, and 31.5, 39.4, and 43.4% were due to intra-individual factors. The ICC (2) values were all greater than 0.70, indicating that the multilayer linear model was appropriate for this study (LeBreton and Senter, 2008).

Cognitive–emotional downward-spiral model

This study explored the interconnections between perceived stress, anxiety, and depression in healthy individuals' everyday lives. Therefore, we first examined the relationships within and between individuals with perceived stress and negative emotions (perceived anxiety and depression).

In the mediating model of negative emotions at *t*, daily perceived stress at $t + 1$, and negative emotions at $t + 2$ (results shown in Tables 2, 3), we found that a higher level of participants' negative emotions at *t* predicted more negative emotions at $t + 2$ ($b_{10(Anxiety(t) \to Anxiety(t + 2))} = 0.146$, $SE = 0.037$, $p < 0.001$; $b_{10(Depression(t) \to Depression(t + 2))} = 0.121$, $SE = 0.034$, $p < 0.001$). Similarly, Level 1 results showed that negative emotions at *t* were significantly positively correlated with daily perceived stress at $t + 1$ ($b_{10(Anxiety(t) \to DPS(t + 1))} = 0.229$, $SE = 0.026$, $p < 0.001$; $b_{10(Depression(t) \to DPS(t + 1))} = 0.168$, $SE = 0.033$, $p < 0.001$). Moreover, this mediating model revealed that daily perceived stress at $t + 1$ played a remarkable mediating role in the association between negative emotions at t and $t + 2$ ($b_{10(DPS(t + 1) \to Anxiety(t + 2))} = 0.260$, $SE = 0.036$, $p < 0.001$; $b_{10(DPS(t + 1) \to Depression(t + 2))} = 0.072$, $SE = 0.028$, $p < 0.05$).

TABLE 5 Step 2 in mediating analysis of DPS_t, $Anxiety_{t+1}$, and DPS_{t+2} and mediating analysis of DPS_t, $Depression_{t+1}$, and DPS_{t+2}.

Step 2. Independent variable	Mediating variable					
	$Anxiety_{t+1}$			$Depression_{t+1}$		
	B	*SE*	*p*	*B*	*SE*	*p*
DPS_t	0.298	0.043	<0.001	0.108	0.028	<0.001

We also examined the mediating model of daily perceived stress at *t*, negative emotions at $t + 1$, and perceived stress at $t + 2$ (results shown in Tables 4, 5). The model indicated that participants' daily perceived stress at *t* could predict higher perceived stress at $t + 2$ ($b_{10(\mathrm{DPS(t)} \to \mathrm{DPS(t + 2)})} = 0.255$, $SE = 0.030$, $p < 0.001$). Our results furtherly demonstrated that daily perceived stress at *t* was positively associated with negative emotions at $t + 1$ ($b_{10(\mathrm{DPS(t)} \to \mathrm{Anxiety(t + 1)})} = 0.298$, $SE = 0.043$, $p < 0.001$; $b_{10(\mathrm{DPS(t)} \to \mathrm{Depression(t + 1)})} = 0.108$, $SE = 0.028$, $p < 0.001$). We also found negative emotions at $t + 1$ were remarkably positively related to daily perceived stress at $t + 2$ after controlling for daily perceived stress at *t* ($b_{10(\mathrm{Anxiety(t + 1)} \to \mathrm{DPS(t + 2)})} = 0.255$, $SE = 0.030$, $p < 0.001$; $b_{10(\mathrm{Depression(t + 1)} \to \mathrm{DPS(t + 2)})} = 0.255$, $SE = 0.030$, $p < 0.001$). Notably, the dynamic relationship between daily perceived stress at *t* and $t + 2$ was also significantly mediated by perceived depression and anxiety at $t + 1$.

Emotional–emotional downward-spiral model

We also explored the dynamic relationship and influence of the trajectory between perceived anxiety and depression. The results showed that perceived depression at $t + 1$ was an effective mediator for the dynamic relationship between anxiety at *t* and anxiety at $t + 2$ ($b_{10(\mathrm{Anxiety(t)} \to \mathrm{Depression(t + 1)})} = 0.102$, $SE = 0.021$; $b_{10(\mathrm{Depression(t + 1)} \to \mathrm{Anxiety(t + 2)})} = 0.118$, $SE = 0.031$; $ps < 0.001$). However, the results also showed that anxiety at $t + 1$ played a remarkable mediating role in the dynamic relationship between perceived depression at *t* and perceived depression at t + 2 ($b_{10(\mathrm{Depression(t)} \to \mathrm{Anxiety(t + 1)})} = 0.155$, $SE = 0.037$; $b_{10(\mathrm{Anxiety(t + 1)} \to \mathrm{Depression(t + 2)})} = 0.080$, $SE = 0.012$; $ps < 0.001$). Tables 6, 7 present the results.

Discussion

This research aimed to determine how natural stresses and negative emotions (i.e., anxiety and perceived depression) dynamically interact in everyday life and why they can gradually become severe and lead to mental health problems. Therefore, we examined a double-downward-spiral process model of daily perceived stress, anxiety, and depression using an ESM approach. Consistent with our initial hypothesis, the results showed that perceived anxiety or depression at *t* predicted a higher level of perceived stress at $t + 1$, whereas perceived stress at $t + 1$ predicted more severe perceived anxiety or depression at $t + 2$. These results suggest that each time participants perceived more anxiety and depression, they perceived higher stress at the next moment and then experienced still more perceived anxiety and depression. In other words, the hysteretic positive prediction of the same negative emotion was dynamically mediated by perceived stress. Additionally, perceived stress at *t* predicted a higher level of perceived stress at $t + 2$ via an increase in perceived anxiety or depression at $t + 1$. These findings suggest that daily perceived stress and negative emotions (i.e., anxiety and perceived depression) could mutually and reciprocally reinforce one another with the characteristic dynamics of a cognitive–emotional downward spiral

TABLE 6 Step 1 and Step 3 in mediating analysis of Depression$_t$, Anxiety$_{t+1}$, and Depression$_{t+2}$ are outside the parentheses; mediating analysis of Anxiety$_t$, Depression$_{t+1}$, and Anxiety$_{t+2}$ are inside the parentheses.

Dependent Variable	Step 1. Independent variable			Step 3. Independent variable and mediating variable					
	Depression$_t$ (Anxiety$_t$)			Depression$_t$ (Anxiety$_t$)			Anxiety$_{t+1}$ (Depression$_{t+1}$)		
	B	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
Depression$_{t+2}$ (Anxiety$_{t+2}$)	0.121(0.146)	0.034(0.037)	<0.001(<0.001)	0.109(0.134)	0.015(0.034)	<0.01(<0.001)	0.080(0.118)	0.012(0.031)	<0.001(<0.001)

(Hypothesis 1) in healthy individuals' daily lives. People perceive stress and negative emotions every day; these emotions reinforce each other and become increasingly negative if they do not regulate or handle them properly.

The results also supported the emotional–emotional downward-spiral model of Hypothesis 2 between perceived anxiety and depression. That is, perceived anxiety at this moment would lead to more severe depression in the next moment, and then more severe depression would cause more anxiety in a lagging moment; subsequently, the expanded anxiety would further promote later perceived depression. These two intertwined downward-spiral processes constitute a double-downward-spiral model. Our results corroborated and extended the findings of many previous studies on the association between perceived stress, anxiety, and depression.

In the cognitive–emotional downward-spiral process, perceived stress and negative emotions appeared to be reciprocally strengthened. This finding aligned with the cognitive model of depression. Beck (2008) comprehensively reviewed the psychological and biological correlates of depression and deemed that stress can trigger depression and is probably mediated by cognitive distortions. From the perspective of cognitive resource allocation, daily perceived stress might encourage individuals to be highly alert and induce negative emotions (Bulley et al., 2017). Negative emotions might also largely occupy attentional resources and prevent individuals from focusing on information more conducive to solving problems, resulting in more passive and fixed thinking (Meinhardt and Pekrun, 2003). Negative emotions associated with threats might induce rumination (Curci et al., 2013), which can impair the analytical thinking and executive control needed to cope with stressful life events and lead to inefficient processing and increased self-criticism as individuals further perceive the stress of unresolved life events (Bernstein et al., 2017; Zuroff et al., 2021). This cognitive–emotional downward-spiral process is essential in understanding cognitive–emotional interactions in theory (Simpson et al., 2001). Symptomatology does not occur in isolation; examining how stress and negative emotions influence each other helps us understand the effect of these variables on mental health and how poor mental health outcomes could be sustained over time. In practice, these results imply that an effective way to prevent mental problems would be to interrupt the downward spiral of perceived stress and negative emotions (anxiety and depression) in daily life.

TABLE 7 Step 2 in mediating analysis of Depression$_t$, Anxiety$_{t+1}$, and Depression$_{t+2}$ are outside the parentheses; mediating analysis of Anxiety$_t$, Depression$_{t+1}$ and Anxiety$_{t+2}$ are inside the parentheses.

Step 2. Independent variable	Mediating variable		
	Anxiety$_{t+1}$ (Depression$_{t+1}$)		
	B	*SE*	*p*
Depression$_t$ (Anxiety$_t$)	0.155 (0.102)	0.037 (0.021)	<0.001 (<0.001)

Our results also demonstrated an emotional–emotional downward spiral of perceived anxiety and depression in everyday contexts. More anxiety might expose individuals to more depression later; in turn, individuals who experience more depression might be more anxious at the next moment. Empirical research supports our results. For instance, studies have found that anxious individuals tend to experience persistent negative rumination (Modini et al., 2018), which leads to fatigue (Querstret and Cropley, 2012). Fatigued individuals exhibit more depressive symptoms than those who are not fatigued (Corfield et al., 2016). Studies have also suggested that individuals with depression have lower self-efficacy and are more likely to perceive anxiety when facing external events (Dai and Feng, 2008; Sharma and Kumra, 2022). This finding provides further insight into understanding and extending the self-predictive emotion system enabling individuals to respond directly to their emotions rather than uncontrolled ongoing events (Kuppens and Verduyn, 2015).

Prior studies on the relationship between stress, anxiety, and depression have mostly focused on participants who met those clinical diagnostic criteria (Price et al., 2019; Tolin et al., 2021; Truchot et al., 2021). However, daily prevention is more practical and effective than treatment alone. Addressing the dynamic processes of emotions and their regulation in healthy people has great value (Kuppens and Verduyn, 2015). The current study found that the interconnection of perceived stress, anxiety, and depression among typical college students followed a dynamic downward spiral that increased their perceived stress, anxiety, and depression over time. College students daily stressors include academic performance, interpersonal relationships, life adjustment, and employment (Li and Mei, 2002). Without effective regulation of the stress triggered by these daily pressures, long-term maintenance and accumulation of perceived stress and induced negative emotions can synergistically lead to serious mood disorders (Kong et al., 2021). Therefore, action is necessary to interrupt the downward spiral and mitigate the deterioration of negative cognitions and emotions to prevent mood disorders. In clinical practice, interventions for established mood disorders require more therapeutic resources and time than interventions for negative cognition and emotions in daily life. Therefore, daily interventions are of practical importance for maintaining emotional health as a low-cost, high-yield way to prevent psychological problems (Beames et al., 2021).

Although this study produced some innovative results, it had some limitations. First, emotions include three dimensions: physiological arousal, subjective experience, and behavioral responses (Kuppens and Verduyn, 2017). However, we only examined the subjective experience of emotions and not physiological arousal or behavior. Future studies should use all three dimensions to comprehensively and dynamically assess daily stress and negative emotions. Second, our results were based on a sample of college students in China; thus, they should be applied cautiously to other populations. Third, we did not consider specific natural factors that might confuse the double-downward-spiral processes. Future studies should consider more contextual mediating or moderating factors, such as positive emotions, which might have a potential buffering effect on this downward-spiral process. Also, the dropout participants showed higher perceived depression than the participants who completed more than 75% of the tests, implying that the depressive mood affected their daily life behavior and highlighting the need for more research considering the dynamic negative emotions of daily life.

In conclusion, this study provides further insight into the dynamic interaction between perceived stress, anxiety, and depression in an everyday context through an ESM investigation. We found that daily perceived stress and negative emotions (i.e., perceived anxiety and depression) could reinforce one another over time in a cognitive–emotional downward spiral; also, perceived anxiety and depression could also affect each other over time by activating an emotional–emotional downward spiral. These results imply a double-downward-spiral process model to better understand the reciprocal relationship of daily perceived stress, anxiety, and perceived depression in a natural context. Our findings highlight the value of timely regulation and intervention of subtle stress and negative emotions in daily life and extend the results of previous work on the associations between stress and negative emotions.

Data availability statement

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

Ethics statement

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

Author contributions

GF involved in the conceptualization of the study, writing, revising, and editing the manuscript, and the supervision of the project. XX involved in collecting the data, writing the manuscript, and data analyses. JL involved in collecting the data and reviewing the manuscript. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

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

Publisher's note

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Stress phenotypes in epilepsy: impact on cognitive functioning and quality of life

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Introduction: Drug-resistant epilepsy has been proposed as a chronic stress model. Stress can be measured in terms of chronicity (epilepsy duration) and intensity (comorbidities), with depression and anxiety among the most important comorbidities in epilepsy due to its prevalence and its relationship with cognitive functioning and quality of life. This study aims to establish phenotypes according to how patients face a stressful condition (epilepsy) and examine differences in cognition and quality of life depending on these phenotypes. We hypothesize that there will be an interrelationship between epilepsy duration and negative affectivity, and these variables will influence cognition and quality of life.

Methods: 170 patients (82 men and 88 women) underwent a neuropsychological evaluation in which trait anxiety, depression, attention and executive function, verbal and visual memory, language, emotional recognition, and quality of life were assessed. Hierarchical clustering was performed using z-scores for three variables: trait anxiety; depression; and epilepsy duration.

Results: Three clusters were found: vulnerable (high negative affectivity and short duration); resilient (moderate negative affectivity and long duration); and low-impact group (low negative affectivity and short duration). Results show that the vulnerable group had poorer cognitive functioning and quality of life than the other groups. Specifically, the vulnerable group had poorer scores than the low-impact group on verbal memory, visual confrontation naming, and quality of life (except seizure worry). Furthermore, resilient patients had better scores than the low-impact group on cognitive flexibility variables, but lower scores on some quality-of-life subscales (i.e., overall quality of life, emotional well-being, and energy). Finally, the vulnerable group had poorer scores than the resilient group in executive functioning, naming, and quality of life.

Discussion: These results suggest that dealing with stress in patients with epilepsy is related to cognitive performance and quality of life. These findings underline the relevance of considering comorbidities in epilepsy and may be useful for detecting vulnerable or resilient profiles as risk or protective factors for cognitive and quality of life decline.

KEYWORDS

epilepsy, stress, resilience, memory, executive function, naming, cognition, quality of life

1. Introduction

Epilepsy is a disease that affects almost 1% of the general population and is characterized by the recurrence of seizures and its global impact on the individual (Fiest et al., 2017). Seizures have been considered an acute stressor, within the framework of epilepsy as a potentially chronic stress state (Cano-López and Gonzalez-Bono, 2019). Stress has been defined as "a process in which an individual perceives that demands exceed the organism's regulatory capacity to adapt to a psychological or physiological challenge or stressor" (Cano-López and Gonzalez-Bono, 2019). The impact of the stress process on the individual can be measured in terms of chronicity or intensity.

Regarding chronicity, seizures are stressful events that lead to the hypersecretion of cortisol in patients with epilepsy (Cano-López and Gonzalez-Bono, 2019; Brandner et al., 2022). Therefore, prolonged exposure to seizures can lead to a situation of chronic stress. In this regard, the number of years suffering from the disease (i.e., epilepsy duration) is a measure that reflects the chronicity of the stressor (i.e., epilepsy) and it may have implications on different areas of the individual. Longer periods of epilepsy duration have been related to poorer verbal memory functioning in patients with temporal lobe epilepsy (TLE) (Kent et al., 2006), which is the main cognitive concern in this population (Helmstaedter and Kockelmann, 2006; Thompson et al., 2016). Similarly, several studies have found that longer epilepsy duration is related to poorer executive function (Kim et al., 2007; Black et al., 2010; Zamarian et al., 2011). Bonilha et al. (2006) suggested that longer epilepsy duration may imply greater gray matter loss, and this may lead to further cognitive impairment. Nevertheless, the relationship between epilepsy duration and health-related quality of life (QOL) has been found to be inconsistent (Taylor et al., 2011) although several studies have found that longer epilepsy duration is related to poorer QOL (Piperidou et al., 2008; Edefonti et al., 2011; Pauli et al., 2012).

Stress intensity is a more complex factor since it may include seizure frequency and the comorbidities of epilepsy—the presence of which is being increasingly recognized by the International League Against Epilepsy (ILAE) (Scheffer et al., 2017). The difficulty of reliable recording of the seizure frequency should be emphasized, since this information is usually collected by patients and relatives, but patients are not always aware of when they have seizures, or sometimes even forget to write them down (Blachut et al., 2017). For this reason, although this variable offers an approximate value, it cannot be considered a precise variable, especially when the number of seizures is very high. Negative affectivity is considered one of the most frequent comorbidities in patients with epilepsy (Fiest et al., 2013; Kwon and Park, 2014; Park, 2016; Pham et al., 2017) and provides a measure of the interpretation that the individual makes of the stressful event. It has been conceptualized as an exacerbated emotional response to unpredictable seizures (including depression and anxiety), as well as to activity restriction, which in turn leads to low self-esteem, stigma, and social rejection (Kotwas et al., 2017). It has been suggested that negative affectivity would be a more integrative concept than seizure frequency, overlapping with the seizure frequency in some aspects and providing further information even on stressful life events (i.e., factors related and not related to epilepsy) (Kotwas et al., 2017). Specifically, negative affectivity is directly related to clinical variables such as seizure frequency or adverse effects derived from anti-seizure medications (ASMs) (Thapar et al., 2009; Kanner et al., 2012; Dehn et al., 2017), as well as with other stress variables such as social stigma (Thapar et al., 2009), so it may have an even more important contribution to impaired QOL in this population (Kotwas et al., 2017). Thus, it has been found that stigma is strongly correlated to more depressive symptoms and poorer QOL in people with epilepsy (Tombini et al., 2019). Furthermore, negative affectivity is also linked to other psychosocial processes, being alexithymia (i.e., a subclinical phenomenon involving a lack of emotional awareness) an important concept due to its high prevalence epilepsy (Tojek et al., 2000; Bewley et al., 2005; Myers et al., 2013). Specifically, people with epilepsy with higher levels of anxiety or depression are more likely to experience alexithymia (Tombini et al., 2020a; Choi et al., 2021). In this regard, Tombini et al. (2020a) suggested that alexithymia could be considered a symptom of depression, or even alexithymia could be considered a risk factor for depression, given the scarcity of coping strategies for dealing with hard-to-identify emotions in these patients. Finally, negative affectivity has also been related to poor cognitive functioning and QOL in patients with epilepsy (Tracy et al., 2007; Kanner et al., 2010; Cano-López et al., 2018; Cano-López, 2019) suggesting that this variable holistically affects individuals with epilepsy. Therefore, it is not surprising that patients with epilepsy show lower life satisfaction than people without epilepsy, which could be explained, at least in part, by negative affectivity (Kang, 2023).

Negative affectivity can be considered a factor involved in stress intensity and as a key variable related to coping with the disease. Risk or protection profiles for coping with the disease have been developed considering emotional and other epilepsy-related variables. An example of this is the model proposed by Ring et al. (2016) using qualitative research methods which differentiate vulnerable and resilient individuals and explain how different socioemotional and clinical factors influence QOL in patients with epilepsy. Furthermore, Tedrus et al. (2020) suggest that resilience, which can be considered as the ability to cope with a stressful situation satisfactorily (Zapater-Fajarí et al., 2021), is a protective factor for mood disorders in patients with epilepsy. To date, however, this approach has considered the chronicity of the alterations as an extraneous variable to be controlled and not as a measure of the chronicity of the stressor.

Studies focused on the relationship between epilepsy duration and negative affectivity offer heterogeneous results. A recent meta-analysis carried out by Yang et al. (2020) showed that patients with a shorter epilepsy duration had a lower risk of depression. The meta-analysis by Scott et al. (2020) also found that shorter epilepsy duration was associated with a lower prevalence of depressive and anxiety disorders in young people with epilepsy. Brandt (2016), however, found that younger patients with a shorter epilepsy duration were more likely to have anxiety disorders, underlying that an adaptation period is required to develop coping strategies for the stressful situation. These results suggest that there is an interrelationship between epilepsy duration and negative affectivity, and these variables may influence cognition and QOL. However, as far as we know, no studies have summarized stress chronicity and intensity variables in different profiles, nor explored their association with cognition and QOL in the same sample of patients with epilepsy. For this reason, the present study aims to detect phenotypes based on indicators of stress chronicity and intensity (i.e., epilepsy duration, trait anxiety, and depression) in patients with drug-resistant epilepsy, as well as examine differences in cognition and QOL depending on these phenotypes. Although the longer duration of epilepsy and greater negative affectivity may be separately related to poorer cognitive functioning and poorer QOL, we hypothesize that there may be a profile of patients who have adapted adequately to the disease, despite having suffered from it for a long time, presenting moderate levels of negative affectivity. We hypothesize that this profile will be more adaptive at a cognitive and QOL level than the profile of patients with greater negative affectivity.

2. Materials and methods

2.1. Patients

This is a cross-sectional study in which participants were recruited from the Refractory Epilepsy Unit of the Hospital Universitario y Politécnico La Fe between April 2015 and November 2022. The inclusion criteria were: (a) patients with a diagnosis of drug-resistant epilepsy, thus ensuring that the disease was chronic; (b) candidates for epilepsy surgery to ensure relative homogeneity of the sample (i.e., suspected focal onset seizures); (c) a chronological age of at least 18, to ensure cognitive development; (d) and a neuropsychological assessment performed before surgery. Excluded were patients who: (a) were older than 65, to avoid the possible presence of sensory deficits and fatigue effects; (b) in whom the assessment could not be carried out with a minimum of reliability due to their high level of cognitive impairment; and (c) had a history of severe psychiatric conditions, since it could affect the results obtained in the neuropsychological evaluation.

2.2. Procedure

The study was conducted following the Declaration of Helsinki and approved by the ethics committee of the hospital. All participants provided informed consent. Our reporting followed STROBE guidelines (Von Elm et al., 2007).

Demographic characteristics (i.e., age, sex, handedness, educational level, academic/employment insertion, and household members), as well as clinical data (i.e., epilepsy type, TLE (yes/no), side of seizure focus, age at epilepsy onset, epilepsy duration, magnetic resonance imaging (MRI) findings, hippocampal sclerosis (HS) (yes/no), number of ASMs, and seizures per month and seizure type) were registered. In this regard and given the objectivity, robustness, and relevance of the variable in this study, epilepsy duration was collected during the interview before the neuropsychological assessment, in which the information provided by the patients was contrasted with the relatives. This variable considered the years elapsed from the time the diagnosis was made until the neuropsychological assessment was performed.

Presurgical assessment included the diagnosis of the epilepsy type and the lateralization of the epileptogenic area based on a comprehensive assessment made by members of a multidisciplinary team. This evaluation included seizure history and semiology, neurologic assessment, video-electroencephalography monitoring, 3-Tesla MRI, psychiatric assessment, and neuropsychological evaluation. Fluorodeoxyglucose (FDG)- positron emission tomography (PET), single-photon emission computed tomography (SPECT), and intracranial EEG recording were performed selectively. A comprehensive neuropsychological evaluation was carried out for all patients. From this assessment, anxiety, depression, attention, executive functioning, memory, language, and QOL tests were selected for the present study. Furthermore, to ensure that the differences in negative affectivity values in each group were not due to difficulties in emotion recognition, an instrument that assessed the ability to recognize emotional states was administered.

2.3. Neuropsychological assessment

The neuropsychological assessment was designed following the recommendations of the E-PILEPSY consortium (Vogt et al., 2017).

2.3.1. Anxiety

This was assessed using the State–Trait Anxiety Inventory (STAI) (Spielberger, 1989). The trait anxiety scale (STAI-T) evaluates relatively stable aspects of anxiety and is composed of 20 items rated on a four-point scale ranging from 0 (“hardly never”) to 3 (“almost always”), with higher scores indicating higher anxiety. Cronbach’s alpha of the Spanish adaptation of this inventory is 0.94 (Guillén-Riquelme and Buela-Casal, 2011). This instrument was selected since, despite being a test developed for the general population, it is a valid and reliable instrument with acceptable sensitivity and specificity in patients with epilepsy, with a high negative predictive value and a low positive predictive value (Wiglusz et al., 2019; Zingano et al., 2019). It is a strong predictor for QOL in this population (Johnson et al., 2004; Cano-López et al., 2018). Moreover, it is one of the most widely used measures of anxiety in clinical research (Spielberger et al., 1970; Spielberger, 1983; Kennedy et al., 2001; Wiglusz et al., 2019), thus enabling us to have a large literature with which to compare our results (Cano-López et al., 2018; Lima et al., 2021; Cano-López et al., 2023).

2.3.2. Depression

The Beck Depression Inventory-II (BDI-II) (Beck et al., 1996) was used to assess depression with 21 items rated on a four-point scale, with higher scores indicating higher depression levels. Cronbach’s alpha is 0.89 (Sanz and García-Vera, 2009). This instrument was selected since the E-PILEPSY consortium (Vogt et al., 2017) reported that the BDI was the wide instrument used by clinicians (60%) to assess mood in patients with drug-resistant epilepsy. Furthermore, it has been shown that BDI-II is a more robust measure than other instruments in patients with epilepsy (de Oliveira et al., 2014).

2.3.3. Attention and executive functioning

The Trail Making Test (TMT) (Reitan and Wolfson, 1985) was used to measure attention and executive functions (working memory, attention, planning, and set-shifting) that require motor skills and visual–spatial processing. In part A (TMT-A), participants were requested to draw a line to connect 25 circles with successive numbers and in the correct order, whereas in part B (TMT-B) participants must alternate between letters, joining them in the specific order. In this test, longer task completion times indicate poorer performance.

The Wisconsin Card Sorting Test (WCST) (Heaton et al., 1993) was used to evaluate cognitive flexibility, abstract conceptualization, and responsiveness to feedback. Higher scores indicated poorer performance in the following indices: number of trials; number and percentage of errors; number and percentage of perseverative responses; number and percentage of non-perseverative errors; trials to complete the first category; and failure to maintain a set. Additionally, higher scores showed better performance in the following indices: correct responses; number and percentage of conceptual level responses; categories completed; and learning to learn.

2.3.4. Memory

The Spanish Complutense Verbal Learning Test (TAVEC) (Benedet and Alejandre, 1998) was used to assess episodic verbal memory. This test is a Spanish version of the California Verbal Learning Test (CVLT) (Delis et al., 1987). It consists of three shopping lists: a learning list (list A); an interference list (list B); and a recognition list (list C). The following indices were computed: immediate verbal memory; short-term verbal memory; short-term verbal memory with semantic cues; long-term verbal memory; long-term verbal memory with semantic cues; recognition; and discriminability. In all cases, higher scores indicated better performance.

The Rey-Osterrieth Complex Figure test (ROCF) (Rey, 1941; Osterrieth, 1944) was used to assess immediate visual memory. It consists of the presentation of a two-dimensional figure that must be copied by the patient, without rotating the model sheet. After 3 min, participants were asked to recall the figure and draw it again without the presence of the model, assessing the immediate visual memory. The scores were computed as the sum of the drawn elements considering the degree of accuracy, deformation, and location. According to this correction system, each of the 18 elements of the figure received a score of 0, 0.5, 1, or 2 points. The maximum possible score was 36 points.

2.3.5. Language functions

The Boston Naming Test (Kaplan et al., 2001) was used to assess visual confrontation naming. Semantic and phonemic cues were provided in the case of no response or incorrect response. The total score was computed as the number of cards correctly named without phonemic cues and with 60 being the maximum score.

The FAS (Spreen and Benton, 1977) was used to assess phonemic fluency. In this task, participants were requested to say as many words as they can that start with the letters F, A, and S in 1 min. The total score was computed as the sum of all admissible words for the three letters.

The Animal Naming Test (ANT) (Rosen, 1980) was used to evaluate semantic fluency. In this test, participants were required to name as many animals as possible in 1 min. The total score was computed as the sum of admissible words for this semantic category.

2.3.6. Emotional recognition

The Reading the Mind in the Eyes Test (RMET) (Baron-Cohen et al., 2001) was used in its Spanish version (Fernández-Abascal et al., 2013). This test measures the ability to recognize other people's emotions. It consists of 36 photographs of people's gazes, each with four response options. Participants are asked to choose which adjective best describes that look. The test score ranges from 0 to 36, the higher the score, the better the performance. Cronbach's alpha of the Spanish adaptation is 0.63.

2.3.7. QOL

Quality-of-Life in Epilepsy Inventory (QOLIE-31) (Cramer et al., 1998), in its Spanish version (Torres et al., 1999), was used to assess QOL and includes 31 items distributed in seven scales: seizure worry; overall QOL; emotional wellbeing; energy; cognitive self-rating; medication effects; and social functioning. Scores for each subscale ranged from 0 to 100, with higher scores indicating better QOL (including seizure worry and medication effects, which were scored on an inverse scale). A QOL composite score was computed using a weighted average of subscales. Cronbach's alpha of the Spanish adaptation of this inventory ranges from 0.55 to 0.92 (Torres et al., 1999).

2.4. Statistical analysis

Outliers were defined as values ±2.5 SD. We detected three outliers for BDI-II and one for epilepsy duration, and they were winsorized by replacing their values with values equal to the mean ± 2.5 SD to control for the possible effect of extreme values in further analyses (Dixon and Tukey, 1968). A cluster analysis was used to identify groups of participants based on their average z-scores across three variables: anxiety; depression; and epilepsy duration. We used Ward's hierarchical clustering method with squared Euclidean distance as the index of the length between patient profiles. This method is one of the most widely used (Govender and Sivakumar, 2020) probably due to its effectiveness at the time of classification (Tufféry, 2011). Ward's method aims to achieve the minimization of intragroup variance and maximizes homogeneity within groups. This analysis provides groups or clusters not defined *a priori*. Hierarchical clusters provide an output called dendrogram—in which the progressive formation of clusters is shown from n subjects to a single grouping. The R package NbClust was used to check the optimal number of clusters. This package is particularly useful as it provides 23 indices and indicates how many indices support a given number of clusters after varying all combinations of several clusters, distance measures, and clustering methods (Charrad et al., 2013). Dunn's index, which measures the ratio of the minimum inter-cluster distance to the maximum inter-cluster distance, was also calculated. The value of this index ranges from 0 to infinity with higher scores indicating better clustering. Finally, the analyses were replicated with a k-means cluster to observe agreement with the results of the hierarchical cluster. These analyses were made using Rstudio (version 4.0.0).[1]

Once the clusters were established, univariate ANOVAs were performed for between-group comparisons based on the cluster and clinical and demographical variables (i.e., age, educational level, age at epilepsy onset, epilepsy duration, number of ASMs, and seizures per month). Moreover, the chi-square test was used to study the differences between frequencies in descriptive variables depending on the cluster [i.e., sex, handedness, academic/employment insertion, household members, epilepsy type, TLE (yes/no), side of seizure focus, MRI findings, HS (yes/no) and seizure type]. When significant differences were detected, these demographical and clinical variables were included as covariates in further analyses. Univariate ANOVAs

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[1] https://www.r-project.org/

were performed using the z-scores of each variable to determine whether these clusters differed for attention and executive functioning, memory, language, QOL, and emotional recognition. Bonferroni tests were then performed as *post hoc* analyses. ANOVAs were performed using SPSS 25.0 and two-tailed tests with p set at 0.05 were considered significant. Partial eta squared effect sizes were reported, but this indicator may be difficult to interpret when comparing between studies (Lakens, 2013). Consequently, and considering the recommendation of Preacher and Kelley (2011) of the use of multiple effect size measures, Cohen's f statistic was calculated as a local effect size measure using G*Power 3.1.9.7 software, with values near 0.10, 0.25, and 0.40 representing small, medium, and large effect sizes, respectively (Cohen, 1969).

3. Results

3.1. Characteristics of the total sample

The sample was composed of 170 patients (82 men and 88 women; mean age = 38.21, $SD = 11.20$). The mean age at epilepsy onset was 16.60 ($SD = 11.86$) and the mean of seizures per month was 20.49 ($SD = 44.47$). Characteristics of the sample are shown in Table 1.

3.2. Stress phenotypes

Fourteen of the 23 indices from NbClust R package indicated that a three-cluster solution was an optimal number of clusters for portioning the data. The Dunn index for a three-cluster solution was 1.07. When the K-means cluster was performed with a three-cluster solution, the same grouping of patients was obtained for each of the three clusters. Figure 1 shows the Dunn index plot.

Cluster 1 (i.e., vulnerable phenotype) comprised 26.47% of patients and was characterized by high anxiety and depression, but short epilepsy duration (mean = 14.42 years, $SD = 9.07$). Cluster 2 (i.e., resilient phenotype) included 27.65% of the patients and was characterized by moderate levels of anxiety and depression, and long epilepsy duration (mean = 40.75 years, $SD = 8.77$). Cluster 3 (i.e., low-impact phenotype) comprised 45.88% of patients and was considered as a relative control group as patients in this group had low levels of anxiety, depression, and short durations (mean = 14.22 years, $SD = 8.72$). Mean z-scores and SD for each group are shown in Table 2. As expected, significant differences were found in epilepsy duration, anxiety, and depression depending on the cluster (for all, $p < 0.0001$).

3.3. Patient characteristics depending on stress phenotypes

Patient characteristics depending on stress phenotypes are shown in Table 1. Significant differences depending on stress phenotypes were found for age [$F_{(2, 169)} = 35.84$, $p < 0.0001$] with the resilient group being significantly older than the vulnerable and low-impact groups ($p < 0.0001$). Significant differences were also found in age for epilepsy onset [$F_{(2, 169)} = 27.33$, $p < 0.0001$], resilient patients having an earlier onset than patients from vulnerable and low-impact phenotypes ($p < 0.0001$); and for educational level [$F_{(2, 169)} = 4.72$, $p = 0.01$] with resilient patients showing lower educational levels than the low-impact group ($p = 0.011$). Furthermore, significant differences were found in the number of ASMs [$F_{(2, 168)} = 5.34$, $p = 0.006$] with resilient patients taking more ASMs than the other phenotypes (for both, $p \leq 0.036$). Finally, significant differences were found in MRI findings with resilient patients having HS more frequently than the other groups ($p = 0.002$). Age, educational level, number of ASMs, and HS (yes/no) were included as covariates in further analyses to control the possible influence of these variables. Age of onset of epilepsy was not included as a covariate since it was directly related to epilepsy duration (i.e., the variable of interest in this study). No other significant differences were found in demographical or clinical variables (e.g., seizure frequency).

It should be noted that no differences were found depending on stress phenotypes in the RMET total score. Furthermore, all groups achieved a hit rate of more than 50%, so patients did not seem to have significant difficulties in perceiving and identifying emotions.

3.4. Differences in attention, executive functioning, memory, and language depending on stress phenotypes

Regarding executive functioning (Figure 2), significant differences were also found in the following WCST variables: errors [$F_{(2, 168)} = 4.09$, $p = 0.019$, $n^2_p = 0.05$, Cohen's $f = 0.24$]; percentage of errors [$F_{(2, 168)} = 3.79$, $p = 0.025$, $n^2_p = 0.05$, Cohen's $f = 0.23$]; perseverative responses [$F_{(2, 168)} = 5.29$, $p = 0.006$, $n^2_p = 0.06$, Cohen's $f = 0.29$]; percentage of perseverative responses [$F_{(2, 168)} = 5.83$, $p = 0.004$, $n^2_p = 0.07$, Cohen's $f = 0.30$]; perseverative errors [$F_{(2, 168)} = 6.08$, $p = 0.003$, $n^2_p = 0.07$, Cohen's $f = 0.31$]; percentage of perseverative errors [$F_{(2, 168)} = 5.99$, $p = 0.003$, $n^2_p = 0.07$, Cohen's $f = 0.31$]; percentage of conceptual level responses [$F_{(2, 168)} = 3.81$, $p = 0.024$, $n^2_p = 0.045$, Cohen's $f = 0.23$]; completed categories [$F_{(2, 168)} = 4.61$, $p = 0.011$, $n^2_p = 0.054$, Cohen's $f = 0.24$]; and trials to completed the first category [$F_{(2, 168)} = 3.54$, $p = 0.031$, $n^2_p = 0.04$, Cohen's $f = 0.23$]. In these variables, vulnerable patients had significantly poorer performance than resilient patients (for all, $p < 0.03$). It should be noted that a tendency was also observed on conceptual level responses [$F_{(2, 168)} = 2.88$, $p = 0.059$, $n^2_p = 0.03$], specifically vulnerable patients performing worse than resilient patients ($p = 0.056$). Furthermore, the low-impact group performed significantly worse than the resilient group on perseverative responses, percentage of perseverative responses, perseverative errors, percentage of perseverative errors, and completed categories (for all, $p < 0.05$).

With respect memory (Figure 3), significant differences were found in the following TAVEC variables: immediate verbal memory [$F_{(2, 168)} = 3.41$, $p = 0.036$, $n^2_p = 0.04$, Cohen's $f = 0.18$]; short-term verbal memory [$F_{(2, 168)} = 4.86$, $p = 0.009$, $n^2_p = 0.06$, Cohen's $f = 0.22$]; short-term verbal memory with semantic cues [$F_{(2, 168)} = 3.69$, $p = 0.027$, $n^2_p = 0.04$, Cohen's $f = 0.19$]; long-term verbal memory [$F_{(2, 168)} = 5.12$, $p = 0.007$, $n^2_p = 0.06$, Cohen's $f = 0.23$]; long-term verbal memory with cues [$F_{(2, 168)} = 5.81$, $p = 0.004$, $n^2_p = 0.07$, Cohen's $f = 0.24$]; recognition [$F_{(2, 168)} = 3.18$, $p = 0.044$, $n^2_p = 0.04$, Cohen's $f = 0.19$]; and discriminability [$F_{(2, 168)} = 3.48$, $p = 0.033$, $n^2_p = 0.04$, Cohen's $f = 0.20$]. In these variables, vulnerable patients performed significantly worse than the low-impact group (for all, $p \leq 0.04$), except on recognition, in which the difference did not reach statistical significance ($p = 0.06$). Furthermore, vulnerable patients had lower scores than resilient

TABLE 1 Characteristics of the total sample and clusters [mean±SD or n (%)].

	Vulnerable phenotype (*n*=45)	Resilient phenotype (*n*=59)	Low-impact phenotype (*n*=66)	Total (*n*=170)	*p*
Age (years)	36.04 ± 9.88	47.98 ± 8.73	33.58 ± 9.56	38.21 ± 11.20	0.0001
Sex					0.73
Male	24 (53.3%)	22 (46.8%)	36 (46.2%)	82 (48.2%)	
Female	21 (46.7%)	25 (53.2%)	42 (53.8%)	88 (51.8%)	
Handedness					0.48
Right	37 (82.2%)	44 (93.6%)	70 (89.7%)	151 (88.8%)	
Left	5 (11.1%)	2 (4.3%)	4 (5.1%)	11 (6.5%)	
Mixed	3 (6.7%)	1 (2.1%)	4 (5.1%)	8 (4.7%)	
Educational level					0.01
Primary	7 (15.6%)	5 (10.6%)	6 (7.7%)	18 (10.6%)	
Secondary	20 (44.4%)	30 (63.8%)	27 (34.6%)	77 (45.3%)	
Lower university	10 (22.2%)	7 (14.9%)	26 (33.3%)	43 (25.3%)	
University	8 (17.8%)	5 (10.6%)	19 (24.4%)	32 (18.8%)	
Academic/employment insertion					0.06
Yes	19 (42.2%)	21 (44.7%)	48 (61.5%)	88 (51.8%)	
No	26 (57.8%)	26 (55.3%)	30 (38.5%)	82 (48.2%)	
Household members					0.11
Family	16 (35.6%)	9 (19.15%)	34 (43.6%)	59 (34.7%)	
Partner	23 (51.1%)	32 (68.1%)	38 (48.7%)	93 (54.7%)	
Flatmate	2 (4.4%)	0 (0%)	1 (1.3%)	3 (1.8%)	
Living alone	4 (8.9%)	6 (12.8%)	5 (6.4%)	15 (8.8%)	
Epilepsy type					0.51
FLE[a]	6 (13.3%)	11 (23.4%)	16 (20.5%)	33 (19.4%)	
TLE[b]	34 (75.6%)	34 (66.1%)	51 (77.3%)	119 (70%)	
PLE[c]	3 (6.7%)	1 (2.1%)	8 (10.3%)	12 (7.1%)	
OLE[d]	1 (2.2%)	0 (0%)	1 (1.3%)	2 (1.2%)	
ILE[e]	0 (0%)	1 (2.1%)	0 (0%)	1 (0.6%)	
Multifocal	1 (2.2%)	0 (0%)	2 (2.6%)	3 (1.8%)	
TLE[b] (yes/no)					0.46
Yes	34 (75.6%)	34 (72.3%)	51 (65.4%)	119 (70%)	
No	11 (24.4%)	13 (27.7%)	27 (34.6%)	51 (30%)	
Side of seizure focus				0.86	
Left	23 (51.1%)	23 (48.9%)	34 (43.6%)	80 (47.1%)	
Right	20 (44.4%)	22 (46.8%)	38 (48.7%)	80 (47.1%)	
Bilateral	2 (4.4%)	2 (4.3%)	6 (7.7%)	10 (5.9%)	
Age at epilepsy onset (years)	21.62 ± 11.36	7.23 ± 6.47	19.36 ± 11.56	16.60 ± 11.86	0.0001
Epilepsy duration (years)	14.42 ± 9.07	40.75 ± 8.77	14.22 ± 8.72	21.61 ± 14.76	0.0001
MRI[f] findings					0.009
HS[g]	10 (22.2%)	23 (48.9%)	16 (20.5%)	49 (28.8%)	
FCD[h]	5 (11.1%)	13 (27.7%)	18 (23.1%)	36 (21.2%)	
Tumor	10 (22.2%)	2 (4.3%)	13 (16.7%)	25 (14.7%)	
Heterotopia	2 (4.4%)	0 (0%)	3 (3.8%)	5 (2.9%)	
Cavernona	5 (11.1%)	2 (4.3%)	8 (10.3%)	15 (8.8%)	

(Continued)

TABLE 1 (Continued)

	Vulnerable phenotype (*n*=45)	Resilient phenotype (*n*=59)	Low-impact phenotype (*n*=66)	Total (*n*=170)	*p*
Non-specific pathology	13 (28.9%)	7 (14.9%)	20 (25.6%)	40 (23.5%)	
HS[g] (yes/no)					0.002
Yes	10 (22.2%)	23 (48.9%)	16 (20.5%)	49 (28.8%)	
No	35 (77.8%)	24 (51.1%)	62 (79.5%)	121 (71.2%)	
Number of ASMs[i]	2.76 ± 0.88	3.21 ± 0.93	2.71 ± 0.81	2.86 ± 0.89	0.006
Seizures per month	26.05 ± 50.77	22.95 ± 42.62	17.15 ± 42.09	20.49 ± 44.48	0.583
Seizure type					0.498
FAS[j]	1 (2.2%)	0 (0%)	6 (7.7%)	7 (4.1%)	
FIAS[k]	15 (33.3%)	22 (46.8%)	24 (30.8%)	61 (35.9%)	
FBTCS[l]	1 (2.2%)	0 (0%)	2 (2.6%)	3 (1.8%)	
FAS[j] + FIAS[k]	9 (20%)	10 (21.3%)	13 (16.7%)	32 (18.8%)	
FAS[j] + FBTCS[l]	2 (4.4%)	0 (0%)	3 (3.8%)	5 (2.8%)	
FIAS[k] + FBTCS[l]	13 (28.9%)	10 (21.3%)	23 (29.5%)	46 (27.1%)	
FAS[j] + FIAS[k] + FBTCS[l]	4 (8.9%)	5 (10.6%)	7 (9%)	16 (9.4%)	
RMET[m]	18.81 ± 5.88	18.84 ± 5.42	20.53 ± 4.70	19.62 ± 5.27	0.318

[a]FLE, frontal lobe epilepsy; [b]TLE, temporal lobe epilepsy; [c]PLE, parietal lobe epilepsy; [d]OLE, occipital lobe epilepsy; [e]ILE, insular lobe epilepsy; [f]MRI, magnetic resonance imaging; [g]HS, hippocampal sclerosis; [h]FCD, focal cortical dysplasia; [i]ASM, antiseizure medication; [j]FAS, focal aware seizure; [k]FIAS, focal impaired awareness seizure; [l]FBTCS, focal to bilateral tonic–clonic seizures; [m]RMET, Reading the Mind in the Eyes Test.

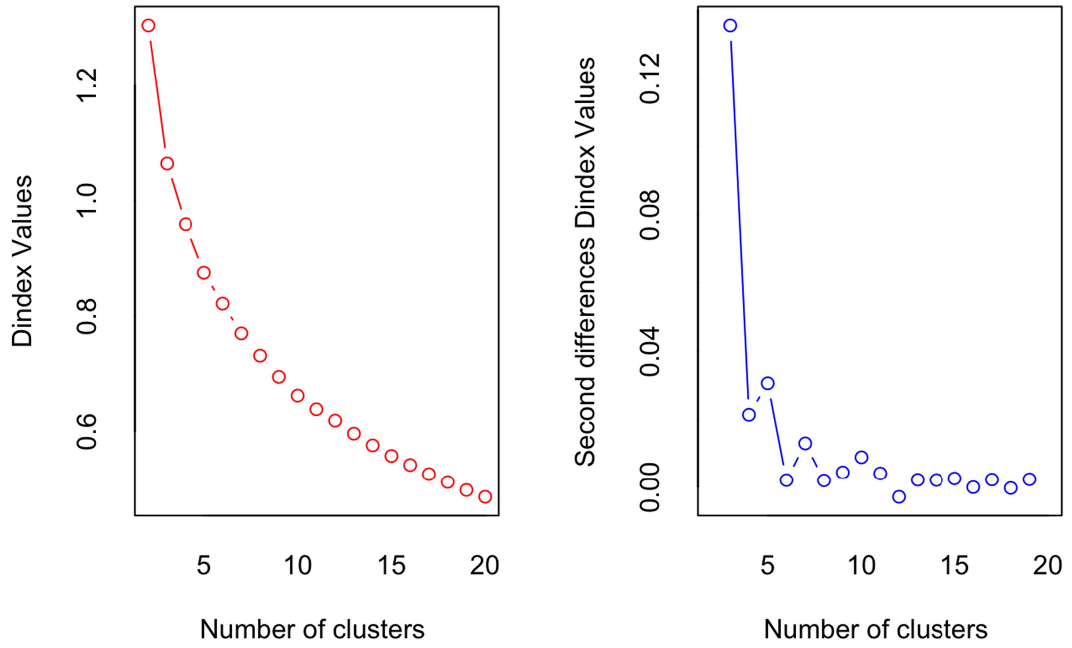

FIGURE 1
D-index for the determination of the number of clusters. The sharp change in the slope of the D-index second differences plot indicates a significant increase in the value of the measure.

patients on long-term verbal memory and long-term verbal memory with semantic cues ($p < 0.03$).

Finally, concerning the naming functions (Figure 4), significant differences were found in the number of correct responses [$F_{(2, 168)} = 5.14$, $p = 0.007$, $n^2_p = 0.06$, Cohen's $f = 0.24$]; the number of phonemic cues [$F_{(2, 168)} = 4.21$, $p = 0.017$, $n^2_p = 0.05$, Cohen's $f = 0.22$]; and the total score [$F_{(2, 168)} = 5.20$, $p = 0.006$, $n^2_p = 0.06$, Cohen's $f = 0.24$]. In these variables, vulnerable patients performed significantly poorer

TABLE 2 Mean and SD of each cluster based on z scores.

	Vulnerable phenotype (*n*=45)	Resilient phenotype (*n*=47)	Low-impact phenotype (*n*=78)	Differences between groups
BDI-II	1.06 ± 0.83	−0.04 ± 0.75	−0.60 ± 0.53	$p < 0.0001$
STAI-R	1.09 ± 0.52	0.07 ± 0.77	−0.65 ± 0.74	$p < 0.0001$
Epilepsy duration	−0.47 ± 0.62	1.32 ± 0.59	−0.49 ± 0.59	$p < 0.0001$

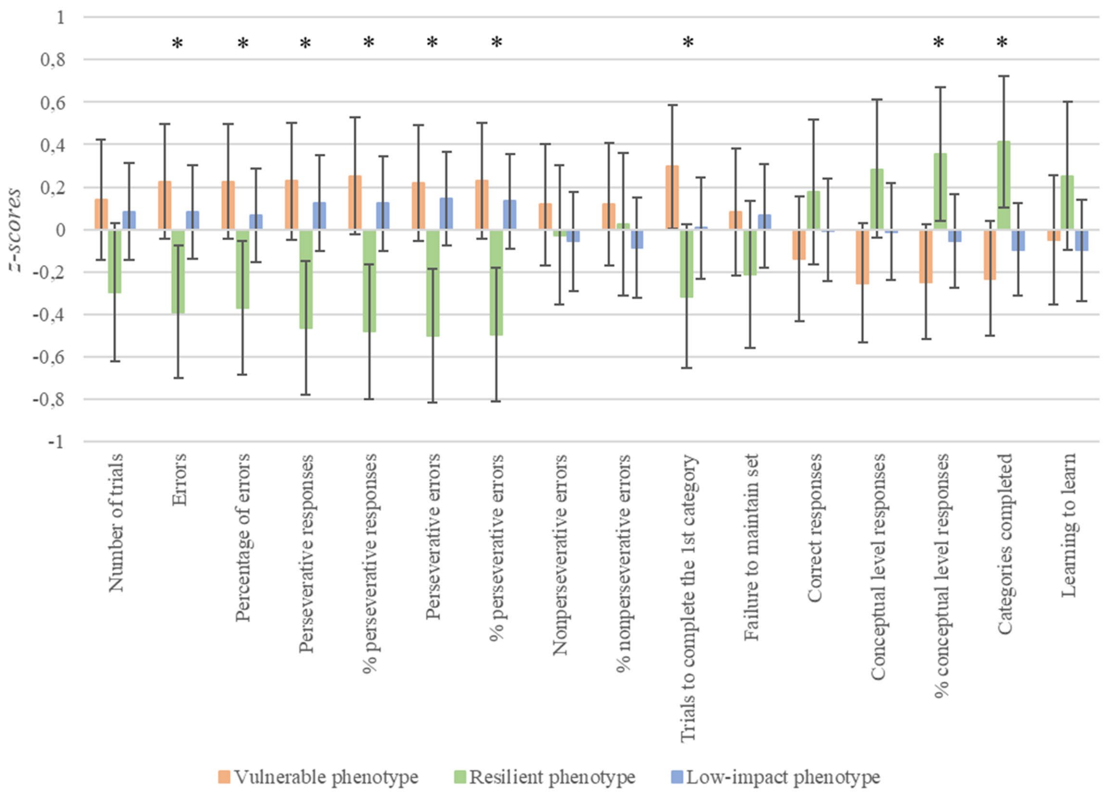

FIGURE 2

Differences in cognitive flexibility depending on stress phenotypes. *$p<0.05$; error bars represent 95% confidence intervals. Higher scores indicate poorer performance in most variables (from number of trials to failure to maintain set). However, higher scores indicate better performance in the case of correct responses, conceptual level responses, categories completed, and learning to learn.

than the low-impact group (for all, $p < 0.04$) and the resilient group [for all, $p < 0.04$, except for the number of phonemic cues, where a tendency was found ($p = 0.059$)].

No significant differences were found in other processes (i.e., attention, visual memory, verbal fluency).

3.5. Differences in QOL depending on stress phenotypes

Regarding QOL (Figure 5), significant differences were found in overall QOL [$F_{(2,\ 168)} = 12.25$, $p < 0.0001$, $n^2_p = 0.13$, Cohen's $f = 0.38$]; emotional wellbeing [$F_{(2,\ 168)} = 48.27$, $p < 0.0001$, $n^2_p = 0.37$, Cohen's $f = 0.63$]; energy [$F_{(2,\ 168)} = 32.06$, $p < 0.0001$, $n^2_p = 0.28$, Cohen's $f = 0.55$]; cognitive self-rating [$F_{(2,\ 168)} = 15.44$, $p < 0.0001$, $n^2_p = 0.16$, Cohen's $f = 0.40$]; medication effects [$F_{(2,\ 168)} = 6.80$, $p = 0.001$, $n^2_p = 0.08$, Cohen's $f = 0.29$]; social functioning [$F_{(2,\ 168)} = 9.60$, $p < 0.0001$, $n^2_p = 0.11$, Cohen's $f = 0.32$]; and QOL composite score [$F_{(2,\ 168)} = 39.62$, $p < 0.0001$, $n^2_p = 0.33$, Cohen's $f = 0.57$]. Vulnerable patients had significantly poorer QOL than the low-impact group in all these variables (for all, $p \leq 0.005$). Furthermore, resilient patients had significantly lower scores than the low-impact group on overall QOL ($p = 0.024$), emotional wellbeing ($p < 0.0001$), and energy ($p < 0.0001$). Finally, vulnerable patients showed poorer QOL than resilient patients on emotional wellbeing ($p = 0.028$), cognitive self-rating ($p < 0.001$), medication effects ($p = 0.008$), social functioning ($p < 0.0001$) and QOL composite score ($p < 0.0001$). It should be noted that a tendency was found for energy, with vulnerable patients having lower scores than resilient patients ($p = 0.052$). No other significant differences were found.

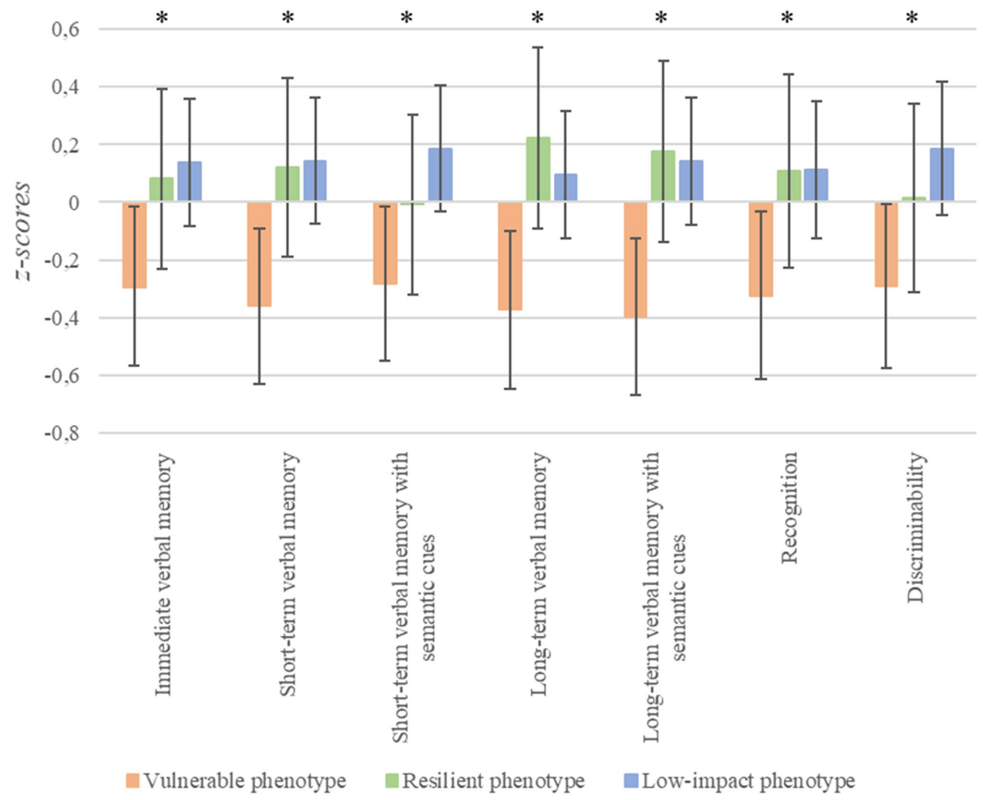

FIGURE 3
Differences in memory depending on stress phenotypes. *$p<0.05$; error bars represent 95% confidence intervals.

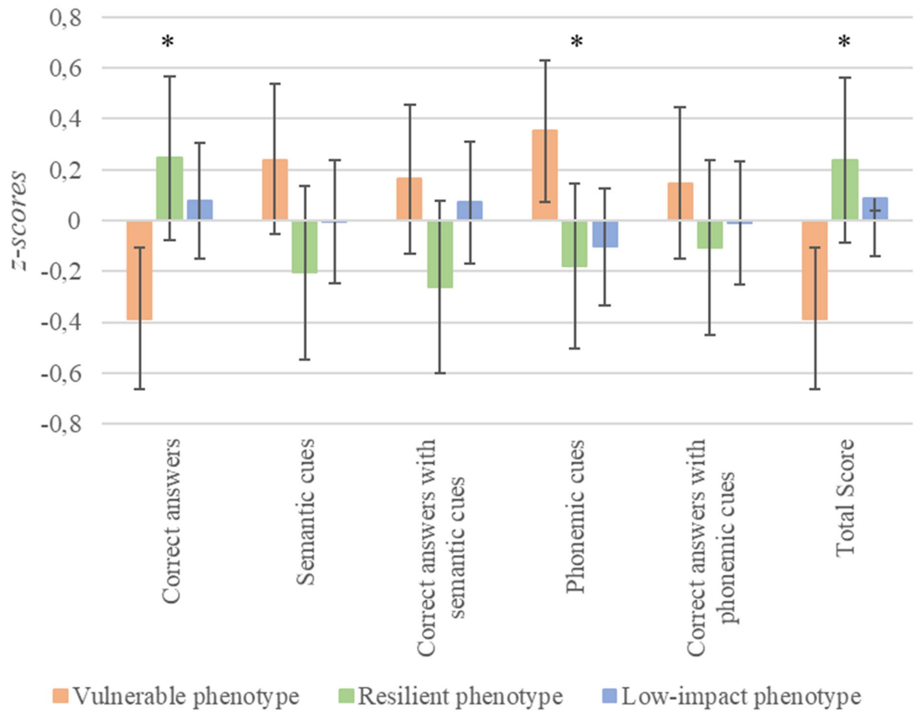

FIGURE 4
Differences in visual confrontation naming depending on stress phenotypes. *$p<0.05$; error bars represent 95% confidence intervals.

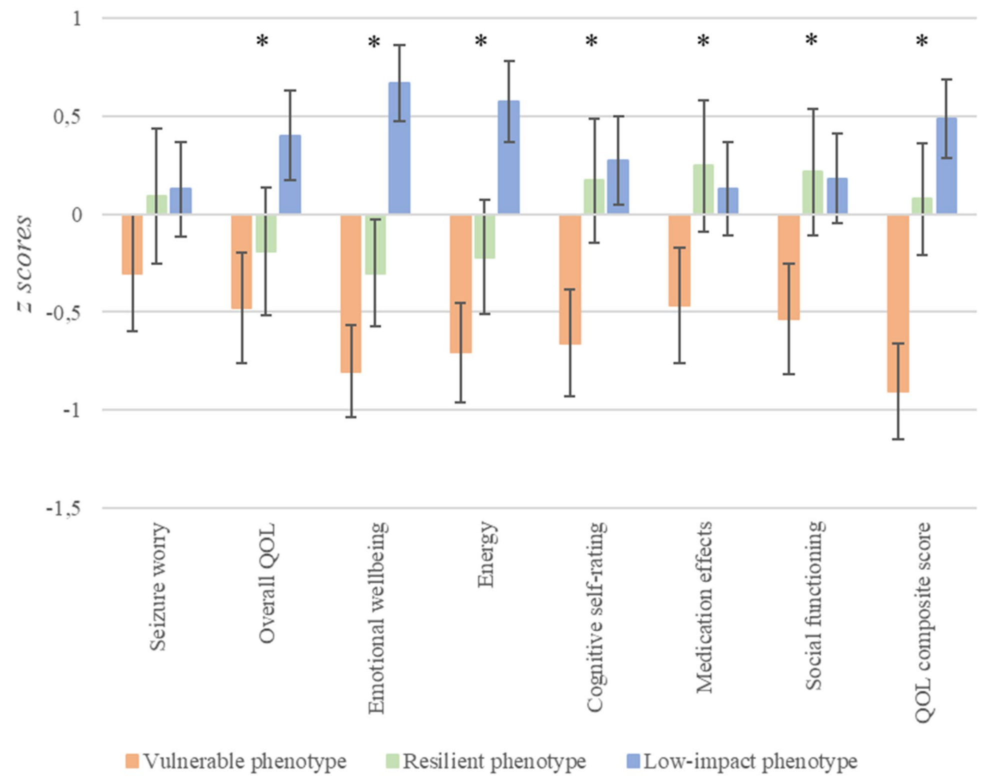

FIGURE 5
Differences in QOL depending on stress phenotypes. **p* <0.05; error bars represent 95% confidence intervals.

4. Discussion

The results of the current study show three stress phenotypes in patients with drug-resistant epilepsy based on indicators of stress chronicity and intensity (i.e., epilepsy duration and negative affectivity): vulnerable; resilient; and low-impact phenotypes. Our findings show that executive function, memory, naming, and QOL differ depending on stress phenotypes. These main findings are discussed below.

4.1. Stress phenotypes in epilepsy: characteristics

The vulnerable phenotype was characterized in our study by shorter epilepsy duration, but high levels of anxiety and depression. The resilient phenotype was characterized by long epilepsy duration and moderate anxiety and depression, suggesting that patients included in this group may have established effective coping strategies or the chronicity of the disease favored compensatory mechanisms that lead to a moderation of negative affectivity. It should be noted that this was the only group to present a long duration for the disease. A low-impact group with low anxiety, depression, and epilepsy duration was also identified. These phenotypes provide us with a new classification of patients with epilepsy in the context of epilepsy as a chronic stress setting. To our knowledge, no previous studies have established phenotypes from a quantitative research perspective considering both stress chronicity and intensity of stress in patients with epilepsy.

Our results showed that stress phenotypes were similar in terms of clinical variables such as epilepsy type, side of seizure focus, and seizure frequency. However, differences were found in MRI findings, with a higher frequency of HS in the resilient group. HS is the most common finding in epilepsy surgery (Malmgren and Thom, 2012) and so the surgery rate is high. Therefore, patients with this condition may be more likely to feel more hopeful about their futures and feel that they have more options and so, therefore, can adopt more resilient behavior. Furthermore, we found that patients in the resilient group had a lower educational level than patients in the low-impact group. The fact that patients from the resilient group had an earlier age of onset of epilepsy (i.e., longer epilepsy duration) could have hindered subsequent academic development in the resilient group with respect to the low-impact group. Furthermore, it should be noted that patients in the low-impact group had lower levels of negative affectivity than the resilient group, and some studies have found that a higher educational level is related to lower anxiety (Mensah et al., 2007; Peterson et al., 2014), so having low negative affectivity could have acted as a protective factor for educational attainment for the low-impact group.

We also found that resilient patients were significantly older and took more ASMs than the other groups. In samples of people with epilepsy, older patients were found to have healthier coping styles than younger patients (Bautista et al., 2013) and were better adapted to a chronic illness (Canuet et al., 2009). Regarding the number of ASMs, Şenadım et al. (2021) found that focusing on and venting emotions was more frequent in patients with epilepsy who were receiving polytherapy than in those receiving monotherapy (without examining the influence of the specific number of ASMs and so underlying the need for further studies to clarify this relationship). It should be noted that, in our study, most patients (95.3%) received polytherapy. The fact that resilient patients took more ASMs than vulnerable patients may be due to higher chronicity of the disease (i.e., epilepsy duration) and an earlier onset of the disease (Szaflarski et al., 2006; Witt et al., 2020). Together, these results indicate that age and number of ASMs are important factors in understanding stress phenotypes, so they were included as covariates in the further analyses together with educational level and HS.

Due to the high rate of alexithymia in patients with epilepsy (Ricciardi et al., 2015), differences between these groups in emotional recognition were studied. No significant differences were observed among the three groups, with all three presenting a hit rate of at least 50%. This suggests that the differences found in negative affect and QOL in these groups may be not due to possible difficulties in emotional perceiving.

4.2. Differences in attention and executive functioning depending on phenotypes

Significant differences were found in executive functioning between stress phenotypes with the resilient group performing better than the vulnerable and low-impact groups, with small-to-medium effect sizes depending on the variable considered. Although some studies have indicated that longer epilepsy duration is related to poorer performance in executive functions (Kim et al., 2007; Black et al., 2010; Zamarian et al., 2011), other studies have found that duration is a weak predictor of this variable (Thompson and Duncan, 2005; Wang et al., 2011). Some studies have found no relationship between epilepsy duration and executive functioning (Agah et al., 2017; DeGeorge et al., 2021) and our results suggest that negative affectivity, an increasing factor of stress intensity, may be more relevant to explain executive function deficits in patients with epilepsy than stress chronicity.

More detailed vulnerable patients had poorer performance in executive functions than the resilient group, despite the latter group having longer duration of epilepsy. Espinosa et al. (2010) found that WCST performance was related to the severity of depressive disorders in patients with TLE, suggesting that patients with a larger number of total errors were more likely to have depression. This finding is interesting, as significant differences in the total number of errors were only found between the resilient and vulnerable groups, without differences with the low-impact group—who had low negative affectivity despite having the same duration as the vulnerable group. Significant differences were also found in perseverative errors, which has been found to be a predictor of postsurgical BDI score in a sample of TLE patients (Pope et al., 2019). However, there are few studies that address this relationship while considering anxiety. As an exception, Hermann et al. (1991) addressed the relationship between the number of perseverative errors and negative affectivity, including measures of depression and anxiety, and found a significant association between these variables in patients with left TLE, but no significant results in patients with right TLE.

Surprisingly, we also found that the resilient group also performed better in executive function than the low-impact group—with lower perseverative errors and perseverative responses (these variables being measures of cognitive flexibility). These findings are relevant, as patients with a longer history of illness have been found to perform better than those with a shorter duration and lower emotional comorbidity. Cognitive flexibility is a domain related to problem-solving skills and decision-making, that enables the patient to develop different coping strategies to deal with a problem. Some studies that have examined cognitive flexibility with self-report questionnaires have found a positive relationship between resilience and stress coping (Martin and Anderson, 2001; Bonanno et al., 2004; Arici-Ozcan et al., 2019). Soltani et al. (2013) proposed that this relationship may be more complex, and found that cognitive flexibility mediates the relationship of coping styles and resilience with depression. These findings suggest that cognitive flexibility may interfere with the moderate levels of negative affectivity shown in this group.

It should be underlined that, although it cannot be established with certainty that the differences found in executive function tests depending on stress phenotypes were not influenced by other factors, stress phenotypes did not differ in attention functioning, so differences in executive functioning may not be attributed to deficits in this cognitive domain.

4.3. Differences in memory depending on phenotypes

We found significant differences in verbal memory functioning depending on stress phenotypes, with small effect sizes. Specifically, we found poorer memory functioning in the vulnerable group than in the low-impact group. This suggests that negative affectivity is more related to memory impairment than the duration of the disease itself, as both the vulnerable and low-impact groups were equal in epilepsy duration. These results are in line with previous studies that showed that trait anxiety is a predictor of memory functioning (Cano-López et al., 2019) and that patients with epilepsy with depression had cognitive impairments (Arend et al., 2018). Rayner et al. (2016a) suggested that depression may be more strongly linked to deficits in cognitive networks in patients with epilepsy than in cases of primary depression, as there may be mechanisms underlying depression that could affect brain networks in some neurological diseases.

Our results also showed significantly poorer verbal memory functioning in vulnerable patients compared to the resilient group in two subscales (i.e., long-term verbal memory and long-term verbal memory with semantic cues). It should be noted that in our sample resilient patients began to have seizures in childhood and, consequently, have longer epilepsy duration, whereas the vulnerable group began to have seizures in adulthood (with a shorter epilepsy duration). In contrast to our results, it has been found that an early onset of epilepsy may cause changes in brain development characterized by an age-related delay in white matter gain, possibly leading to problems in cognitive development (Hermann et al., 2010), and that epilepsy duration and age of epilepsy onset are predictors of memory failure in children (Menlove and Reilly, 2015) and adults with TLE (Uslu et al., 2019). However, it should be noted that some studies have found memory deficits in patients with a recent diagnosis of epilepsy not treated with ASMs, suggesting that memory impairment in patients with long-standing epilepsy cannot be attributed exclusively to seizure recurrence and the effects of ASMs, and other factors must be explored (Aikia et al., 2001). It is also possible that the early onset of the resilient group could favor a better performance in the adult stage due to the efficiency of the plasticity and compensatory mechanisms in childhood and adolescence. In our study, vulnerable patients had more negative affectivity than resilient patients, so our results suggest that it is not so much the duration of epilepsy that matters, but how it combines with negative affectivity to explain the differences between the resilient and vulnerable phenotypes in memory functioning.

Rayner et al. (2016b) show that memory failures could be explained depending on the age at epilepsy onset. In this regard, memory failures in patients with early epilepsy onset are mainly explained by neurobiological factors (i.e., the resilient group in our sample), whereas in patients with late-onset these deficits are due to psychological maladaptation (i.e., vulnerable and low-impact groups). Our findings partially agree with this model, as we conclude that in patients with late epilepsy onset, memory failures are mainly related to negative affectivity. In our study, the group with high negative affect and short epilepsy duration (vulnerable group) performed worse than the group with low negative affect and low epilepsy duration (low-impact group) on all memory subscales. Furthermore, these differences were also significant for the long-term memory subscales between the group with moderate levels of negative affect and long epilepsy duration (resilient group) and the vulnerable group (with the vulnerable group showing poorer performance). These results suggest that negative affect is a sensitive factor that may have a stronger effect on memory than epilepsy duration.

It should be noted that no significant differences were found in visual memory depending on stress phenotypes. This could be due to the type of task used to evaluate visual memory, as there are difficulties in finding a 'pure' test of visual memory (Helmstaedter et al., 1995; Vaz, 2004), and patients often use verbal strategies to perform visual tests such as the ROCF (Barr et al., 1997).

4.4. Differences in language functioning depending on phenotypes

Significant differences were found in visual confrontation naming, with small effect sizes. Specifically, the vulnerable group showed poorer performance than the low-impact group and the resilient group. Vulnerable and low-impact groups had similar epilepsy duration, so our results highlight the relevance of negative affectivity in naming and semantic memory processes. Furthermore, the fact that the vulnerable group (i.e., high negative affectivity and short epilepsy duration) had also poorer performance than the resilient group (i.e., moderate negative affectivity and long epilepsy duration) in naming suggests that naming deficits in patients with late epilepsy onset are mainly associated with negative affectivity. These results are in line with those found by Paradiso et al. (2001), showing that patients with TLE and depression had poorer performance than patients with TLE without depression in a neuropsychological evaluation, in which visual naming was assessed. As indicated above, mechanisms underlying negative affectivity may affect brain networks involved in cognitive functioning (Rayner et al., 2016a).

Decreased naming ability is commonly found in patients with epilepsy, especially in those with TLE, indicating a key role of the medial temporal lobe in this process (Goodglass and Wingfield, 1997; Ogden-Epker and Cullum, 2001; Schefft et al., 2003; Bonelli et al., 2011). It should be noted that stress phenotypes did not differ in verbal fluency, suggesting that the differences found in naming may be attributed to semantic memory functioning and not to other processes such as verbal fluency. Taken together, our results are in line with those found with episodic verbal memory, pointing to an interrelation between semantic and episodic memory (Cano-López et al., 2017; Barrett Jones et al., 2022).

4.5. Differences in QOL depending on phenotypes

In terms of QOL, significant differences with medium-to-large effect sizes (depending on the QOL score considered) were found depending on stress phenotypes. Specifically, we found that the vulnerable group had poorer QOL than the low-impact group in QOL composite score and most QOL subscales. These findings are in line with several studies that showed that depressive symptoms and anxiety are negatively related to QOL (Kwan et al., 2009; Gur-Ozmen et al., 2017; Micoulaud-Franchi et al., 2017; Scévola et al., 2017; Cano-López et al., 2018; Tombini et al., 2020b; Lima et al., 2021), with anxiety even being the strongest predictor of QOL in patients with TLE (Cano-López et al., 2018; Lima et al., 2021).

Our results also showed that the resilient group had poorer QOL than the low-impact group in overall QOL, emotional wellbeing, and energy subscales. Regarding overall QOL, some studies have found that epilepsy duration is related to poorer scores in this subscale in people with epilepsy (Shetty et al., 2011; Pauli et al., 2012). We argue that patients with longer durations may have a more comprehensive affectation of the disease that may affect different areas, and therefore they may have poorer overall QOL. Regarding emotional wellbeing, it should be noted that the low-impact group was taken as a representation of patients who did not yet have emotional alterations associated with epilepsy. However, the resilient group was not completely exempt from these emotional alterations (i.e., having moderate levels of negative affectivity). This may explain why patients from the resilient group, with moderate levels of anxiety and depression, have less QOL related to emotional wellbeing than the low-impact group. Regarding the energy subscale, our results may be influenced by the longer epilepsy duration that characterized resilient patients compared to patients from the low-impact group, considering that recurrent exposition to seizures may worsen the signs of fatigue associated with age and chronic illness in patients with epilepsy (Baranowski, 2018).

We also found a significantly poorer QOL in the vulnerable group compared to the resilient group in all the QOL subscales, except for seizure worry and overall QOL (where no differences were found) and energy (where a tendency was found). Regarding emotional wellbeing, since the vulnerable group had a higher negative affectivity than the resilient group, it was to be expected that they would perceive a lower related QOL. As regards cognitive self-rating, the vulnerable group had poorer objective memory scores than the resilient group, but the differences did not reach statistical significance for most variables. This suggests that differences between vulnerable and resilient groups are more notable in subjective cognitive performance than in objective cognitive functioning, which is congruent with the high negative affectivity scores of the vulnerable group. In the case of medication effects, we found that the resilient group, despite taking the largest number of ASMs, perceived fewer medication effects than the vulnerable group. This contrasts with studies that showed that the number of ASMs is related to QOL (Lozano-Garcia et al., 2021) even when depression was considered in this relation (Wang et al., 2022). However, other studies have found that patients with comorbid depression (Josephson et al., 2017) or anxiety (Kanner et al., 2012) experience greater adverse effects from ASMs. This could explain, at least in part, why patients with higher negative affectivity experience worse adverse effects and, consequently, a poorer related QOL. Regarding social functioning, the vulnerable group had poorer scores than the resilient group. This may be explained by two facts. Firstly, vulnerable patients with a shorter period of adaptation to the disease may feel more stigmatized and may perceive less seizure control and a greater sense of unpredictability, which may be associated with greater social isolation and, therefore, with reduced QOL (Suurmeijer et al., 2001; Błaszczyk and Czuczwar, 2016). Secondly, the vulnerable group had higher negative affectivity, and this could be related to social problems. In this line, a study of patients with TLE found that anxiety was negatively related to both perceived social support and social functioning (Catalán-Aguilar et al., 2022). Furthermore, it has been shown that social support plays an important role as a predictor of negative affectivity in epilepsy (Gandy et al., 2012).

4.6. Strengths and limitations of this study

This study has strengths such as the large and relatively homogeneous sample (i.e., adult patients with drug-resistant epilepsy). Although Ring et al. (2016) differentiated vulnerable and resilient individuals and analyzed how different socioemotional and clinical factors influence QOL in patients with epilepsy using qualitative methods, our study represents an advance over previous studies, since, as far as we know, it is the first to summarize stress chronicity and intensity variables in different profiles from a quantitative research perspective and to explore their association with cognition and QOL in patients with epilepsy. Our findings highlight that it is not so much the epilepsy duration and negative affectivity separately that are relevant, but how these variables combine to form phenotypes. It is worth noting that the anxiety assessed in this study is the anxiety trait and not a scale of clinical anxiety. This enhances the predictive power of this dimension in the detection of vulnerable and resilient individuals since it is not necessary to reach clinical scores. Hermann et al. (2021) recommended that future studies move toward a new taxonomy of epilepsy, in which cognitive and psychological comorbidities become more relevant. Considering this suggestion, we proposed new phenotypes according to emotional comorbidity and epilepsy duration. In addition, to ensure that other comorbidities such as memory deficits, executive functioning impairment, naming difficulties or poor QOL are examined, we show differences depending on stress phenotypes in these variables.

Despite these strengths, some limitations should be considered. First, although our sample was composed of patients with drug-resistant epilepsy sample, different types of epilepsy were included. For this reason, future studies should explore the identified phenotypes with specific types of epilepsy. Second, due to the cross-sectional nature of the data, we cannot conclude causality in the relationships. Third, larger sample sizes could provide more information and ensure statistical power. Fourth, executive function is a complex cognitive domain, so the inference of executive function only from WCST and TMT scores should be considered with caution (Miranda et al., 2020). Fifth, although negative affectivity has been considered in stress phenotypes and may summarize the heightened emotional response to unpredictable seizures, the unpredictability of seizures was not registered, so further studies may design new measurements for this variable. In this line, stress indicators such as cortisol levels or response are also needed to confirm the stress in these three phenotypes and future research in this line must be encouraged. Sixth, although side of seizure focus is a variable of great interest for understanding the idiosyncrasies of epilepsy, it was not considered in determining stress phenotypes since its relationship with stress processes is inconsistent. Specifically, some studies showed that patients with left TLE have higher levels of depression and anxiety (Altshuler et al., 1990), whereas others found a lack of relationships of side of seizure focus with negative affectivity (Devinsky et al., 2005; Sperli et al., 2009; Cano-López et al., 2019) or cortisol response (Cano-López et al., 2019). This highlights the need for further studies to assess the possible relationship between stress and lateralization of epilepsy. Seventh, the group labels of "resilient," "vulnerable," and "low-impact" must be taken cautiously since they are supported by criteria of negative affectivity and duration of epilepsy. This does not mean that resilient patients show better outcomes or vulnerable patients display worse outcomes in all the assessed dimensions. On the contrary, these phenotypes point to the strengths and weaknesses of each type of patient to better outline the necessary interventions. Eighth, although our anxiety and depression scores could be useful for detecting susceptibilities to clinical disorders (Cano-López et al., 2019) they are not diagnostic measures (Kendall et al., 1987). We used the BDI and STAI to evaluate negative affectivity since data collection began in 2015 using these tests and it was decided to continue using the same instruments for reasons of comparability, but future studies should replicate these results with screening tools specifically designed and validated in patients with epilepsy for depressive disorders and anxiety disorders. Finally, to ensure the ability of the participants to recognize one's own emotions, future studies should consider including a measure of alexithymia that allows for the assessment of the possible difficulties in emotional self-recognition.

4.7. Conclusion

The results of the current study contribute to differentiating phenotypes based on stress chronicity and intensity, while considering both epilepsy duration and negative affectivity. Vulnerable patients have poorer memory, naming, and QOL. This group of patients is the most clinically relevant, as it corresponds to a risk profile. This indicates the need to detect non-clinical anxiety and depression in the early years of epilepsy. Patients in the resilient group perform better on executive functions. These patients have experienced epilepsy practically all their lives, adapting the disease to their environment. However, this does not imply better memory functioning and QOL than the low-impact group. Finally, it should be noted that participants from the low-impact group had a low negative affect and a similar level of memory to those from the resilient group, and had a higher QOL than the rest of the groups. These findings show the importance of taking into account negative affectivity and memory functioning during the early years of the disease, whereas in later stages executive functions become more relevant. Furthermore, these results highlight the relevance of considering epilepsy as a model of interconnected networks, in which comorbidities and clinical and demographic variables interact with each other. In fact, people with epilepsy perceive poor life satisfaction, probably due to the interaction between low perceived QOL, socio-emotional limitations, daily challenges, and the effects of the disease itself (Kang, 2023). Resilience is not a static variable, but a dynamic progress (Luthar and Cicchetti, 2000; Hatala et al., 2013), so our results could be useful for detecting vulnerable or resilient profiles and implementing individualized clinical treatments that are more tailored to patient needs. Wagner et al. (2010) demonstrated the benefits of promoting resilience in patients with epilepsy. Future research with patients with epilepsy should examine stress chronicity and intensity variables together with specific coping instruments, as well as study the relevance of possible modulating factors such as social support. Finally, we encourage assessing the efficacy of interventions designed to enhance resilience in patients with drug-resistant epilepsy.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of the Hospital Universitario y Politécnico La Fe, Valencia, Spain. The patients/participants provided their written informed consent to participate in this study.

Author contributions

VV and KH established the diagnosis of drug-resistant epilepsy, recruited the patients for neuropsychological evaluation, and revised the manuscript. JC-A, AL-G, and PT-P participated in the neuropsychological assessment and interpretation of the data. JC-A managed the literature search. JC-A and KH undertook the statistical analyses. JC-A, EG-B, and IC-L interpreted the results, revised the literature, and wrote the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher’s note

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Emotion regulation moderates the association between COVID-19 stress and mental distress: findings on buffering, exacerbation, and gender differences in a cross-sectional study from Norway

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Background: Maintaining good mental health is important during a crisis. However, little attention has been given to how people achieve this, or how they evaluate emotions associated with stressors, such as the COVID-19 pandemic. This study aims to (1) investigate whether emotion regulation, in particular cognitive reappraisal and suppression, moderates the relationship between COVID-19 stress and general mental distress and (2) examine gender differences in the interrelations between COVID-19 stress, emotion regulation, and mental distress.

Methods: Data from a population in Norway (n =1.225) were collected using a cross-sectional survey during the early months of the COVID-19 pandemic. Emotion regulation was measured using the Emotion Regulation Questionnaire Scale (ERQ), COVID-19 stress with the COVID-19 Stress Scale, and mental distress with the Patient Health Questionnaire 4 (PHQ-4). Moderation analyses were conducted using the PROCESS macro for SPSS.

Results: There was a strong association between COVID-19 stress and general mental distress (r =0.61). The moderation analyses showed substantial moderation effects of cognitive reappraisal and suppression on the relationship between COVID-19 stress and mental distress. Cognitive reappraisal served as a buffer (p =0.001) and suppression (p =0.002) exacerbated the relation between COVID-19 stress and mental distress. Men had higher scores of suppression (p <0.001), and women had higher scores of cognitive reappraisal (p =0.025). The buffering effect of cognitive reappraisal presented itself only in women (p <0.001), while the exacerbation effect of suppression appeared only in men (p <0.001).

Conclusion: The current study suggests that COVID-19 pandemic-related stress is easier to deal with for those who have the tendency to cognitively reappraise. In contrast, suppression is associated with symptoms of depression and anxiety.

The prevention of mental distress can be supported by guiding people about the importance of using healthy emotion regulation strategies, as well as helping them to become more aware of the way they interpret and regulate their emotions. Gender differences in emotion regulation suggest gender awareness, e.g., tailored programs for men and women.

KEYWORDS

COVID-19, anxiety, depression, emotion regulation, moderator analysis, public mental health, reappraisal, suppression

Introduction

In early 2020, SARS-CoV-2 infected millions of people and the death toll associated with COVID-19 increased rapidly worldwide (WHO, 2020; Schöley et al., 2022). To limit and delay the COVID-19 outbreak, societies went into lockdown, and both the pandemic and its aftermath changed the daily life of most people globally (OECD, 2021; WHO, 2022b). During the first year of the pandemic the global prevalence of anxiety and depression increased by 25% (WHO, 2022a). This increase in mental distress is documented in numerous systematic reviews and meta-analyses reporting that the COVID-19 pandemic has generated major psychological health problems worldwide (e.g., Cénat et al., 2021; Wu et al., 2021; Robinson et al., 2022). Today, research shows that many people have rebounded from the mental distress caused by the pandemic, mostly returning to previous health. However, a small but significant number of individuals are still suffering from mental health problems (Lopez-Leon et al., 2021; Saunders et al., 2021; Robinson et al., 2022). Moreover, mental health problems are associated with long COVID, a chronic condition with high incidence rates (Lopez-Leon et al., 2021; Sachs et al., 2022).

According to the Lancet COVID-19 commission, governments around the world were too slow to acknowledge the seriousness of the pandemic and act with urgency in response (Sachs et al., 2022). Norway with a population of 5.3 million people was probably among the first countries to implement a nationwide lockdown on March 12, 2020 (Ursin et al., 2020; Andreas, 2021). The lockdown in Norway included school closures, working from home and limitations on nonessential services (sports, non-essential business etc.). Overall, only grocery stores, pharmacies, and gas stations remained open. The authorities also implemented forced self-isolation for those at risk of infection and those who were infected. In addition, they implemented several quarantine restrictions, travel restrictions, prohibition from staying overnight in holiday cabins across municipal borders, as well as spatial distancing and the compulsory wearing of face masks in public places (Ursin et al., 2020; Andreas, 2021; Blix et al., 2021). Experiencing the outbreak of a novel and life-threatening virus disease, together with the restrictions on individuals' autonomy and freedom, seems to have prompted an increase in mental distress in many people in Norway, particularly during the first months of the COVID-19 outbreak (Hoffart et al., 2020; Blix et al., 2021; Ebrahimi et al., 2021; Ernstsen and Havnen, 2021; Lassen et al., 2022). Even though Norway's mortality and infection rate from Sars-CoV-2 were low compared to many other countries (Hvide and Johnsen, 2022), loneliness and fear were reported as substantial factors associated with mental distress during the outbreak (Hoffart et al., 2020; Bemanian et al., 2021; Blix et al., 2021; Ebrahimi et al., 2021).

Although individuals may face the same stressful event (for example COVID-19) there are individual differences in how associated negative emotions are experienced or regulated (Gross and John, 2003; Too and Butterworth, 2018; Raymond et al., 2019). Recent studies found that during the COVID-19 pandemic, several resources and resilience factors played moderating and/or mediating roles in the associations between stressful experiences and mental health, e.g., individuals' sense of meaning of life (Schnell and Krampe, 2020), locus of control (Krampe et al., 2021), psychological flexibility (Smith et al., 2020), personality traits (Bacon and Corr, 2020; Smith et al., 2020; Liu et al., 2021; Abdelrahman, 2022; Lassen et al., 2022), as well as emotion regulation abilities (Xu et al., 2020; Liang et al., 2021; Ye et al., 2021; Gullo et al., 2022; Vertsberger et al., 2022). These findings imply that the way individuals deal with negative emotions in their daily lives, as well as under long term crises (e.g., pandemic), can either be a motivation for coping or it can have a negative impact on mental health and well-being (Garland et al., 2011; Conway et al., 2013; Xu et al., 2020).

Gross (1998b) differentiates between two emotion regulation strategies in his process model of emotion regulation: cognitive reappraisal and suppression. Both cognitive reappraisal and suppression behaviour operate along a continuum from conscious, effortful controlled regulation of emotions to unconscious, effortless, and automatic regulation (Gross and Thompson, 2006; Bargh and Williams, 2007). Emotion regulation is an important protective factor, and it concerns individuals' attempts to control (modify) their emotions to respond in a flexible and adaptive way to the environment (Gross, 1998a; Boyes et al., 2016). Cognitive reappraisal involves a reinterpretation of a situation into a more positive light (Ford et al., 2017), changing its potential meaning. Notably, it is not the situation itself that is changed, it is the individual's evaluation of the situation (Gross and Barrett, 2011; Raymond et al., 2019). Cognitive reappraisal can be employed prior to experiencing an emotion (Gross, 1998a), and it is therefore an effective strategy to reduce negative emotions through reframing emotion-eliciting experiences or stimuli (Gross and John, 2003). The second major emotion regulation strategy is suppression, involving the conscious inhibition of one's emotion expressive behaviors, whether they are covert, overt or both (Lazarus and Alfert, 1964; Gross, 1998a). Suppression is a response-focused strategy that intervenes once an emotion is "under way," or after the emotional response has been triggered (Gross, 1998a). For example, an individual may not be able to express their anxiety or fear about COVID-19, and may thus suppress their outer expression of negative emotion by putting on a façade of control, mutual agreement, or by becoming “paralyzed” by overwhelming negative emotions and therefore being unable to move forward. An individual inner emotion would thus remain unchanged, meaning that the expression of negative emotions is suppressed.

Literature review

Cognitive reappraisal and suppression differ in their adaptiveness in regard to promoting or undermining psychological health (for review, see Aldao and Nolen-Hoeksema, 2010). Extensive research shows that cognitive reappraisal is beneficial for psychological health (for review, see Webb et al., 2012; Hu et al., 2014), and that it is linked to resilience, positive affect, mental well-being, increased life satisfaction, better job performance, as well as favorable cognitive and social outcomes (Gross and John, 2003; John and Gross, 2004; Kashdan et al., 2006; Kraiss et al., 2020). In contrast, suppression is considered a maladaptive strategy, associated with worse psychological health outcomes (Aldao et al., 2010; Hu et al., 2014; Chervonsky and Hunt, 2017; Cameron and Overall, 2018). The tendency to withhold the expression of emotions is linked to, for example, impaired interpersonal relationships, greater anxiety and depression, poorer life satisfaction, lack of authenticity, lower self-esteem and increased negative emotions (Gross and John, 2003; Kashdan et al., 2006; English and John, 2013). The differential effects of cognitive reappraisal and suppression have also been confirmed in several correlational studies during the pandemic (Cardi et al., 2021; Liang et al., 2021; Low et al., 2021; Santi et al., 2021; Ye et al., 2021; Gullo et al., 2022).

Moreover, previous research found that emotion regulation is a significant moderator of the association between stress and symptoms of anxiety and depression. While cognitive reappraisal seems to buffer the relationship between stress and symptoms of anxiety and depression (Troy et al., 2010; Vanderhasselt et al., 2014; Johnson et al., 2016), suppression seems to exacerbate the relationship between stress and anxiety/depression (Boyes et al., 2016; Hosogoshi et al., 2020). Recent COVID-19 studies also investigated the moderating role of emotion regulation in diverse populations. The majority of the investigations found that cognitive reappraisal buffered the positive relationships between diverse types of perceived stress and subjective health (Prikhidko et al., 2020; Xu et al., 2020; Yang et al., 2020; Gröndal et al., 2021; Kuhlman et al., 2021; Raio et al., 2021; Ye et al., 2021; Chen et al., 2022; Vertsberger et al., 2022), while suppression exacerbated these relationships (Wu et al., 2021; Ye et al., 2021; Chen et al., 2022). However, some investigations did not find the buffering effect of cognitive reappraisal (Zhang et al., 2021) or the exacerbating effect of suppression (Yang et al., 2020; Gröndal et al., 2021; Raio et al., 2021).

Various studies indicate gender differences in emotion regulation (Tamres et al., 2002; Nolen-Hoeksema, 2012; Rogier et al., 2019). Women generally seem to use more emotion regulation strategies than men, including cognitive reappraisal, but not expressive suppression (Tamres et al., 2002; Goubet and Chrysikou, 2019). Importantly, data suggest that women apply emotion regulation strategies in more flexible ways (Goubet and Chrysikou, 2019). Concerning gender differences in the use of the specific strategies of cognitive reappraisal and suppression, the evidence is inconsistent. Several researchers showed that women have a stronger tendency to use cognitive reappraisal (Tamres et al., 2002; Nolen-Hoeksema and Aldao, 2011; Megıas-Robles et al., 2019; Rogier et al., 2019), while men seem to tend toward expressive suppression (Flynn et al., 2010; Megıas-Robles et al., 2019; Rogier et al., 2019; Santi et al., 2021). However, some studies did not find these differences for either cognitive reappraisal (Santi et al., 2021) or suppression (Tamres et al., 2002; Nolen-Hoeksema and Aldao, 2011). The evidence is also inconclusive regarding the interplay of emotion regulation, stress and mental distress. On the one hand, convincing data suggest that the interrelations of emotion regulation and forms of stress and mental distress are rather similar in women and men (Aldao and Nolen-Hoeksema, 2012; Lutz et al., 2022). On the other hand, a variety of gender differences have been reported. For example, in several studies, gender moderated the associations of reappraisal and suppression with diverse mental health outcomes, with significant effects sometimes only in men (Flynn et al., 2010; Rogier et al., 2019; Jiang et al., 2022), sometimes only in women (Nolen-Hoeksema, 2012; Rogier et al., 2019), and sometimes in different ways in men and women (Flynn et al., 2010; Megıas-Robles et al., 2019; Zhang et al., 2020; Jiang et al., 2022). Gender analyses of emotion regulation are sparse in psychosocial COVID-19 research. While Li et al. (2022) found higher reappraisal scores in women and higher suppression scores in men, Canlı and Karaşar (2020) and Santi et al. (2021) reported higher suppression scores in men, but no gender differences for reappraisal. Rodas et al. (2022) stated some moderation effects of gender but they did not describe these. Muñoz-Navarro et al. (2021) found that emotion regulation strategies mediated the associations between COVID-19 worries and anxiety differently in women and men. Finally, Panno et al. (2022) showed that cognitive reappraisal was negatively associated with COVID-19 stress and general mental distress in women but not in men, while there were no gender effects for the association of suppression with COVID-19 stress and mental distress. To our knowledge, until now, gender comparisons have not been published for the buffering and exacerbating effects of reappraisal and suppression, respectively.

The aims of this study were to (1) investigate whether emotion regulation moderated the relationship between COVID-19 stress and general mental distress during the first months of the pandemic in a community sample from Norway (Figure 1), and (2) examine in an exploratory way to what extent there were gender differences in the interrelations between COVID-19 stress, emotion regulation, and mental distress. After descriptive analyses, we performed moderation analyses for the complete sample. In the next step, we compared men and women regarding the study variables and repeated moderation analysis separately for women and men. We argue that high cognitive reappraisal will buffer the relationship between COVID-19 stress and general mental distress, and suppression will strengthen the relationship between COVID 19 stress and general mental distress. Previous research, using the same dataset, showed that COVID-19 stress was positively related to general mental distress in a population in Norway during the early months of the COVID-19 pandemic (Krampe et al., 2021). Consequently, COVID-19 stress and general mental distress are key research variables in this study. Age was included as a covariate, given that research shows emotion regulation behaviour is linked to lifespan (Carstensen et al., 2011). Regarding gender differences, we expected women to show higher scores of cognitive reappraisal and men to show higher scores of expressive

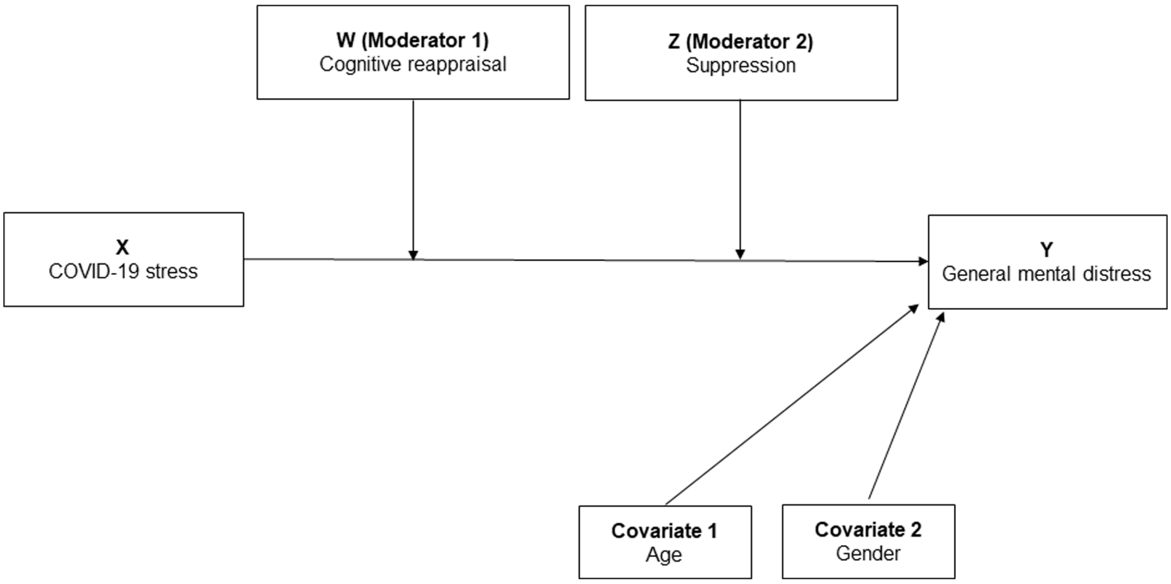

FIGURE 1
Conceptual model of how cognitive reappraisal (ERQ-CR) and suppression (ERQ-S) moderate the relationship between COVID-19 stress and general mental distress (PHQ 4) (double moderator, PROCESS model 2, *n*=1,207).

suppression. Given the conflicting evidence on gender effects within the relations of stress, emotion regulation and mental health, the separate moderation analyses for women and men were performed in an explorative way.

Materials and methods

Sample and procedures

This cross-sectional study was conducted in Norway ($n = 1{,}225$) from the period May 26th to June 4th 2020. During this time the Norwegian Government's COVID-19 regulations were gradually eased (Hansen et al., 2021). The study was distributed on several web pages of the collaborating institutions (e.g., Innlandet Hospital Trust, MF Specialized University, University of Stavanger) as well as forwarded by social media (e.g., Facebook). All participants expressed their informed consent by explicitly agreeing to continue with the questionnaire after being informed about the study's aims, employed data protection, participants' rights, and contact points for questions or concerns. Participation was voluntary and with no compensation. Ethical approval was obtained by Personvernombudet Innlandet Hospital Trust, Norway, No. 20/02104–1.

Measures

COVID-19 stress

The COVID-19 Stress Scale comprises seven items and involves a broad range of affective stress reactions to the pandemic situation (e.g., feelings of intolerability, boredom, anger and being left alone) as well as fears and pessimism about personal resources and the future (Schnell and Krampe, 2020). Sample items include *"I am irritated"* and *"I am afraid of the pandemic and what will happen to us."* The response scale ranged from 0 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha in this study was $\alpha = 0.73$. Confirmatory factor analyses were conducted showing a one-dimensional model of COVID-19 stress (Krampe et al., 2021). The scale has proven valid in several studies (Schnell and Krampe, 2020, 2022a,b; Dyrendal and Hestad, 2021; Krampe et al., 2021; Schnell et al., 2021).

General mental distress

General mental distress was measured with the Patient Health Questionnaire 4, PHQ-4 (4 items) (Kroenke et al., 2009, 2010). The PHQ-4 has demonstrated good reliability and validity in both clinical and population samples in Norway (Andreassen et al., 2019; Solem et al., 2021) and measures core symptoms of current depression and anxiety. Participants were asked to respond to the items in regard to the past two weeks (*"Over the last 2 weeks, how often have you been bothered by the following problems?"*). Sample items included *"Little interest or pleasure in doing things"* (depression) and *"Feeling nervous, anxious or on edge"* (anxiety). The response scale ranged from 0 = not at all to 3 = nearly every day. The sum score ranges from 0 to12, and cut-off points > 2, >3, and > 5 indicate mild, moderate, and severe mental distress, respectively (Kroenke et al., 2009; Kerper et al., 2014). Cronbach's alpha in this study was $\alpha = 0.82$.

Emotion regulation

Emotion regulation was measured using the 10-item Emotion Regulation Questionnaire (ERQ: Gross and John, 2003). This is one of the most widely used instruments to measure emotion regulation and has shown good psychometric properties in both clinical and population samples (Gómez-Ortiz et al., 2016; Sætren et al., 2019; Preece et al., 2020). Instructions were adjusted to how participants generally regulated their emotions when encountering stressful situations during COVID-19 restrictions. Participants were asked to rate the degree to which they regulated their emotions *via* cognitive reappraisal (6 items, sample item, e.g., "*When I want to experience more positive emotions, I change my way of thinking*") – or *via* suppression (4 items, *sample item,* e.g., *"I control my feelings by not expressing them*"). The response scale ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). The measures were translated from English into Norwegian and then professionally and independently back-translated to ensure language equivalence. After some adjustment, the back-translation was approved by the original developer James Gross (personal communication). In this study, Cronbach's alphas of the two subscales were $\alpha = 0.88$ for cognitive reappraisal and $\alpha = 0.81$ for suppression.

Statistical analyses

For all statistical tests, a two tailed value of $p < 0.05$ was considered statistically significant. Due to their small number, data from participants identifying as gender diverse were excluded from analyses that contained gender as a variable ($n = 2$). To test whether cognitive reappraisal and suppression moderate the relationship between COVID-19 stress and general mental distress (HQ1) a double moderation analysis was conducted using PROCESS 4.1 macro for SPSS (version 27), model 2 (Hayes and Andrew, 2013; Figure 1). PROCESS is a widely used regression-based path analytic approach to modeling mediation and moderation relationships, and therefore appropriate for testing our first hypothesis (Hayes et al., 2017). The moderation analyses employed bootstrapping with 5,000 samples. Independent t-test and a gender specific moderation analysis were applied to evaluate any gender differences in emotion regulation.

TABLE 1 Sociodemographic characteristics of the sample (N=1,225).

	Number or mean	% or SD
Age (Years)[+]	50.27	13.16
Gender		
Women	897	73.2
Men	326	26.6
Diverse	2	0.2
Nationality		
Norwegian	1,170	95.5
Denmark	8	0.7
Sweden	17	1.4
Other nationalities	30	2.4
University education	1,073	87.6
Occupation		
Health care[a]	325	26.5
Education system[b]	238	19.4
Different industries[c]	482	39.4
Currently not working	180	14.7

[+] $n = 1,209$. [a] e.g., nurses, doctors, psychologists. [b] e.g., kindergarten, school, higher education. [c] e.g., cultural sector, social organizations, hotel and catering industry, trade, and police.

Results

Sample characteristics and correlational analyses

Means, standard deviations and inter-correlations among the study variables are reported in Table 1. While COVID-19 stress and general mental distress showed a large positive correlation, all other correlations were of moderate to small size. Both COVID-19 stress and general mental distress correlated negatively with cognitive reappraisal and positively with suppression. Younger age was related to higher values in COVID-19 stress, general mental distress, and suppression. Gender was only marginally related to COVID-19 stress, general mental distress, cognitive reappraisal and age, but markedly associated with suppression (Table 2).

Moderating role of cognitive reappraisal and suppression

Cognitive reappraisal and suppression moderated the relationship between COVID-19 stress and general mental distress (Table 3). As expected, the positive relationship between COVID-19 stress and general mental distress was moderated negatively by cognitive reappraisal ($B = -0.17$, $SE = 0.05$, $p \leq 0.001$) and positively by suppression ($B = 0.15$, $SE = 0.05$, $p = 0.002$) (Table 3). Both cognitive reappraisal and suppression acted as independent moderators (Figure 2). When COVID-19 stress was low, general mental distress was also low, regardless of the extent of emotion regulation through cognitive reappraisal or suppression. However, with increasing COVID-19 stress, general mental distress levels were significantly higher for those who suppressed their emotions and for those who used less cognitive reappraisal. The model was significant at $F(7, 1{,}199) = 125.22$, $p < 0.001$. COVID-19 stress, cognitive reappraisal, suppression, age and gender explained 42% of the variance in general mental distress.

Comparisons of women and men

There were no statistically significant differences between women and men concerning mean scores of COVID-19 stress, general mental distress, or age (Table 4). Moreover, women and men did not differ significantly regarding rates of general mental distress for the cut-offs >5 (w: 9.3%, m: 8.3%, $p = 0.600$), >3 (w: 30.4%, m: 24.8%, $p = 0.057$), and >2 (46.6%, m, 40.5% $p = 0.058$). Consistent with our hypotheses, men reported using suppression to a higher degree than women, with a small to medium observed effect (Hedges' $g = 0.4$). Women, on the other hand, used significantly more reappraisal than men, with a rather small observed effect (Hedges' $g = -0.15$).

Separate moderation analyses were performed for women and men. Both regression models were significant: For women at $F(6, 877) = 106.82$, $p < 0.001$, and 42% of the variance explanation in general mental distress; for men at $F(6, 316) = 142.54$, $p < 0.001$, and 45% of the variance explanation in general mental distress. The models revealed significant gender differences. In women, the directions of regression coefficients remained equal to the ones of the regression model for the total sample. However, the effect sizes were

TABLE 2 Descriptive statistics, reliabilities and inter-correlations among variables^{+}.

	M	SD	1	2	3	4	5
COVID-19 stress	1.34	0.82	**0.73**				
General mental distress	2.51	2.35	0.61**	**0.82**			
Cognitive reappraisal	4.45	1.27	−0.20**	−0.21**	**0.88**		
Suppression	2.51	1.20	0.19**	0.23**	−0.04	**0.81**	
Age	50.27	13.16	−0.12**	−0.19**	0.01	−0.10**	
Gender			0.03	0.05*	0.06*	−0.17**	−0.06*

$^{+}$Reliability estimates are shown in bold along the diagonal; $n = 1{,}207–1{,}225$, due to missing data; Measures: COVID-19 stress: COVID-19 Stress Scale (range: 0–5); general mental distress: PHQ-4 (range: 0–12); emotion regulation (cognitive reappraisal, suppression): ERQ (range: 1–7); Gender: 1 = male ($n = 326$), 2 = female ($n = 897$). *$p < 0.05$, **$p < 0.001$, two-tailed.

TABLE 3 Cognitive reappraisal and suppression as moderators of the relationship between COVID-19 stress and general mental distress; *n*=1,207.

PHQ-4			95% CI for estimate		
	B (SE)	*t*	LL	UL	*p*
Intercept	2.86 (0.30)	9.50	2.27	3.45	<0.001
COVID-19 Stress (IV)	1.55 (0.07)	23.07	1.42	1.68	<0.001
Reappraisal (Mod. 1)	−0.19 (0.04)	−4.59	−0.27	−0.11	<0.001
Interaction IV × Mod1	**−0.17 (0.05)**	**−3.28**	**−0.26**	**−0.07**	0.001
Suppression (Mod. 2)	0.19 (0.05)	4.19	0.10	0.28	<0.001
Interaction IV × Mod2	**0.15 (0.05)**	**3.06**	**0.05**	**0.24**	0.002
Gender	0.29 (0.12)	2.47	0.06	0.53	0.014
Age	−0.02 (0.01)	−4.64	−0.03	−0.01	<0.001

Measures: COVID-19 stress: COVID-19 Stress Scale (range: 0–5); general mental distress: PHQ-4 (range: 0–12); emotion regulation (cognitive reappraisal, suppression): ERQ (range: 1–7); Gender: 1 = male, 2 = female. Bold values refer to the interaction effects.

higher for reappraisal and its interaction with COVID-19 stress and slightly lower for suppression. Importantly, the interaction of suppression and COVID-19 stress was not significant (Table 4). Independent of each other, COVID-19 stress and suppression were associated with higher, and reappraisal with lower mental distress. With increasing COVID-19 stress, mental distress levels were not significantly different for women who used more suppression. However, they were significantly higher for those who used less cognitive reappraisal (Table 5 and Figure 3).

In men, both the main regression effects of reappraisal and its interaction effect with COVID-19 stress were not significant. Compared with the model of the total sample, the main effect of suppression and its interaction effect with COVID-19 stress were larger (Table 5). Independent of each other, COVID-19 stress and suppression were associated with higher mental distress. With increasing COVID-19 stress, mental distress levels were significantly higher for men who used more suppression (Table 5 and Figure 4). The results of the gender-specific moderation analyses are also supported by the zero-order correlational patterns of the subsamples of women and men (Supplementary Table S1).

Discussion

Major findings

This study investigated whether cognitive reappraisal and expressive suppression moderated the relationship between COVID-19 stress and general mental distress during the early months of the COVID-19 pandemic in Norway. We found that cognitive reappraisal and suppression were differently related to COVID-19 stress and had opposite associations with general distress. Moreover, both variables served as moderators of the relationship between COVID-19 stress and general mental distress. While suppression worsened the relationship between COVID-19 stress and general mental distress, cognitive reappraisal buffered the relationship. When COVID-19 stress was low, this was also the case for general mental distress, and the mode of emotion regulation did not matter. This changed with increasing severity of COVID-19 stress. Here, lower cognitive reappraisal and higher emotion suppression were associated with elevated levels of general mental distress. Our findings revealed two significant gender differences. (1) Men had higher scores of expressive suppression, and women had higher scores of cognitive reappraisal. (2) Gender-specific moderation analyses suggest differential ways of emotion regulation. In women, cognitive reappraisal showed a significant negative relation to mental distress, and a substantial buffering effect of the relation between COVID-19 stress and mental distress. While suppression was positively related to higher distress, it did not buffer the relation between COVID-19 stress and mental distress. In men, cognitive reappraisal was not significantly related to mental distress, and it did not show a buffering effect. However, suppression was significantly associated with higher mental distress, and as a moderator, it substantially exacerbated the association of COVID-19 stress and mental distress. All in all, our data suggest that constructive emotion regulation became particularly relevant in situations of high COVID-19 stress.

Overall, our results are consistent with pre-pandemic research on emotion regulation showing that reappraisal buffered and suppression exacerbated associations between stress and symptoms of mental distress like anxiety and depression (e.g., Troy et al., 2010; Vanderhasselt et al., 2014; Boyes et al., 2016). The findings of the study at hand are also in line with recent COVID-19 studies that replicated the stress-distress buffering effect of cognitive reappraisal and the exacerbating effect of expressive suppression (Prikhidko et al., 2020; Xu et al., 2020; Yang et al., 2020; Gröndal et al., 2021; Kuhlman et al., 2021; Raio et al., 2021; Ye et al., 2021; Zhang et al., 2021; Chen et al., 2022; Vertsberger et al., 2022).

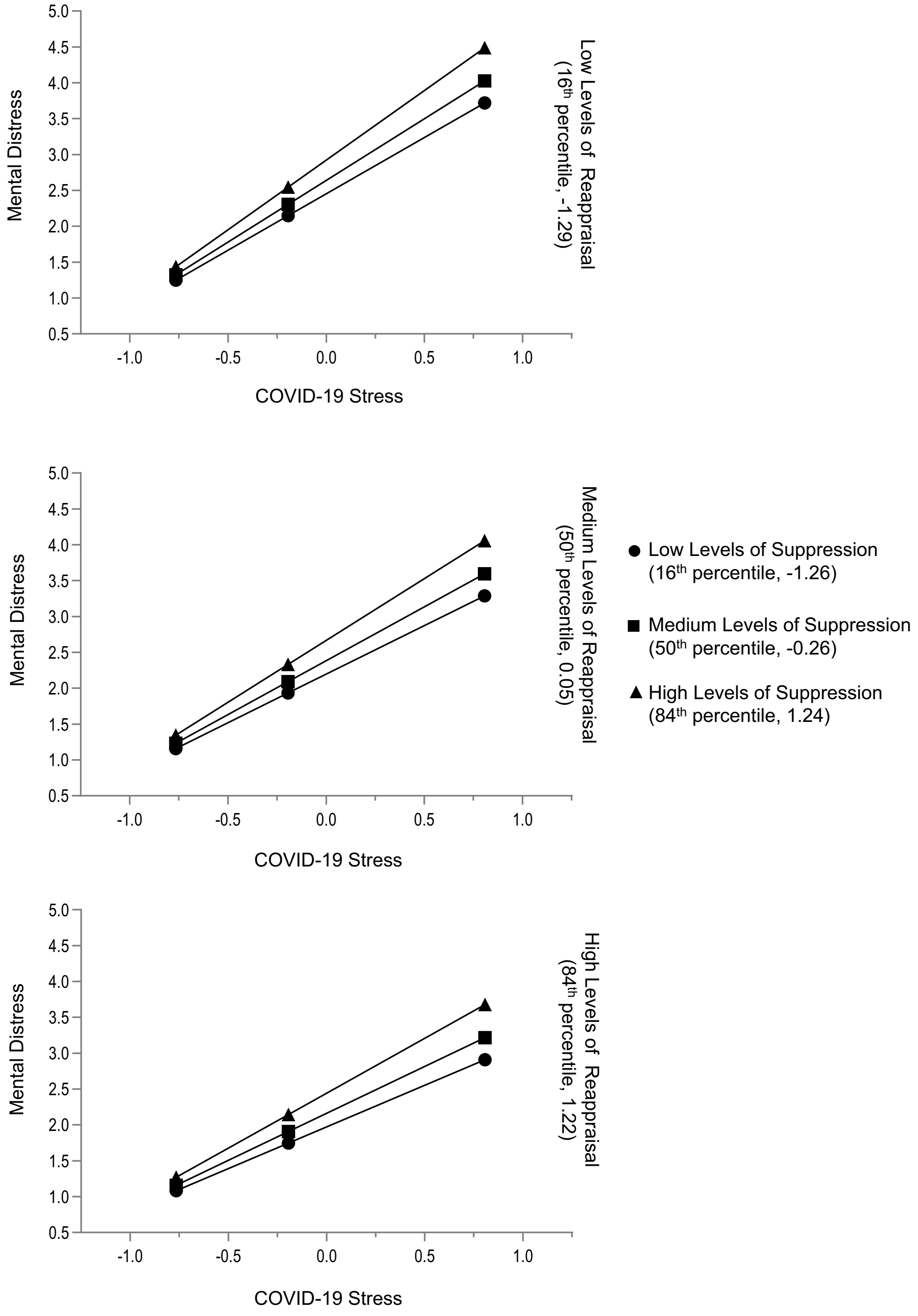

FIGURE 2
Total sample: conditional effects of COVID-19 stress on general mental distress for low, medium, and high levels of reappraisal and low, medium, and high levels of suppression. The variables ERQ Suppression, ERQ Reappraisal, and COVID-19 Stress Scale were mean centered prior to analysis (n=1,207).

Our results concerning gender-specific differentiations confirm extensive previous research that suggested gender differences in emotion regulation (Tamres et al., 2002; Nolen-Hoeksema, 2012; Goubet and Chrysikou, 2019; Rogier et al., 2019). The higher use of reappraisal by women and of suppression by men is in accordance with several previous studies before and during the COVID-19 pandemic (Tamres et al., 2002; Flynn et al., 2010; Nolen-Hoeksema and Aldao, 2011; Megıas-Robles et al., 2019; Rogier et al., 2019; Canlı and Karaşar, 2020; Santi et al., 2021; Li et al., 2022).

We are unaware of previous investigations comparing women and men regarding stress-distress buffering and exacerbating moderator effects of cognitive reappraisal and expressive suppression, respectively. However, our data fit into the puzzle of different gender-specific results of moderation analyses of emotion regulation before

TABLE 4 Comparison of women and men regarding study variables.

	Women (*n*=897)	Men (*n*=326)				95% CI	
	M (SD)	*M* (SD)	*t*	*p*	Hedges' *g*	Lower	Upper
COVID-19 stress	1.35 (0.83)	1.30 (0.77)	−0.91	0.364	−0.06	−0.19	0.07
General mental distress	2.57 (2.32)	2.29 (2.37)	−1.87	0.061	−0.12	−0.25	0.01
Reappraisal	4.50 (1.24)	4.32 (1.32)	−2.25	0.025	−0.15	−0.27	−0.02
Suppression	2.38 (1.15)	2.85 (1.28)	5.85	< 0.001	0.40	0.27	0.53
Age^{+}	49.79 (12.52)	51.60 (14.72)	1.96	0.050	0.14	0.01	0.27

$^{+}$n = 1,207, due to missing data. Measures: COVID-19 stress: COVID-19 Stress Scale (range: 0–5); general mental distress: PHQ-4 (range: 0–12); emotion regulation (cognitive reappraisal, suppression): ERQ (range: 1–7). Gender: 1 = male, 2 = female.

the COVID-19 pandemic (Flynn et al., 2010; Nolen-Hoeksema, 2012; Megıas-Robles et al., 2019; Rogier et al., 2019; Zhang et al., 2020; Jiang et al., 2022; Lutz et al., 2022), and also during the pandemic (Muñoz-Navarro et al., 2021; Santi et al., 2021; Panno et al., 2022; Rodas et al., 2022). At this point, we suggest that further studies are necessary with the aim of exploring potential superordinate factors and processes to explain common patterns and pathways underlying the diverse findings on specific moderation effects.

The role of cognitive reappraisal and suppression in stressful COVID-19 times

As previously stated, people's emotion regulation abilities seem to be influenced by contextual factors (Troy et al., 2010; Gross, 2015; Tamir, 2016; Troy et al., 2017). Research shows that in contexts of uncontrollable stressors, cognitive reappraisal becomes particularly beneficial for people's mental health. However, contextual factors are defined as all intervening factors that affect a complex phenomenon (c.f. Ploeg et al., 2019) (e.g., transactions between individuals and the environment) (Nolen-Hoeksema, 2012). Examples of (external) contextual factors in this study are the culture, welfare, state of health, living conditions, severity of the COVID-19 restrictions, COVID-19 mortality rates, leadership (authorities) and political trust. The Norwegian lockdown was relatively short in duration (From March 11th 2020, with a gradual relaxation in April 2020). At the time of performing this study, the authorities in Norway were gradually dispensing with some of COVID-19 restrictions (Ursin et al., 2020), although social distancing, social isolation, working from home and travel restrictions were still applicable (Knudsen et al., 2021). Health and welfare are contextual factors that may have influenced our findings (Sachs et al., 2022). Norway is ranked among the top 10 countries of the world in GNP *per capita*, with a high level of welfare and strong and resilient national health systems, including public health (OECD, 2020; Britannica, 2022), (e.g., Sachs et al., 2022). The COVID-19 mortality rate in Norway was low (0.45%) compared to its neighboring countries (1.6–2%) and further afield, such as Italy and Spain (7–10%) (Sciencenorway, 2022). Another contextual factor that may have influenced our findings was that the public had a high level of trust in the Norwegian authorities and viewed them as being transparent and honest (Offerdal et al., 2021; Ihlen et al., 2022). Moreover, lifespan (individual factors) also appears to influence people's emotion regulation behaviour (Carstensen et al., 2011; Kunzmann and Wrosch, 2018). Lifespan changes are associated with improved emotional stability (e.g., using more adaptive emotion regulation strategies) and well-being (Martins et al., 2016; Livingstone and Isaacowitz, 2018). A comparative study of COVID-19 stress and general mental distress between Norway and Germany/Austria (Krampe et al., 2021) (same data set) shows that Norwegian citizens had better mental health, indicated by less COVID-19 stress and general mental distress. Other studies comparing mental health/well-being before and during the onset of the pandemic in Norway found only a slight increase in mental health issues, particularly in vulnerable groups (Hoffart et al., 2020; Ebrahimi et al., 2021). However, constructive use of cognitive reappraisal is not always easy (Troy et al., 2018) and requires sufficient mental resources, such as vitality and mental well-being (Troy et al., 2018; Haver et al., 2021; Wu et al., 2021). Since cognitive reappraisal is closely linked to lifespan (average age: 52 years) and mental health/well-being, we believe that contextual and individual factors may have influenced our findings.

In terms of suppression, numerous COVID-19 studies indicate that lack of social support, loss of community and friendship worsened psychological distress (e.g., Banerjee and Rai, 2020; Jain et al., 2020; Smith et al., 2020; Philpot et al., 2021; von Mohr et al., 2021). It is well-researched that social connectedness e.g., social networking, community, engagement and friendly touch, acts as a buffer against various forms of distress (for review, see Gariépy et al., 2016). Having positive relationships is associated with mental health, particularly in times of crisis and involves the opportunity to express both negative and positive emotions through verbal and non-verbal communication (Phutela, 2015). It may thus be argued that worries, together with social distancing and social isolation (e.g., felt left to themselves), may have diminished the likelihood of using cognitive reappraisal or other adaptive emotion regulation strategies. Suppressors often experience lack of communication skills and poor relationships and they do not normally share their emotional experiences with others (Gross, 2015). In the long term this may lead to rumination thinking or at worst catastrophic thinking (Aldao and Nolen-Hoeksema, 2010), undermining psychological health (Aldao et al., 2010). That said, we do not yet know whether suppression was frequently or chronically used by the study subjects before the pandemic. Thus, this interpretation has to be handled with caution. Finally, we found a small to medium negative association between age and suppression, showing that younger people are more prone to using suppression. Most research shows that older adults are more consistent in their emotion regulation pattern across situations and are more likely to regulate their emotions by engaging in cognitive reappraisal (John and Gross, 2004; Webb et al., 2012; Sims et al., 2015). These differences in

TABLE 5 Differential moderation effects of emotion regulation in women and men: cognitive reappraisal and suppression as moderators of the relationship between COVID-19 stress and general mental distress.

(A) Women (*n*=884)			95% CI for estimate		
	B (SE)	*t*	LL	UL	*p*
Intercept	3.33 (0.25)	13.46	2.84	3.81	<0.001
COVID-19 Stress (IV)	1.51 (0.08)	19.58	1.35	1.66	<0.001
Reappraisal (Mod. 1)	−0.27 (0.05)	−5.44	−0.37	−0.17	<0.001
Interaction IV × Mod1	**−0.22 (0.06)**	**−3.77**	**−0.34**	**−0.11**	<0.001
Suppression (Mod. 2)	0.15 (0.05)	2.83	0.05	0.26	0.005
Interaction IV × Mod2	**0.08 (0.06)**	**1.40**	**−0.03**	**0.19**	**0.161**
Age	−0.02 (0.01)	−3.39	−0.03	−0.01	<0.001

(B) Men (*n*=323)			95% CI for estimate		
	B (SE)	t	LL	UL	*p*
Intercept	3.30 (0.38)	8.74	2.55	4.03	<0.001
COVID-19 Stress (IV)	1.65 (0.14)	12.01	1.38	1.91	<0.001
Reappraisal (Mod. 1)	−0.02 (0.08)	−0.25	−0.17	0.13	0.802
Interaction IV xMod1	**−0.03 (0.10)**	**−0.33**	**−0.22**	**0.16**	0.746
Suppression (Mod. 2)	0.26 (0.08)	3.25	0.10	0.42	0.001
Interaction IV × Mod2	**0.38 (0.10)**	**3.64**	**0.17**	**0.58**	<0.001
Age	−0.02 (0.01)	−2.93	−0.03	−0.01	0.004

Measures: COVID-19 stress: COVID-19 Stress Scale (range: 0–5); general mental distress: PHQ-4 (range: 0–12); emotion regulation (cognitive reappraisal, suppression): ERQ (range: 1–7); Gender: 1 = male, 2 = female. Bold values refer to the interaction effects.

emotion regulation may be linked to the fact that older adults have longer life experience: they are less physiologically reactive, they experience higher well-being and they have learned which strategies are most effective to achieve their personal goals (Carstensen et al., 2011; Eldesouky and English, 2018).

Gender differences in emotion regulation

Previous research shows gender differences in emotion regulation, particularly in terms of a flexible use of emotion regulation (Nolen-Hoeksema and Aldao, 2011; Goubet and Chrysikou, 2019). Flexible use of emotion regulation (e.g., contextual emotion regulation) refers to matching emotion regulation strategies to environmental circumstances (Aldao et al., 2015; Ullah et al., 2018). Our findings revealed that cognitive reappraisal was negatively related to general mental distress in women but not in men. The moderating role of cognitive reappraisal was significant for women but not for men. This may be linked to previous research arguing that women are more interpersonally oriented – they are more likely than men to seek social support in stressful times and are more prone to experiencing and expressing emotions. Women also have a larger repertoire of different emotion regulation strategies and are more skilled in the emotional domain than men (Brackett et al., 2006; Nolen-Hoeksema, 2012; Chaplin and Aldao, 2013). Several investigations have revealed that women are better at cognitive reappraisal (Tamres et al., 2002; Nolen-Hoeksema and Aldao, 2011; Megıas-Robles et al., 2019; Rogier et al., 2019; Li et al., 2022). These studies, along with our data, may indicate that men engage less in cognitive reappraisal but it is also possible that men use cognitive reappraisal unconsciously and thus do not report it (Nolen-Hoeksema, 2012).

In terms of suppression, our findings revealed that suppression was positively related to general mental distress in both women and men. When examining the moderation role, suppression was significant for men but not for women. These gender differences can be linked to the flexible use of emotion regulation, which involves a sensitivity to the situational demands (context), ability to use different emotion regulation strategies (large repertoire) and the ability to switch emotion regulation strategy if needed (Aldao et al., 2015; Eldesouky and English, 2018; Goubet and Chrysikou, 2019). Notably, flexible use of emotion regulation is found to be adaptive when it results in an enhanced likelihood of achieving personal and meaningful goals (Aldao et al., 2015; Rogier et al., 2019). For example, by engaging in risk-reducing behaviour or responding to environmental demands (e.g., following the government restrictions) the women in this study may have used suppression as a problem-focused strategy, enabling the threat to be endured and/or minimized. Thus, they were able to replace an uncomfortable emotion (anger, fear) with a more acceptable one or protect their relatives from discomfort or pain (e.g., alleviate their relatives' fear). Suppression may therefore have had a functional and adaptive role during the pandemic, serving to mobilize energy for these women and help them pursue their goals (Tamir, 2016; Rogier et al., 2019). This use of suppression may have enabled women to adapt to the pandemic more effectively (e.g., Troy et al., 2013). Concerning men and their use of suppression, our findings are in line with previous meta-analyses, reviews and recent studies showing that men are more likely to engage in suppressing than women (Aldao et al., 2010; Flynn et al., 2010; Webb et al., 2012; Megıas-Robles et al., 2019; Rogier et al., 2019). These findings were also confirmed during the pandemic (e.g., Italy, Turkey; China) (Canlı and Karaşar, 2020; Santi et al., 2021; Li et al., 2022). A potential explanation is complex but may be linked to women reporting more symptoms of anxiety and depression, for example, through emotional expression, venting of emotions and social support, which in turn decreases suppression. Men on the other hand are more likely to hide, remove, reduce or deflect their emotions and depression symptoms. Men also have a greater tendency to use alcohol to cope (Nolen-Hoeksema, 2012; Cavanagh et al., 2016). However, our findings must be interpreted with caution since gender differences in emotion regulation are relatively complex. The gender difference in emotion regulation can be linked to several factors, such as social cultural norms (e.g., masculinity, femininity), values, personality, stereotypes, emotion regulation abilities (flexibility), and biological and psychological explanations (Matsumoto et al., 2008; Chaplin and Aldao, 2013; Lopez-Zafra and Gartzia, 2014; Costa et al., 2017; Rogier et al., 2019).

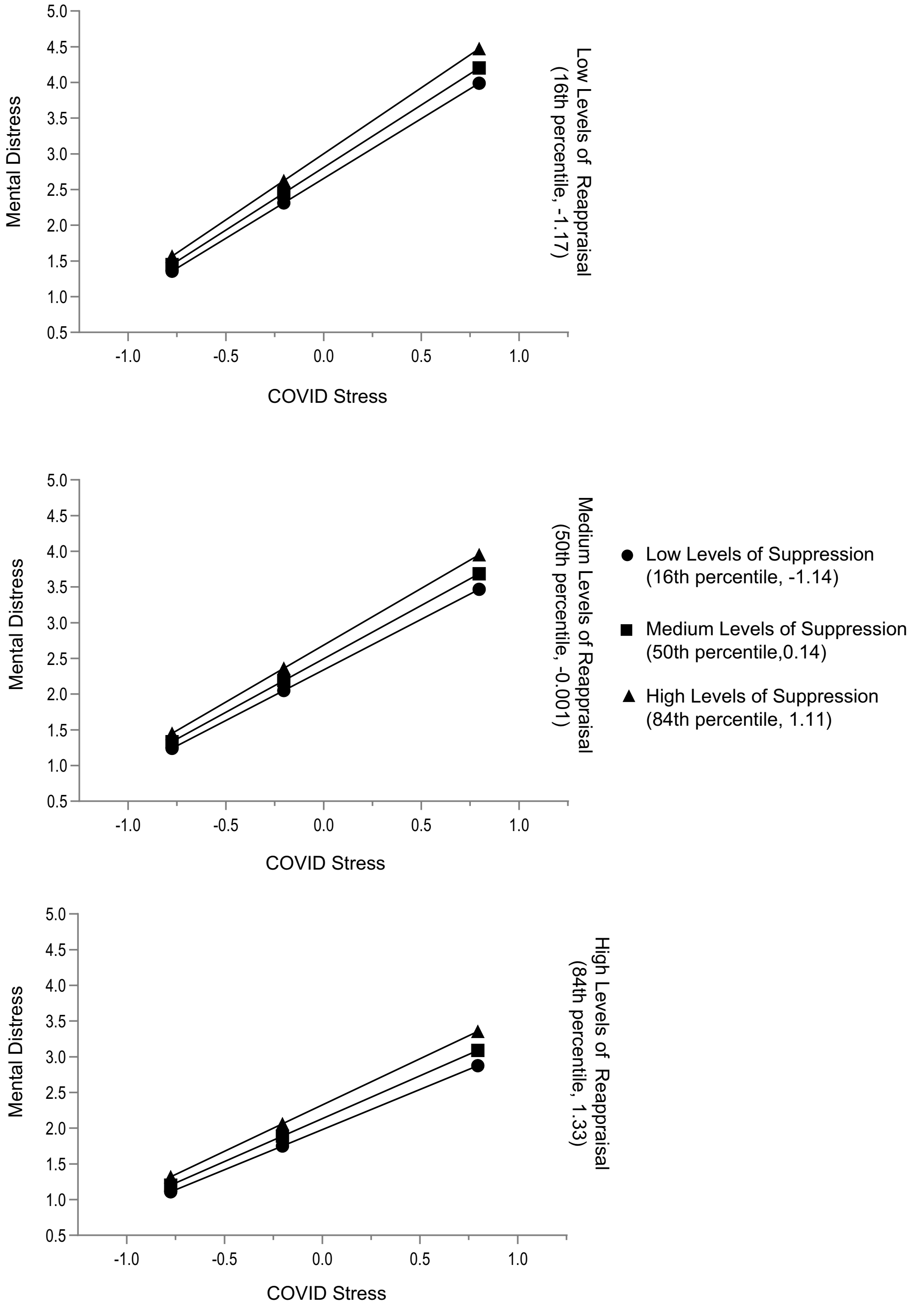

FIGURE 3
Women: conditional effects of COVID-19 stress on general mental distress for low, medium, and high levels of reappraisal and low, medium, and high levels of suppression. The variables ERQ Suppression, ERQ Reappraisal, and COVID-19 Stress Scale were mean centered prior to analysis (*n*=884).

Limitations, future directions, and conclusions

There are several limitations to the present study. Firstly, the study was conducted in Norway with a relatively high level of health and subjective well-being. Surveys conducted to measure life satisfaction in terms of 'the happiest country' have ranked Norway in the top 10 since 2012 (OECD, 2020). Cultural beliefs (e.g., collectivistic vs. individual cultures) and cultural differences, such as norms, values, stereotypes, are all important moderators and mediators in the relationship between emotion regulation and psychological health (Hu et al., 2014; Troy et al., 2018). Moreover, contextual factors, such as welfare, trust in government, infection rates and morality rates during the outbreak of the pandemic are also important aspects in any choice of emotion regulation. Investigating emotion regulation in different countries and contexts is thus required. Secondly, although

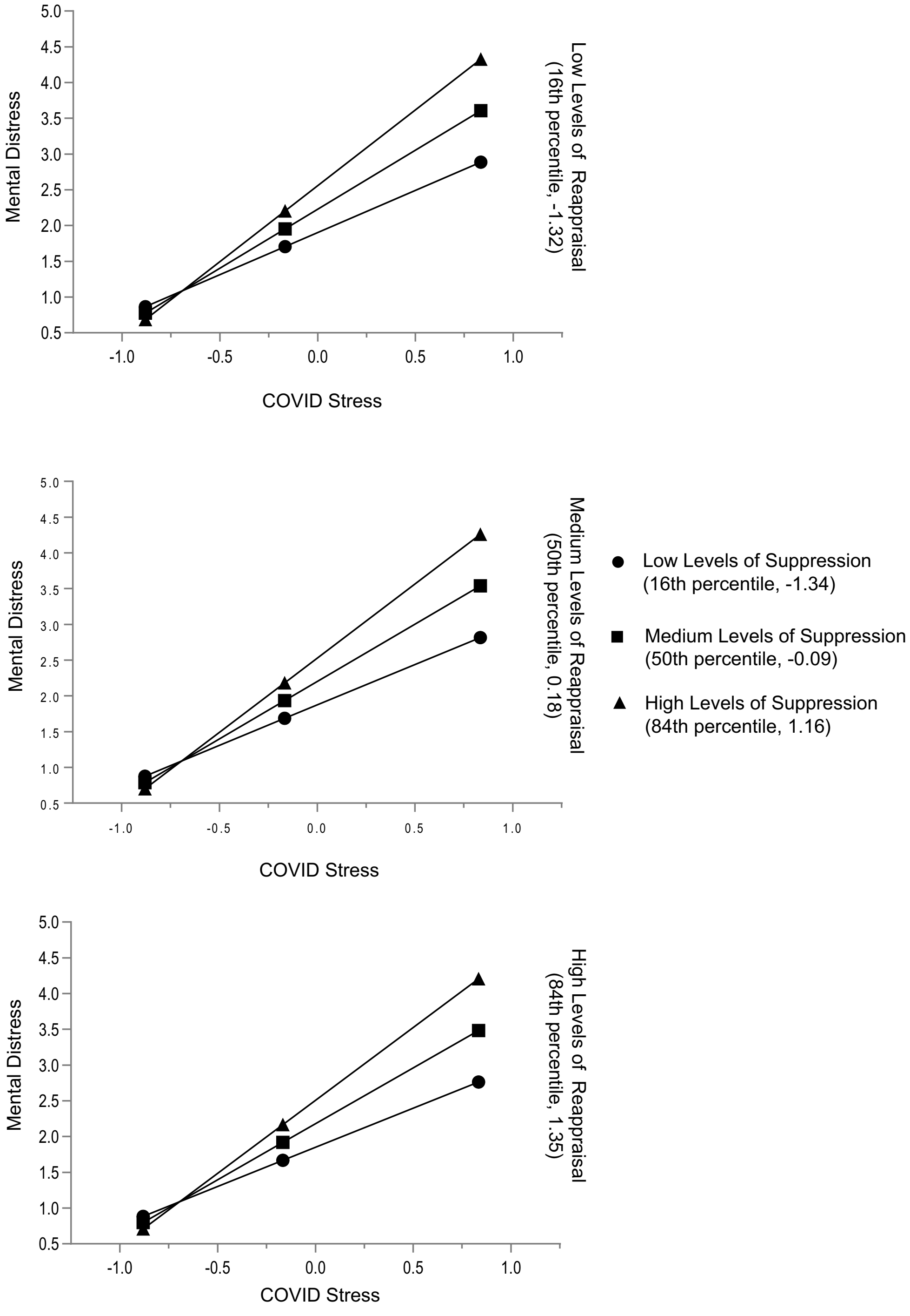

FIGURE 4
Men: conditional effects of COVID-19 stress on general mental distress for low, medium, and high levels of reappraisal and low, medium, and high levels of suppression. The variables ERQ Suppression, ERQ Reappraisal, and COVID-19 Stress Scale were mean centered prior to analysis (*n*=323).

the study covered a wide age range, the sample was not representative of the general population. Gender differences, as well as education level and life span may have influenced choice of emotion regulation. The sample may thus have been biased, with an overrepresentation of women, relatively high average age and highly educated individuals. Thirdly, this study has surveyed cognitive reappraisal and suppression, two of many identified strategies that individuals use to regulate their emotions (Parkinson and Totterdell, 1999). In order to further increase our understanding of which emotion regulation strategies constitute effective emotion regulation during crisis, a wider range of strategies should be included (e.g., maladaptive emotion regulation: rumination, catastrophizing). Fourthly, to strengthen the validity and to extend our knowledge during (global) crisis, longitudinal studies are required to see how individuals' emotion regulation strategies fluctuate over time and the extent of their impact on psychological health, including short-and long-time effects of emotion regulation.

Finally, to expand our conceptual understanding of emotion regulation during crises and to generate relevant hypotheses future research should include more qualitative studies. Despite these limitations, the convenience sampling of this material is coherent and consistent. The present study is well suited as a study aiming to explore new knowledge about COVID-19 stress, emotion regulation and general mental distress during a global health crisis.

This study examines emotion regulation in times of crises. The study also provides a more nuanced understanding of the role of cognitive reappraisal and suppression in a Scandinavian context. Even though COVID-19 now appears to be under control in most countries, it is important to note that new variants of the virus and new pandemics, alongside energy crises, economic crises and natural disasters may arise in the future. Given that cognitive reappraisal and suppression have different influences on the relationships between COVID-19 stress and general mental distress, health authorities should implement emotion regulation programs to promote a healthy and flexible use of emotion regulation. In practical terms, our findings suggest preventive measure responses through health promoting programs for developing/building psychological resilience in adolescents throughout their lives. Vulnerable groups, such as the youngest, would particularly benefit from emotion regulation training in times of crisis (e.g., web-based mindfulness programs). Health authorities should therefore be encouraged to develop health promoting programs (e.g., online self-guided), followed by preventive measures and interventions in school. Moreover, the findings in this study emphasize the importance of considering gender differences in future emotion regulation research. Consequently, it is vital to acknowledge that differences may exist between genders in terms of emotion regulation. This requires gender awareness, e.g., tailored programs for men and women.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Personvernombudet Innlandet Hospital Trust, Norway, No 20/02104–1. All participants expressed their informed consent by explicitly agreeing to continue with the questionnaire after being informed about the study's aims, employed data protection, participants' rights, and contact points for questions or concerns. All methods were carried out in accordance with relevant guidelines and regulations. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

AH wrote the first draft of the manuscript and, together with HK, TS, and LD performed the statistical analyses. LD and GS conceptualized, developed, and concluded the survey. AH contributed to the conceptualization and development of the survey. LD, TS, and HK performed data curation and project administration of the data set. AH, HK, and TS finalized the manuscript. All authors discussed the results, commented on the manuscript, contributed to critical revision of the manuscript, and read and approved the final manuscript.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1121986/full#supplementary-material

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A cross-sectional and longitudinal study of how two intervention methods affect the anxiety, sleep quality, and physical activity of junior high school students under quarantine

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Purpose: This study investigated levels of anxiety and sleep quality and their association with physical activity in junior high school students under quarantine during the COVID-19 pandemic. It also tests the effectiveness of physical activity and psychological nursing interventions in alleviating anxiety 'and improving sleep quality.

Methods: In July 2021, 14,000 home-quarantined junior high school students in Yangzhou City (China) were selected by random cluster sampling to complete an online survey. We then selected 95 junior high school students for an 8-week longitudinal experiment exploring whether the two types of intervention made positive contributions to students' anxiety, sleep quality, and physical activity.

Results: The cross-sectional study revealed that physical activity was significantly related to anxiety and sleep quality. In the longitudinal study, students who underwent the exercise intervention or the psychological nursing intervention experienced significant improvement in their anxiety levels. The exercise intervention also promoted improved sleep quality. Overall, the exercise intervention was more effective than the psychological nursing intervention in reducing levels of anxiety and sleep disorders.

Conclusion: During the epidemic period, junior high school students should be encouraged to spend more time engaging in physical activity, and their sleep quality and anxiety shouldbe focused on.

KEYWORDS

psychological nursing, physical activity, sleep quality, anxiety, junior high school student, cross-sectional-longitudinal study

1. Introduction

Against the background of the normalization of the COVID-19 epidemic in China, the rapid spread of virus mutations necessitates a range of prevention and control measures, including closing workplaces and schools. Residents in affected areas have been required to follow quarantine measures, resulting in negative impacts on their daily life and physical and mental health. One group particularly vulnerable to the detrimental effects of home or hotel quarantine, especially with respect to psychology, sleep, and learning, is junior high school students (Tao et al., 2023). With rising incidences of anxiety and depression in children and adolescents subject to sudden quarantines, there is an urgent need for targeted interventions to improve their physical and mental health (Önder et al., 2022). Therefore, to promote the healthy development of the adolescent population, it is especially important to focus on the physical and mental health problems they experience during COVID-19 quarantine periods, including what factors can worsen or alleviate these problems (Houghton et al., 2022).

Traditional approaches to the prevention and early treatment of common mental health diseases include physical therapy, psychotherapy, and drug therapy, but their effectiveness is somewhat limited by factors such as poor compliance and the side effects of drugs (Samushiya et al., 2021). Exercise intervention is increasingly recognized as an effective treatment for depression because it is easy to regulate and has no obvious side effects. By adjusting the timing, type, and organizational form of exercise intervention, the interests and hobbies of different depressed people as well as the time and frequency of exercise intervention are divided into different exercise items for intervention (Schuch and Stubbs, 2019). The influence of exercise interventions on sleep quality may be related to circadian rhythms. The circadian rhythm system of the human body is mainly concentrated in the suprachiasmatic nucleus of the hypothalamus and adjacent sites. Circadian signals are transmitted to multiple sleep-and-wake brain regions via the suprachiasmatic nucleus to regulate the phase transitions of each sleep stage and the transition between sleep and wake cycles. Disturbance of circadian rhythms and amplitude variation are the main causes of abnormal sleep structure. With the development of modern medicine, increasing attention is being paid to the mental health and happiness of different populations. Research has found that psychological nursing can alleviate low mood in students. Moreover, positive psychological interventions appear to have a calming and comforting effect on patients with schizophrenia. However, there are few reports of such interventions being targeted at primary and middle school students (Singh et al., 2020). Although academic circles have different perspectives on the hot topic of various sports and sports combined intervention in psychological problems, traditional sports may no longer be the most effective exercise for alleviating depression in students; instead, different forms of intervention activities may be more therapeutic.

To address gaps in the literature, this study investigates the influence of two types of intervention—exercise and psychological nursing—on the anxiety and sleep quality of junior high school students under home quarantine. We hope that our findings will offer insights on effective social support for adolescents during the COVID-19 epidemic, as well as providing a theoretical basis for improving adolescent anxiety and sleep quality.

2. Subjects and methods

2.1. Subjects of the survey

For the cross-sectional survey conducted between July and September 2021, we selected 14,000 junior high school students in Yangzhou City, Jiangsu Province, using stratified cluster random sampling. All participants were aged 12–15 years old and were in the first to the third grade. We sought to ensure roughly equal representation of male and female students and urban and rural residents. All participants gave fully informed to participating before completing the questionnaire. A total of 12,927 valid questionnaires were returned, representing an effective response rate of 92.3%. The data were analyzed using chi-square tests and logistic regressions. Table 1 presents basic information on the final sample.

TABLE 1 Basic information of participants.

Category	Items	n	%
Gender	Male	6,230	48.19
	Female	6,698	51.81
Grade	First	4,364	33.76
	Second	4,268	33.01
	Third	4,296	33.23
BMI	Underweight	2,117	16.38
	Normal	8,234	63.69
	Overweight	1,902	14.71
	Obese	675	5.22
Only child?	Yes	4,333	33.52
	No	8,595	66.48
Urban or rural?	Urban	7,859	60.79
	Rural	5,069	39.21
Living mode	With parent(s)	9,023	69.79
	With relative(s)	3,167	24.50
	Trusteeship	738	5.71
Family structure	Two-parent	11,768	91.03
	One-parent	769	5.95
	Recombination	391	3.02
Total		12,927	100

For the longitudinal experiment, which started in September 2021, we selected 95 home-quarantined junior high school students aged 12–15 years old as participants: 75 had anxiety standard scores >4, while the other 20 had scores of 4 or below. Seventy-five participants with elevated anxiety were randomly divided into the anxiety control group (25 people), psychological nursing group (25 people), and exercise group (25 people). The experimental process was divided into pre-test and post-test. All participants took part voluntarily and were free to withdraw at any time. Before the start of the study, we obtained informed consent from the school teachers, participating junior high school students, and their parents. The study design was approved by the Ethics Committee of the Nursing School of Yangzhou University (Batch number: YXYLL-2020-106).

2.2. Measurements

2.2.1. General information questionnaire

The general information questionnaire covered participants' gender, age, grade, body mass index (BMI), only-child status, urban–rural residence, living mode, and family structure. BMI was calculated by dividing weight by height^2 (kg/m^2). Overweightness and obesity were defined according to gender and age BMI thresholds in the national health standard Screening for Overweight and Obesity of School-age Children and Adolescents (WS/T 568-2018) (Chen et al., 2018). For BMI, $<$18.5 kg/m^2 means underweight, 18.5–23.9 kg/m^2 is normal, 24.0–27.9 kg/m^2 signifies overweight, and $\geq$28.0 kg/m^2 denotes obesity.

2.2.2. Generalized Anxiety Scale

We used Generalized Anxiety Scale (GAD-7) to evaluate participants' anxiety symptoms. The scale comprises seven items, each scored from 0 to 3. Total scores of 0–4 indicate minimal anxiety, 5–9 points represent mild anxiety, 10–14 denote moderate anxiety, and 15–21 suggest severe anxiety. Cronbach's α coefficient of the GAD-7 in this study was 0.932.

2.2.3. Physical Activity Rating Scale

The revised Physical Activity Rating Scale (PARS-3) by Liang Deqing was employed to assess the amount of physical activity of junior high school students (Zeng et al., 2022). The scale is divided into three items: exercise intensity, time, and frequency. Each item is answered on a five-point scale from 1 to 5, and exercise amount = intensity × (time−1) × frequency. Following the grade classification criteria used by Xia Xiangwei, a total score of $\leq$4 points denotes no exercise, 5–19 points indicate a small amount of exercise, 20–42 points represent a medium amount, and 43 or more points suggest a large amount. The scale has been shown to have high reliability and validity, with a test–retest reliability of 0.82. In the present study, Cronbach's α value of the scale was 0.639.

2.2.4. Pittsburgh Sleep Quality Index Questionnaire

We used the Chinese version of the Pittsburgh Sleep Quality Index Questionnaire (PSQI), as translated by Zou et al. (2023). The scale comprises seven items, each scored from 0 to 3 points, meaning the total score ranges from 0 to 21. Regarding the total PSQI score, $\leq$5 indicates good sleep quality, 6–10 means average sleep quality, 11–15 represents poor sleep quality, and 16–21 suggests very poor sleep quality. In international tests, the PSQI has demonstrated good reliability and validity. Cronbach's α coefficient of the scale in this study was 0.84.

2.3. Experimental process

The sample size for the longitudinal experiment was determined using Bayesian factor analysis, and the Bayesian factor threshold BF10 for stopping data collection was set at 10 (threshold for accepting H_1) and 1/10 (threshold for accepting H_0). Specifically, to test whether moral valence impacts on matching attempts in perceptual matching, this study focused on the difference in response time under different conditions and adopted Bayesian factor sequence design to test the BF values corresponding to three key effects: (1) the interaction between moral titer and matching degree; (2) the reaction time of the moral positive matching condition is faster than that of the neutral matching condition; and (3) the reaction time of the moral negative matching condition is slower than that of the neutral matching condition. The three key effects will be analyzed using Bayesian repeated-measures ANOVA and Bayesian paired-samples *t*-test (unilateral), respectively, which both use JASP built-in priors. Considering the practical factors of this study, the minimum sample size was set at 18 and the maximum sample size at 25 participants.

In the exercise group, the intervention lasted for 8 weeks and combined high-intensity interval training (HIIT) with regular exercise. The HIIT activities comprised 10 movements: 10 burpees, 30 opening and closing jumps, 10 kneeling push-ups, 20 alternating knee lifts, 20 squats, 20 bench bends, 10 squat jumps, 20 supine tummy rolls, 10 lunge squats, and 20 supine hip straightens on both sides. These exercises were performed at a medium intensity for 20 min, and completed 3 times per week. To ensure that exercise intensity was at the desired (safe) level, we randomly selected six participants to wear Polar heart rate monitors; their heart rates were recorded at quiet time and 3, 6, and 15 min into the exercise. Before the experiment, the research purpose and the exercise regime were clearly explained to all participants. They were forbidden to drink alcohol, coffee, tea, or any other drinks affecting sleep for 48 h before the experiment and instructed not to engage in strenuous exercise for 24 h before the experiment. No participants had any major life events.

In the psychological nursing group, quarantined students with elevated anxiety received remote online support from the nursing staff of Yangzhong People's Hospital. During the 8-week intervention, each student met remotely with a nurse once per week for 30–40 min. The intervention was designed to create a quiet and comfortable environment for dialogue, conducive to good communication; nurses maintained a cordial and warm attitude toward students and used technical language where appropriate, aiming to help students express their innermost thoughts and reduce their resistance to psychological intervention. Nurses explained to students the adverse effects of anxiety and how lack of physical activity is detrimental to physical and mental health, as well as providing information on the main causes of anxiety among junior high school students, such as learning pressure, change of environment, and separation. They also paid close attention to emotional variations in students, and gave targeted guidance based on each student's anxiety level, seeking to reduce their psychological burden and affirm their efforts in the intervention process. In addition, the nurses gave timely examples to illustrate the radical and fluctuating nature of anxiety, thereby aiming to lessen students' fear and concerns and promote their confidence. Students also received training in relaxation methods, such as listening to soft music to relax their minds and reduce both psychological tension and anxiety. Finally, the nurses also encouraged students to actively exercise at home.

TABLE 2 Chi-square test results for comparative levels of anxiety and sleep quality in demographic categories of junior high school students.

Category	Items	Anxiety *n* (%)		Sleep quality *n* (%)	
		Without anxiety	With anxiety	Good	Bad
Gender	Male	3,638 (28.12)	2,592 (20.05)	2,852 (49.77)	3,378 (46.93)
	Female	3,740 (28.93)	2,957 (22.87)	2,878 (50.23)	3,820 (53.07)
		χ^2: 2.218	p: 0.136	χ^2: 10.331	p: 0.001**
Grade	First	2,426 (32.89)	1,689 (30.41)	2,014 (35.15)	2,350 (32.65)
	Second	2,431 (32.95)	1,884 (33.96)	1,807 (31.54)	2,461 (34.19)
	Third	2,521 (34.16)	2,016 (35.63)	1,909 (33.32)	2,387 (33.16)
		χ^2: 8.230	p: 0.016*	χ^2: 12.740	p: 0.002**
Only child?	Yes	4,932 (66.84)	1,863 (33.56)	1,879 (32.79)	2,454 (34.09)
	No	2,446 (33.16)	3,686 (66.44)	3,851 (67.21)	4,744 (65.91)
		χ^2: 0.087	p: 0.768	χ^2: 2.421	p: 0.120
Urban or rural?	Urban	2,517 (34.11)	2,210 (39.82)	2,225 (38.83)	2,844 (39.51)
	Rural	4,861 (65.89)	3,339 (60.18)	3,505 (61.17)	4,354 (60.49)
		χ^2: 16.864	p: 0.000**	χ^2: 0.619	p: 0.431
Living mode	With parent(s)	5,198 (70.46)	3,869 (69.72)	3,956 (69.04)	5,067 (70.39)
	With relative(s)	1,734 (23.51)	1,366 (24.61)	1,445 (25.22)	1,722 (23.92)
	Trusteeship	446 (6.02)	314 (5.67)	329 (5.74)	409 (5.68)
		χ^2: 0.968	p: 0.616	χ^2: 3.042	p: 0.219
Family structure	Two-parent	6,773 (91.80)	5,045 (90.93)	5,235 (91.36)	6,533 (90.76)
	One-parent	407 (5.52)	332 (6.00)	330 (5.76)	439 (6.10)
	Recombination	198 (2.69)	172 (3.07)	165 (2.88)	226 (3.14)
		χ^2: 1.177	p: 0.555	χ^2: 1.459	p: 0.482

*$p < 0.05$.

**$p < 0.01$.

Participants in the anxiety control group and the normal control group lived a normal home life and engaged in study as usual.

2.4. Statistical analysis

The Kolmogorov–Smirnov normality test was conducted on the questionnaire results. p-values for anxiety, sleep quality, and total questionnaire all exceeded 0.05. At the test level of $\alpha = 0.05$, we can conclude that the survey results of each dimension and the total questionnaire did not significantly differ, indicating bivariate normal distributions suitable for Pearson correlation analysis. As p-value of the attitude dimension was <0.001, Spearman correlation analysis was used.

The data were analyzed using SPSS 26.0 software. For MPAI, total scores of 34–50 represent mild cell phone addiction, 51–68 denote moderate addiction, and 69–85 indicate severe addiction. Paired-samples t-tests were used to compare the data before and after the intervention, and independent-samples t-tests and one-way ANOVAs were used to test the different groups.

3. Results

3.1. Comparative levels of anxiety and sleep quality according to demographic characteristics

Chi-square tests were performed to identify any significant differences in the levels of anxiety and sleep quality within demographic categories. The results indicate that anxiety ($p < 0.05$) and sleep quality ($p < 0.01$) significantly differed among participants of different grades during the quarantine period. Anxiety also significantly differed between urban and rural dwellers, while sleep quality significantly differed between male and female students. No other significant differences were found. The full results are shown in Table 2.

3.2. Correlations and regressions of physical activity with anxiety and sleep quality

As shown in Table 3, Pearson correlation analysis revealed that physical activity was correlated with anxiety ($r = -0.174$,

TABLE 3 Pearson correlations of physical activity with anxiety and sleep quality.

		Physical activity
Anxiety	Correlation coefficient	-0.174^{**}
	p	0.000
Sleep quality	Correlation coefficient	-0.258^{**}
	p	0.000

$^{**}p < 0.01$.

$p < 0.001$) and sleep quality ($r = -0.258$, $p < 0.001$). Next, we used a simple linear regression model to analyze the impact of physical activity (independent variable) on anxiety and sleep quality (dependent variables). The model formulas were as follows:

$$\begin{aligned}\text{Anxiety} &= 10.954 - 0.054\,^{*}\,\text{physical activity}\\ \text{Sleep quality} &= 9.074 - 0.087\,^{*}\,\text{physical activity}\end{aligned}$$

with respective R^2 values of 0.030 and 0.066, indicating that physical activity explains the reasons of 3.0 and 6.6% changes in anxiety and sleep quality. Both regressions have overall significance (anxiety: $F = 402.645$, $p = 0.000 < 0.05$; sleep quality: 919.384, $p = 0.000 < 0.05$). The regression results are presented in Table 4.

3.3. Comparative levels of anxiety, physical activity, and sleep quality among different groups of junior high school students

As shown in Table 5, the results of independent-samples t-tests revealed significant differences in anxiety, physical activity, and sleep quality between the normal control group and the anxiety control group. The results illustrate that levels of anxiety, physical activity, and sleep quality significantly improved after the exercise intervention and psychological nursing during the quarantine period.

A one-way ANOVA was performed to reveal differences between the anxiety control group, exercise group, and nursing group in levels of anxiety, physical activity, and sleep quality. As reported in Table 6, we found significant differences in anxiety, physical activity, and sleep quality between the three groups.

3.4. Pre- to post-intervention changes in levels of anxiety, physical activity, and sleep quality in each group

We carried out paired-samples t-tests to compare levels of anxiety, physical activity, and sleep quality in each group before and after the intervention. After the exercise intervention, there were significant improvements in student's levels of anxiety ($p = 0.000$), physical activity ($p = 0.000$), and sleep quality ($p = 0.019$). After the psychological nursing intervention, there was no significant difference in anxiety ($p > 0.05$), but there were significant differences in physical activity and sleep quality ($p < 0.01$). In both the anxiety control group and the normal control group, anxiety, sleep quality, and physical activity all significantly declined over the 8-week period. The full results are shown in Table 7.

4. Discussion

The results demonstrated that, during the quarantine period, the incidence of anxiety among junior high school students was 43.0%, while 55.7% had sleep quality disorders. These levels are consistent with those reported by and Xu et al. (2019) and Chen and Qu (2021) for samples of junior high school students during the epidemic, but higher than those reported by Yao and Cao (2021) and Chen et al. (2022) in a normal environment. The epidemic is thus likely to explain differences in reported levels of anxiety and sleep quality. In our cross-sectional survey, anxiety was slightly more prevalent in female students (28.93%) than in male students (28.12%); bad sleep quality was also more prevalent in female students (53.07%) than in male students (46.93%). Anxiety prevalence was highest among third-grade students (35.63%), followed in turn by second-grade (33.96%) and first-grade students (30.41%); bad sleep quality was most prevalent in second-grade students (34.19%). Having one or more siblings, residing in a rural area, living with parents, and being in a two-parent family structure possessed significant anxiety and sleep quality problems.

Moderate exercise plays an important role in the physical and mental health development of adolescents (Biddle and Asare, 2011). According to the Guidelines for Physical Activity of Children and Adolescents in China, regular exercise can improve cardiovascular function, enhance metabolism, and improve muscle and bone health (Chen et al., 2020). The results show that the average level of moderate-to-vigorous physical activity among China's adolescents is only 37.66 min per day, far lower than the 60+ min per day recommended by the World Health Organization. In our study, the average physical activity level of junior high school students was only at a medium level; just 17.8% reported engaging in a high level of physical activity. Moreover, as BMI increases, the level of physical activity decreases, indicating that students who do not exercise are more likely to develop obesity. Male students reported significantly higher levels of physical activity compared with female students, consistent with the results of multiple prior studies. While in junior high school, children undergo rapid changes in physical form, physical function, and psychological state. In particular, boys experience rapid development in speed, strength, and endurance, resulting in greater gender differences in these physical attributes. Whereas male students often participate in sports and physical exercise in daily life, female students, due to physiological reasons, derive insufficient sense of self-efficacy from such activities, resulting in low enthusiasm for sports.

The level of self-reported physical activity was lowest in third-grade students, significantly lower than the levels reported by second- and first-grade students. In the third grade, students face heavy workloads and pressure to prepare for the high school entrance examination; devoting most of their time to study, they have little time available for physical exercise. At the end of the term, physical education is often given to the main class, resulting in insufficient physical education class hours, reduced activity time, and insufficient activity levels. We found that physical activity

TABLE 4 Linear regressions of sleep quality and anxiety on physical activity.

	Unstandardized coefficients		Standardized coefficients	*t*	*p*-value	VIF	R^2	Adjusted R^2	*F*
	B	Standard error	*β*						
Constant	9.074	0.091	–	99.533	0.000**	–	0.066	0.066	$F_{(1,12,926)} = 919.384$, $p = 0.000$
Sleep quality	−0.087	0.003	−0.258	−30.321	0.000**	1.000			
Constant	10.954	0.086	–	127.395	0.000**	–	0.030	0.030	F (1,12,926) = 402.645, $p = 0.000$
Anxiety	−0.054	0.003	−0.174	−20.066	0.000**	1.000			

D-W value of sleep quality: D-W value of anxiety.

**$p < 0.01$.

TABLE 5 Results of independent-samples *t*-tests comparing levels of anxiety, physical activity, and sleep quality between the normal control group and the anxiety control group.

Group (mean ± standard deviation)	Anxiety	Physical activity	Sleep quality
Normal control group ($n = 20$)	4.84 ± 1.64	19.65 ± 7.67	7.75 ± 3.02
Anxiety control group ($n = 25$)	10.40 ± 3.73	21.87 ± 9.01	9.80 ± 3.78
t	−10.125	−1.390	−3.150
p	0.000**	0.007**	0.002**

*$p < 0.05$.

**$p < 0.01$.

TABLE 6 ANOVA results for levels of anxiety, physical activity, and sleep quality in the three groups of students with elevated anxiety.

	Group (mean ± standard deviation)			*F*	*p*-value
	Anxiety control ($n = 25$)	Nursing ($n = 25$)	Exercise ($n = 25$)		
Anxiety	6.84 ± 3.89	9.20 ± 2.64	14.42 ± 4.98	53.008	0.000**
Physical activity	27.29 ± 11.59	26.49 ± 9.30	31.13 ± 9.60	3.240	0.042*
Sleep quality	6.22 ± 3.81	9.56 ± 3.32	9.65 ± 2.85	18.822	0.000**

*$p < 0.05$.

**$p < 0.01$.

was negatively related to anxiety and sleep quality in junior high school students, indicating that the decline in physical activity under quarantine negatively impacted on their psychological wellbeing and sleep, due to the factors such as environment, online classes, and electronic devices. Therefore, our findings suggest that increasing physical activity levels could alleviate anxiety and improve the sleep quality of junior high school students.

Overall, the cross-sectional survey results indicate that junior high school students experienced an increase in anxiety, a drop in physical activity, and a decline in sleep quality while quarantined. One explanation for our findings is that junior high school students are a vulnerable group in public health emergencies: losing access to timely psychological guidance, they may be prone to developing negative psychological problems such as depression and anxiety. Another explanation is that these students usually engage in physical exercise on weekends after class or at school. Although it is possible to exercise at home, the influence of learning pressure, emergency issues, and students' consciousness may have contributed to a decline in their physical activity levels. Prior research has revealed that excessive use of electronic devices by junior high school students became a serious issue during the epidemic period; spending so much time looking at screens and remaining sedentary have been associated with anxiety, sleep disorders, and other physical and mental health problems. The anxiety of junior high school students during the epidemic urgently requires high vigilance and attention from society, schools, and responsible authorities (Bateman et al., 2016; Woods and Scott, 2016).

Adolescent mental health has always been a hot topic in China and abroad, with great importance to the nation, society, and families. Studies show that more than 30% of adolescents worldwide have mental health problems (Auerbach et al., 2018). Moreover, depression and anxiety are reportedly the third most common psychological problems in adolescents. Consistent with this study's results, depression levels rise with a decrease in physical activity: possible mechanisms include leptin resistance caused by low physical activity, anxiety induced by high levels of pro-inflammatory factors crossing the blood–brain barrier, and disturbance of intestinal flora. In our longitudinal experiment, junior high school students who underwent 8 weeks of exercise intervention or psychological nursing experienced a significant reduction in anxiety. The results thus demonstrate that both forms of intervention helped to alleviate students' anxiety, and the interventions were feasible and effective. The exercise intervention

TABLE 7 Comparative levels of anxiety, physical activity, and sleep quality within each group before and after intervention.

Group	Measurement time	*n*	Statistical value	Anxiety	Physical activity	Sleep quality
Exercise	Pre-intervention	25		10.58 ± 3.59	27.09 ± 9.38	10.75 ± 3.74
	Post-intervention	25		8.47 ± 2.91	31.13 ± 9.60	9.65 ± 2.85
			t	8.443	−5.338	2.414
			p	0.000**	0.000**	0.019*
Nursing	Pre-intervention	25		9.25 ± 2.82	30.15 ± 8.51	8.51±3.78
	Post-intervention	25		9.01 ± 2.64	27.96 ± 7.59	9.56 ± 3.32
			t	0.256	2.407	−3.219
			p	0.014*	0.020*	0.002**
Anxiety control	Pre-intervention			6.84 ± 3.89	27.29 ± 11.59	6.22 ± 3.81
	Post-intervention			10.40 ± 3.73	21.87 ± 9.01	9.80 ± 3.78
			t	−12.445	6.293	−8.253
			p	0.000**	0.000**	0.000**
Normal control	Pre-intervention			2.27 ± 1.51	27.29 ± 11.59	5.44 ± 2.51
	Post-intervention			4.84 ± 1.64	19.65 ± 7.67	7.75 ± 3.02
			t	−10.427	6.747	−7.900
			p	0.000**	0.000**	0.000**

$^{*}p < 0.05$.
$^{**}p < 0.01$.

was also found to promote students' levels of physical activity and improve their sleep quality. By contrast, the psychological nursing intervention did not lead to improvements in levels of physical activity or sleep quality, which might be explained by the sedentarism and use of electronic devices that characterize learning through online courses. Therefore, students under quarantine should be encouraged to actively engage in physical exercise during the quarantine period. Moreover, schools and society should provide psychological guidance such as counseling, as well as conducting publicity campaigns and holding lectures on physical activity, sedentary behavior, and other related topics. These steps would help to reduce the pressure and difficulties of learning for junior high school students during the epidemic. In the home, parents should supervise how much time their children spend playing video games and pay attention to any changes in their children's psychological state. It is important that parents establish their own role models and drive students to engage more in physical exercise (Paolucci et al., 2018).

5. Limitations and future prospects

In recent years, depression has become considerably more common in student populations. With modern developments and lifestyle changes, traditional ways of treating depression have gradually lost their effectiveness, and exercise therapy has begun to be accepted by young patients. This study focused on junior high school students under quarantine status during the COVID-19 epidemic, resulting in several limitations. First, the online design of the experimental research made it difficult to control for various environmental factors likely to influence the measured variables. Moreover, we did not control for family structure and parenting behavior, which likely had a greater impact on students during the quarantine period compared with normal times. Second, the ratio of experimental staff to study participants was relatively large; in particular, the one-to-many approach of the psychological nursing intervention may have affected the experimental results, which consequently could not be well-promoted and applied. Third, longer term research is needed to investigate the volatility of anxiety in the target population. In addition, the causal associations between factors such as family support, diet, and anxiety levels require further study. Our findings suggest that exercise and psychological nursing interventions could be combined as a low-cost approach for reducing anxiety in junior high school students: future studies should test the effectiveness of this combination. Researchers should also test other innovative interventions for students and social families during the normalization of the epidemic.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of Nursing School of Yangzhou University (Batch number: YXYLL-2020-106). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

PC and YC contributed to study conception and design, and to manuscript polishing, and revision. SJ and PL organized the database, performed statistical analysis, and wrote the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

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The influence of social alienation on maintenance hemodialysis patients' coping styles: chain mediating effects of family resilience and caregiver burden

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Objective: Research on the possible impact of social alienation, family resilience, and caregiver burden on the coping styles of Chinese patients on maintenance hemodialysis (MHD) is scarce. We explore the influence of social alienation, family resilience, and caregiver burden on the coping styles of MHD patients, both directly and indirectly.

Methods: We invited 173 MHD patients and their primary caregivers for a cross-sectional study; the study using convenience sampling method at the hemodialysis center of the First People's Hospital of Foshan. The Chinese version of the generalized social of alienation scale, the Chinese version of the simplified coping style questionnaire, and a sociodemographic questionnaire were completed by the MHD patients, while their primary caregivers had filled out the Chinese family resilience assessment scale, the Chinese version of the Zarit caregiver burden interview, and provided socio-demographic information. SPSS macro program PROCESS v3.3 Model 6 were used for analyses of chain-mediated effects.

Results: In the mediating effects model, the direct influence of social alienation upon coping styles was significant (95% CI −0.050, −0.014), and social alienation indirectly impacted coping style by family resilience in a significant way (95% CI −0.012, −0.001) or caregiver burden (95% CI −0.013, −0.001). In addition, social alienation significantly impacted coping style by both family resilience and caregiver burden (95% CI −0.008, −0.001).

Conclusion: Social alienation can exert both a direct and indirect influence on coping styles through the mediating factors of family resilience and caregiver burden. Clinicians can take interventions to strengthen family resilience and reduce caregiver burden, which may be useful in improving socially isolated behaviors and coping skills in MHD patients.

KEYWORDS

social alienation, family resilience, caregiver burden, coping style, maintenance hemodialysis

Introduction

Maintenance hemodialysis is essential to postpone disease progression and prolong the life of patients and is the most widely used alternative therapy for the treatment of end-stage renal disease (1). As reported by the most recent data (2), the prevalence of hemodialysis has been increasing over the past few years, and the current total prevalence of hemodialysis in mainland China was 402.18 per million. Maintenance hemodialysis is unable to fully compensate for a patient's metabolic activity (3). MHD patients face many mental stresses during long-term treatment, such as heavy financial burden, negative body image and social isolation (4, 5). This series of negative impacts can cause individuals to withdraw, become alienated, or even develop social anxiety in interpersonal interactions. As a result, they may display social alienation behavior that prevents them from interacting positively with the outside world (6). Social alienation refers to a state in which individuals are unable to establish positive interactions with people or their surroundings, leading to negative emotions (7). Social alienation can be considered a stressor leading to mental stresses among chronic disease patients and is a predictor of various diseases and adverse health outcomes (8). However, this social alienation also increases the burden on their caregivers (9), families, and society (10). A recent study has shown that social alienation is an important factor leading to loneliness and depression (11), which can have an impact on the mental health and quality of life of the elderly (12). In addition, social alienation is one of the main risk factors for suicidal behavior (13). Therefore, it is important to explore how to maximize the return to life and social integration of MHD patients.

Coping is an attitude or action that individual takes in response to stress caused by changes in the internal and external environment (14). According to Lazarus' stress response theory, individuals' cognitive evaluations of stressors can vary, leading them to cope in either a positive or negative way (15). A recent study showed that coping styles are correlated with perceived stress, resilience, and social support (16). If a patient's family possesses strong resilience or if caregivers provide more understanding and support, it can enhance the patient's ability to cope with crises and adopt more proactive measures to alleviate negative stimuli. Positive coping is mainly characterized by the courage to confront difficulties and proactively seek solutions to problems. When patients have a positive coping style, it can assist them in better managing perceived threats and challenges, and give them a sense of control over their diseases (17), Additionally, regular engagement in social activities can foster positive psychological changes and a tendency towards positive coping styles in patients. Therefore, it is crucial to explore how social alienation affects coping styles in MHD patients.

Caregiver burden is described as the multifaceted stress perceived by caregivers as a result of providing care, and may further compromise the caregiver's financial, physical, and mental health (18). The caregiver burden was associated with the patient's conditions, including sociodemographic factors, mental status, disease progression, etc. (19). The caregiver burden was also related to daily caregiving hours, and the caregiver's work status and sleep duration (20). At present, the burden of caring for MHD patients in China mainly rests on their family members. However long-term home care inevitably creates lasting stress on caregivers (21), and they may suffer from serious mental disorders and decreased care provision for patients (22). As a consequence, patients and their caregivers can hardly adapt to the new life status, and ultimately the whole family is involved, which leads to an imbalance in the family system (23, 24). In addition, a recent study showed that the caregiver burden is associated with negative psychological outcomes (25). Emotional issues faced by caregivers may cause patients to feel more isolated and helpless, leading them to adopt negative coping style. However, there have been no studies on the relationship between caregiver burden, social alienation, and coping styles.

When suffering hardships, some families failed to adapt well to changes and leading to deterioration in the quality of life, while some were able to cope well with adversity, one of the factors that determine whether the family adapts well was family resilience (26). Family resilience, as a family strength and power, is a protective factor for caregiver burden and has positive implications for promoting individual and family health. Family resilience helps caregivers to cope with the various challenges they face in long-term caregiving (27). However, family resilience was also vulnerable to multiple factors such as the patient's disease progression (28), psychological status (29), disease perception (30), and caregiver burden level (31). Patients undergoing long-term hemodialysis treatment as a stressful event caused a huge impact on the whole family system. It was known through family resilience theory (32) that family resilience helps the whole family recover from distress and is critical for successful family adaptation to stressful events. Family resilience and caregiver burden may be able to influence patients' social alienation and coping styles. However, the relationship between family resilience, social alienation, coping styles, and caregiver burden have not been confirmed.

Thus, we explore the chain mediating role of family resilience and caregiver burden between patients' social alienation and coping styles at both individual and family levels. Based on the existing theory and literature, the research hypotheses are as follows: (H1) social alienation is negatively correlated with coping styles among MHD patients; (H2) family resilience has a mediating role in the relationship between social alienation and coping styles among MHD patients; (H3) caregiver burden has a mediating role in the relationship between social alienation and coping styles among MHD patients; (H4) family resilience and caregiver burden have a chain mediating role between social alienation and coping styles among MHD patients.

Methods

Participants

A total of 173 MHD patients and their primary caregivers at a hemodialysis center in a public hospital in China were invited to this study from September to October 2022. The inclusion criteria for the present study included: (1) patients should be at least 18 years old; (2) patients on regular dialysis for at least 3 months; (3) the caregiver must be a member of the patient's immediate family; (4) participants have basic reading and expression skills and volunteered to participate in this study. The exclusion criteria included: (1) patients were diagnosed with mental disorders by physicians according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, TR) (33); (2) participants were unable to communicate or failed to complete questionnaires for some reasons; (3) patients combined with other serious life-threatening diseases, such as malignant tumors of other systems, cardiopulmonary failure, serious infections, etc.

Procedure

After obtaining ethical approval from the First People's Hospital of Foshan (No. 2022082), this study was performed in a hemodialysis center according to the 2013 revised Declaration of Helsinki. Before the survey began, participants were informed about the purpose of the study and the requirements to complete it and told that they could withdraw from the study at any time and only answer questions that they were comfortable with. All participants had signed written informed consent, which indicates that they are fully aware of the study procedures. Pen and paper self-report questionnaires were completed by patients and their primary caregivers in two separate quiet rooms before hemodialysis treatment. All self-report assessments were conducted by 2 trained assessors, and they were available to assist participants who had difficulty completing the questionnaire. These investigators were instructed to only read the items verbatim without providing any further explanation. The entire survey process lasted 15–20 min. After each questionnaire was completed, the evaluator reviewed the questionnaire immediately and demanded participants complete any missing items if they were comfortable with. A small gift was provided to all participants at the end of the survey, to compensate them for the time they took to complete the questionnaire.

Measures

Socio-demographic information

The patients' socio-demographic information included age, marital status, residence, living situation, education level, occupational status, medical insurance, duration of hemodialysis, and social contacts. The primary caregivers' socio-demographic information included type of primary caregiver, age, education level, marital status, occupational status, monthly household income *per capita*, and duration of care.

Family resilience

The 20-item Chinese version of the Family Resilience Assessment Scale was used to measure family resilience (34), which has been tested in Chinese families for its psychometric properties, with a Cronbach's α of 0.94. It comprises four subscales: perseverance, harmony, openness, and supportiveness. Each item was answered on a five-point Likert scale from 1 (very non-compliant) to 5 (very compliant), for an overall score range of 20 to 100, with higher scores indicating higher levels of family resilience. The Cronbach's α for the scale in this study was 0.944, and the Cronbach's α for each subscale was from 0.787 for openness to 0.900 for harmony.

Social alienation

The generalized social of alienation scale (GSAS) was developed by Jessor and his colleagues (35) to assess individuals' feelings of alienation and uncertainty about participation in activities. In this study, the 15-item GSAS was used to measure social alienation (36), which was validated to have high validity and reliability, with a Cronbach's α of 0.77. It comprises four subscales: the sense of social alienation, the sense of self-alienation, meaninglessness, and powerlessness. The score was answered on a four-point Likert scale from 1 (strongly disagree) to 4 (strongly agree), and the total score range was 15 to 60, with higher total scores indicating higher social alienation. The Cronbach's α for the 15-item GSAS was 0.805, and the Cronbach's α for each subscale ranged from 0.614 for powerlessness to 0.772 for feelings of self-alienation in this study.

Coping style

The coping style scale was developed by Folkman and Lazarus (37) to assess the coping styles of individuals. The 20-item Chinese version of the simplified coping style questionnaire (SCSQ) was used to assess coping styles (38), which has been tested for suitability in Chinese populations, with a Cronbach's α of 0.90. The 20-item scale contains 2 dimensions: positive coping, and negative coping. The score was based on a four-point Likert scale ranging from 0 (not taken) to 3 (often taken). The higher score on which dimension, the more participants tend to adopt which coping style. The Cronbach's α for the SCSQ in this study was 0.944, the Cronbach's α for positive coping was 0.847 and for negative coping was 0.730.

Caregiver burden

The Zarit caregiver burden interview was developed by Zarit and his colleagues (39) to assess the caregiver burden of providing home care. In this study, the 22-item Chinese version of the caregiver burden inventory (CZBI) was used to measure caregiver burden (40). The scale has been tested in a Chinese sample and has high validity and reliability, with a Cronbach's α of 0.87. It consists of 2 subscales: personal burden (12 items), and responsibility burden (6 items), and the remaining 4 items are independently scored. Each item was scored on a five-point Likert scale from 0 (never) to 4 (nearly always), and the total score range was 0 to 88, the higher scores indicating a greater burden of care. In this study, Cronbach's α for the 22-item CZBI was 0.943, the reliability of the personal burden dimension was 0.847 and for responsibility burden dimension was 0.730.

Statistical analysis

All statistical analyses for this research were performed by using IBM SPSS 23.0 and SPSS macro program PROCESS v3.3. Descriptive data were described using means, standard deviations (mean ± SD), or frequencies (percentages). The correlations between family resilience, social alienation, caregiver burden, and coping styles were explored using Pearson's correlation analysis. The chain-mediated effects analysis was performed using the SPSS macro program PROCESS v3.3 Model 6, and the significance of the mediated model was tested using the bias-corrected percentile Bootstrap method (5,000 resamples, 95% CI). $p < 0.05$ (two-tailed) was set as the statistical significance level for this study.

Results

Descriptive statistics

A total of 173 MHD patients and their primary caregivers participated in this study, and the descriptive statistics for all variables are shown in Table 1. Among the 173 patients, most were married (79.2%), with primary school education or below (54.9%), retired/

TABLE 1 Socio-demographic information on MHD patients and their primary caregivers (N=173).

Variables	Patients (n =173)	Caregivers (n =173)
	N (%)	N (%)
Age (years)		
19 < 45	33 (19.1)	56 (32.4)
45 < 65	65 (37.6)	76 (43.9)
65 < 80	64 (37.0)	37 (21.4)
≥80	11 (6.4)	4 (2.3)
Educational level		
Primary school or below	95 (54.9)	68 (39.3)
Secondary school	54 (31.2)	55 (31.8)
University or above	24 (13.9)	50 (28.9)
Marital status		
Single	9 (5.2)	19 (11.0)
Married	137 (79.2)	142 (82.1)
Divorced/widowed	27 (15.6)	12 (6.9)
Occupational status		
Full-time job	29 (16.8)	74 (42.8)
Part-time job	7 (4.0)	17 (9.8)
Unemployed/retired	137 (79.2)	82 (47.4)
Residence		
City/suburban	113 (65.3)	
Countryside	60 (34.7)	
Living status		
With family	161 (93.1)	
Alone	12 (6.9)	
Medical insurance		
Yes	168 (97.1)	
No	5 (2.9)	
Duration of hemodialysis (months)		
<6	14 (8.1)	
6 < 12	24 (13.9)	
12 < 36	55 (31.8)	
≥36	80 (46.2)	
Social contact		
Normal	104 (60.1)	
Less	60 (34.7)	
Avoid	9 (5.2)	
Primary caregiver		
Spouse		104 (60.1)
Child		56 (32.4)
Parent		11 (6.4)
Sibling		2 (1.2)
Duration of care		
3 months < 1 year		27 (15.6)
1 < 3 years		31 (17.9)
3 < 5 years		23 (13.3)
≥5 years		92 (53.2)
Monthly household income *per capita* (RMB)		
<3,000		33 (19.1)
3,000 < 6,000		85 (49.1)
6,001 < 10,000		34 (19.7)
≥10,000		21 (12.1)

unemployed status (79.2%), living in town (93.1%), normally socialized (60.1%), and had medical insurance (97.1%). Regarding the duration of hemodialysis, 80 (46.2%) were on dialysis for more than 3 years. The patients' primary caregivers were spouses (60.1%), children (32.4%), parents (6.4%), and siblings (1.2%), and most of the primary caregivers had more than 5 years of care (53.2%), full-time status (42.8%), and monthly household income ranges from 3,000 to 6,000 RMB (49.1%).

Correlation between family resilience, social alienation, caregiver burden and coping style

The results of descriptive statistics and bivariate correlations for family resilience, caregiver burden, social alienation, and coping styles are shown in Table 2. A negative correlation was found between social alienation and family resilience ($r=-0.292$) and between social alienation and coping style ($r=-0.371$), while a positive correlation was found between social alienation and caregiver burden ($r=0.341$), both at the 1% significance level. A negative correlation was found between family resilience and caregiver burden ($r=-0.503$), while a positive correlation was found between family resilience and coping style ($r=0.347$), both at a 1% significance level. A negative correlation between caregiver burden and coping style ($r=-0.379$) was found at the 1% significance level.

Chain mediation effects analysis

A chain mediation model was developed with social alienation as the independent variable, family resilience and caregiver burden as mediating variables, and coping style as the dependent variable. An analysis of the chain mediation model between the four variables were depicted in Figure 1. The results of the test for chain-mediated effects of family resilience and caregiver burden on social alienation and coping styles are presented, respectively, in Tables 3, 4. The results indicated that: (a) the direct influence of social alienation upon coping styles was significant, and the value of direct influence was −0.032 (95% CI −0.050, −0.014); (b) social alienation indirectly impacted coping style through family resilience in a significant way, the value of indirect influence was −0.006 (95% CI −0.013, −0.001); (c) social alienation indirectly impacted coping style through caregiver burden, and the value of indirect influence was −0.006 (95% CI −0.012, −0.001); (d) social alienation significantly impacted coping style through both family resilience and caregiver burden, the value of

TABLE 2 Correlation of social alienation, family resilience, coping styles, and caregiver burden in MHD patients (*N*=173).

	Mean±SD	Range	Family resilience	Social alienation	Coping style	Caregiver burden
Family resilience	77.49 ± 11.55	69 (29–98)	1.000			
Social alienation	35.03 ± 5.92	35 (16–51)	−0.292**	1.000		
Coping style	30.96 ± 8.92	51 (2–53)	0.347**	−0.371**	1.000	
Caregiver burden	23.53 ± 15.82	74 (2–76)	−0.503**	0.341**	−0.379**	1.000

**$p < 0.01$.

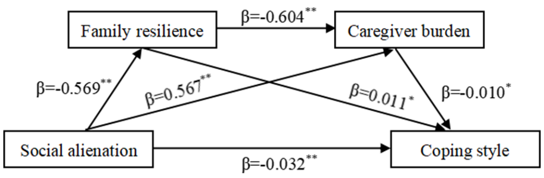

FIGURE 1
Chain mediating effects of family resilience and caregiver burden between social isolation and coping styles in MHD patients. **p<0.01, *p<0.05.

indirect influence was −0.003 (95% CI −0.008, −0.001). The bias-corrected 95% CI for all pathways did not contain 0, which was statistically significant.

Discussion

We explored the influential pathways of coping styles of MHD patients in terms of the family's intrinsic factors and caregivers' external influences. We tested the effects of family resilience and caregiver burden as chain-mediated variables on social alienation and coping styles. The results of the mediated effects analysis indicated that social alienation directly affected the coping style of MHD patients. Moreover, social alienation also indirectly affects the coping styles of MHD patients both through family resilience and caregiver burden. The indirect effects include three mediating pathways: (a) family resilience as a mediating variable; (b) caregiver burden as a mediating variable; (c) chain-mediated pathways with family resilience and caregiver burden as mediating variables.

In this study, social alienation in MHD patients was at a moderate level (35.03 ± 5.92), which is lower than the level (41.57 ± 4.89) (41) of maintenance hemodialysis patients in China. There are several reasons why MHD patients have a moderate level of social alienation. First, the preventive and control measures for the COVID-19 pandemic have been escalating, which reduced opportunities for social interaction and increased the social alienation of MHD patients. Second, two to three per week of maintenance hemodialysis, higher level of mobility, and treatment-related self-image disturbances (42) probably limit the ability of MHD patients to participate in social activities, in other words, this does not facilitate healthy interaction with the outside world. Lastly, it is important to acknowledge that MHD patients typically rely on the support and assistance of caregivers, including family members or friends. However, the caregiving role often places significant physical, psychological, financial, and time-related burdens on caregivers. These burdens can contribute to emotional fatigue and psychological stress (22), which may hinder caregivers from providing optimal support and care to patients. Consequently, the social alienation experienced by MHD patients may be further exacerbated.

Our results support the hypothesis that social alienation negatively correlates with the coping styles of MHD patients. MHD patients tend to adopt a negative coping style when social alienation levels increase. Social alienation is quantifiable for indicating the shrink of social networks and reduce of social connections (43). After staying away from social activities for a long time, patients lose the support of social groups, which in turn aggravates their withdrawal and avoidance and eventually could cause inability to communicate with others. Coping abilities are necessary for people to build healthy social networks. According to Roy et al. (44), human develop adaptive responses when facing stress, and the physiological and psychological regulation of human is mainly expressed through coping behaviors adaptively. A positive coping style can be helpful for patients to maintain normal social activities. Therefore, helping MHD patients to cope better with the struggle of chronic illness and maintain normal social interactions, which is significant for developing strategies to reduce the social alienation of MHD patients.

We validated the mediating effect of family resilience between social alienation and coping styles. Recent research indicated that family resilience was positively correlated with coping styles and had a direct predictive effect on patients' self-care status (45). Family resilience can enhance the ability of family members to cope with adversities and has positive implications for solid family function (46). In this study, MHD patients with higher levels of family resilience were able to manage stressful events better, they developed positive coping styles and reduced social alienation levels while overcoming adversities. Therefore, we recommend that clinicians and nurses pay attention to assessing family resilience levels in MHD patients and developing family resilience-based interventions to promote their positive coping with the negative emotions that arise during long-term hemodialysis treatment.

Our results also validated the mediation effect of caregiver burden between social alienation and coping styles. Caregiver burden is a mediating variable, which mitigates the effect of social alienation on coping styles of MHD patients. In this study, reducing the caregiver burden helped patients build active coping styles for long-term hemodialysis treatment, which was consistent with previous results (47). At the same time, patients and caregivers are emotionally connected and negative emotions of them can lead to negative changes in family relationships (48), these negative changes partially lead to socially alienated behaviors and increase the burden on caregivers, which in turn affects the coping strategies of MHD patients. Therefore, it is necessary to focus on family counseling programs and dualistic interventions that combine patients and caregivers to deal with their negative emotions.

Finally, our results suggest that family resilience and caregiver burden play significant chain mediating roles among social alienation

TABLE 3 Regression analysis of variable relationships in chained mediation models (*N*=173).

Variables	Family resilience			Caregiver burden			Coping style		
	β	SE	*t*	β	SE	*t*	β	SE	*t*
Social alienation	−0.569	0.143	−3.987**	0.567	0.180	3.153**	−0.032	0.009	−3.459**
Family resilience				−0.604	0.092	−6.554**	0.011	0.005	2.134*
Caregiver burden							0.010	0.004	−2.595*
R^2	0.085			0.295			0.231		
F	15.897**			35.487**			16.884**		

$^{**}p < 0.01$, $^{*}p < 0.05$.

TABLE 4 Path analysis of mediating effect among four variables.

Pathways	Effect	SE	95% CI		Percentage of mediating effect %
			LLCI	ULCI	
Social alienation → coping style	−0.032	0.009	−0.050	−0.014	68.08
Social alienation → family resilience → coping style	−0.006	0.003	−0.013	−0.001	12.77
Social alienation → caregiver burden → coping style	−0.006	0.003	−0.012	−0.001	12.77
Social alienation → family resilience → caregiver burden → coping style	−0.003	0.002	−0.008	−0.001	6.38
Total mediating effect	−0.015	0.004	−0.024	−0.008	31.92
Total effect	−0.047	0.009	−0.065	−0.029	100

and coping styles. Previous research has illustrated that family resilience and patients' emotional symptoms were influential factors in caregiver burden because these two factors impact the stress level of the caregiver (49, 50). When MHD patients have higher levels of family resilience, they can better coordinate family relationships, social resources, and support to cope with the adverse effects of long-term treatment. Higher levels of family resilience also promote positive coping and normal social interaction in MHD patients and reduce the burden on caregivers. However, it is worth noting that the indirect influence of family resilience and caregiver burden was relatively modest, suggesting the possibility of additional mediating variables between social alienation and coping styles. Future studies could delve into exploring these potential mediating variables, expanding our understanding of the complex relationship between social alienation and coping styles.

Limitations

The limitations of this study are as follows. Firstly, this study is a cross-sectional study, thus, it cannot infer a causal relationship among social alienation, family resilience, coping styles, and caregiver burden. Secondly, convenience sampling may lead to selection bias, which limits the applicability of the conclusion. Therefore, a multicenter investigation is necessary for future studies. Thirdly, although we reviewed clinical records and asked patients about their mental health history at the beginning of the study, it was insufficient that we did not conduct a standardized interview to assess, the data we collected from the questionnaires may be biased by mental status. Finally, only caregivers reported family resilience in this study, which may not be comprehensive enough to characterize the resilience level of the whole family. Family resilience can be explored in the future from the perspective of all family members.

Conclusion

On one hand, social alienation directly influenced coping styles, on the other hand, it also influenced indirectly the coping styles of MHD patients through family resilience and caregiver burden. In addition, family resilience and caregiver burden have significant chain mediating roles between social alienation and coping styles. Our findings emphasized the importance of three mediated paths between social alienation, family resilience, caregiver burden, and coping styles. Our findings also support the idea that assessing and enhancing family resilience, as well as reducing caregiver burden is critical to changing socially alienated behaviors and improving the coping skills of MHD patients. Therefore, clinical practitioners should pay attention to assessing the level of family resilience in MHD patients, and the family-based intervention combining patient and caregiver can be developed to deal with the negative emotions of long-term treatment and improve the quality of life for patients and their caregivers.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of First People's Hospital of Foshan (No. 2022082). The patients/participants provided their written informed consent to participate in this study.

Author contributions

QL: data collection, methodology, writing original draft, writing review, and editing. XX, XM, YL, JL, and WC: data collection, data curation, and provison of study materials. LZ: conceptualization, project administration, writing review, and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

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Influence of job satisfaction on SRH and happiness among Korean disabled workers: findings from the panel survey of employment for the disabled 2016–2018

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Background: An understanding of the economic life activities of persons with disabilities (PWD) is important. Their ability to perform tasks and an increase in their income are more likely to yield an improvement in their Self-Rated Health (SRH) and happiness. However, there is still a lack of understanding of the specific associations among PWD in South Korea. Thus, this study conducted a longitudinal analysis of the association between job satisfaction and SRH, happiness among the Korean PWD.

Methods: After excluding missing values, data on 1,637 participants at baseline (1st wave) were analyzed using the chi-square test, t-test, Analysis of Variance (ANOVA) and generalized estimating equation (GEE) model for data from 1st to 3rd Panel Survey of Employment for the Disabled (PSED). All analyses were conducted using the SAS statistical software package, version 9.4.

Results: Compared to very high job satisfaction group, low job satisfaction group was more likely to experience negative SRH [odds ratio (OR): 3.497, value of p: <0.0001] and experience low happiness (B: −0.291, value of p: <0.0001). Furthermore, in terms of the overall satisfaction with current job among the PWD, compared to the 'very satisfied' group, 'very unsatisfied' group had higher negative SRH (OR: 5.158, value of p: 0.003) and lower happiness (B: −0.327, value of p: <0.0001).

Conclusion: This study suggests that increasing job satisfaction of PWD possibly leads to decreased negative SRH and to increased happiness, resulting in better SRH and happiness. Furthermore, it suggests the establishment of systemic, policy-oriented measures to enhance the employment opportunities for disabled individuals in Korea and create an inclusive working environment that aligns with their respective job responsibilities.

KEYWORDS

job satisfaction, SRH, happiness, persons with disability, South Korea

Background

Recently, people have increasingly begun to realize that they can enjoy a high-quality life, by maintaining a healthy lifestyle in which their physical health, happiness, and social stability are balanced. One of the major activities of modern industrialized societies is employment, as this is an essential component in ensuring equal opportunities in socioeconomic life (1). Especially, not only in economic activities, but job satisfaction is one of the crucial factors for people with disabilities (PWD). According to previous research (2, 3), the management of job satisfaction among PWD is essential due to complaints arising from organizational structural aspects and income distribution. Also, Unemployment is bound to be characterized by poor psychological and physical health and other problems (4–7). Since income is one of the most significant factors to maintain socioeconomic status, lower incomes might lead to distress arising from social and psychological deprivation, resulting in poor health (5).

The Convention on the Rights of Persons with Disabilities (CRPD) (8) and the enactment of laws to guarantee human rights, including the Disability Discrimination Act (DDA) (9), were intended to raise awareness of disabilities and the human right of the persons with disabilities (PWD) and to strive for social integration.

It is widely assumed that higher employment of PWD improves their subjective well-being. An understanding of the economic life activities of PWD is important. Demonstrations of their ability to perform particular tasks and an increase in their income are more likely to yield an improvement in their quality of life (10). A panel study conducted by Choi, Kim, Han, and Kim (2019) (11) suggests that the lower income of PWD in South Korea and the precarious nature of their employment are significantly related to poor SRH compared with those who have more stable employment or higher incomes. Van Campen and Iedema (12), however, found that employment of PWD was much less closely associated with perceived health and happiness than expected. In fact, they argued that objective aspects of work, such as the number of hours they work in paid employment, have little effect on perceived health and well-being compared to subjective aspects of work, such as the extent to which they enjoy their work. Thus, the job satisfaction of PWD might be a more important factor in promoting better well-being and perceived health than simply the income associated with their work.

Well-being is often regarded as a term that is similar in meaning to happiness (13). According to the recent World Happiness Report released by the United Nations (UN) (14), South Korea ranked 57th out of 137 countries in terms of happiness index, placing it among the lowest-ranking OECD member countries. In particular, by scoring low on social support and generosity, among the six indicators of the World Happiness Index, South Korea falls on the lower end among all countries, indicating a relatively low level within the social and cultural context (14). Furthermore, according to previous research in Korea, comparing the happiness trajectories between PWD and those non-PWD, it has been reported that the happiness index of the disabled group is lower than that of the non-disabled group also, Various factors influencing happiness, such as SRH status, self-esteem, and satisfaction with social relationships, were found to be deteriorated in the disabled group (15).

Happiness is a multidimensional construct that includes cognitive assessment (such as satisfaction with one's life) and affective assessment (such as moods and emotions) (16, 17). The pursuit of happiness is one of the most important goals for many people, and happiness is closely related to health (18). It has been claimed that SRH is more reliable than objective health status in a person's self-evaluation of their own physical and psychosocial status (19). The finding that well-being was strongly associated with SRH (20), but not with objective health (21) suggests that SRH is more important to well-being than objective health. Park et al. (22) investigated whether job satisfaction and security are associated with SRH and well-being of Korean employees. They found that Korean workers who are more satisfied with and secure in their jobs demonstrated good SRH and well-being, even when they are exposed to ergonomic and psychosocial hazards at work which negatively affect their SRH and well-being. A study that evaluated Portuguese workers also showed similar results in which job satisfaction is related to health, happiness, and subjective well-being (23). In addition, the researchers found that job satisfaction has a protective effect on health, happiness, and subjective well-being. This implies that higher job satisfaction potentially can improve workers' health, happiness, and subjective well-being.

Although job satisfaction has been evaluated in relation to SRH, and happiness or well-being for non-PWD, there have been a few studies focused on PWD in the society. in Korean society, research has mainly focused on the factors influencing job satisfaction among PWD (24–26), and as far as we know, there have been no studies conducted on the impact of job satisfaction on SRH. Therefore, to better understand the experiences of PWD and improve their quality of life, it is necessary to examine how job-related factors, such as job satisfaction, are associated with those related to daily life satisfaction, such as SRH and happiness.

By referring to the prior references and other study framework (24–26), we have selected control variables for analyzing the relationship among PWD. In this study, we hypothesize that lower job satisfaction among PWD in South Korea will be associated with lower SRH and happiness. To investigate this, we aim to analyze the association between job satisfaction and SRH or happiness among PWD using the 1st–3rd waves of the Panel Study of Employment for the Disabled (PSED). Through this analysis, the goal of this research is to present these findings as fundamental data for policy and institutional measures aimed at preventing the exacerbation of mental health issues within this specific subgroup of PWD.

Methods

Study sample and design

Data were obtained from 1st–3rd data (2016–2018 year) for 2nd wave Panel Survey of Employment for the Disabled (PSED) (27). The PSED is the first nationally representative longitudinal survey of PWD in South Korea, and nationwide data was collected using a computer-assisted personal interviewing program (CAPI). As of May 15, 2016, about 4,577 registered disabled persons stipulated in Article 2 of the Welfare Act for PWD aged 15 to 64 years old residing nationwide were targeted. In the first baseline survey in 2016, 4,577 individuals from 2,056 households (44.9 per household) were

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Abbreviations: PSED, Panel Survey of Employment for the Disabled; GEE, Generalized Estimating Equation.

interviewed. The second survey, in 2017, followed up with 4,214 participants, who represented 92.1% of the original panel. The third survey, in 2018, followed up with 4,104 participants, who represented 89.6% of the original panel.

The survey includes demographic data (gender, age, education, disability status, disability grade, disability type) and data regarding economic participation. In addition, the individual and environmental factors that influence economic activity are included. For the current study, 1st–3rd data (2016–2018 year) for 2nd wave Panel Survey data were used, as this data includes all measures and variables aligned with the research questions and hypotheses being tested. To estimate the association between job satisfaction and SRH and happiness among disabled who are engaged in economic activities, we included 1,637 participants with no missing information at baseline (the 2016 PSED). Figure 1 displays the timeline and procedure of this study.

Independent variables

Job satisfaction

Job satisfaction, our independent variable of interest, was measured in 10 variables. Briefly (1) wage or income (1, very dissatisfied, 2, dissatisfied, 3, moderate, 4, satisfied, 5: very satisfied), (2) Job security, (3) what you are doing (4) working environment (5) working hours (6) own development potential (7) communication (8) fairness of personnel evaluation (9) welfare benefits (10) convenience for disability. Thus, they are summed and the resulting total ranging from 10 to 50 used. Finally, job satisfaction was grouped into four groups: <20: low job satisfaction, 20–29: medium job satisfaction, 30–39: high job satisfaction and > 39: very high job satisfaction. The validity and reliability of the measurement for that variable were found to be appropriated (28). Specifically, the Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) coefficients are used as criteria to assess the goodness of fit of a model. If these coefficients are above 0.9, the model is considered to be good. The Root Mean Square Error Approximation (RMSEA) below 0.9 indicates a good fit. In this analysis, the model fit for Job Satisfaction was determined to be good with TLI: 0.966, CFI: 0.938, and RMSEA: 0.80.

Overall satisfaction with the current job

Overall satisfaction was measured in only one question. The responses were assigned to 1 of 5 subcategories: 1: very dissatisfied, 2: dissatisfied, 3: moderate, 4: satisfied, 5: very satisfied. According to the reliability analysis conducted in this study for overall satisfaction with the current job, the Cronbach's alpha coefficient was found to be 0.925.

Dependent variables

Self-rated health

Perceived physical health status was assessed with the question: "How do you usually perceive your health?" The response "insufficient" or "very insufficient" indicated "Bad," and the response "normal," "sufficient," or "very sufficient" indicated "Good," thus dichotomizing the response for logistic regression analysis (29).

Level of happiness in mental health

Level of happiness in mental health measures a continuum of subjective probabilities. The response to the question ranges from 0 to 10, where 0 means you are very unhappy, and 10 meaning you are very unhappy, and it is divided into 10 points.

Control variables

Gender was divided into male and female and age groups were divided into three categories: 15–29, 30–39, 40–49, 50–59, and ≥ 60 years. Residential region was categorized into metropolitan (Seoul), urban (Daejeon, Daegu, Busan, Incheon, Kwangju, or Ulsan), and rural (otherwise). Marital status was divided into three groups: Single, Married and separation or separation. Smoking status (never, former smoker, and smoker), alcohol consumption (never, former drinker and drinker) was categorized three groups, respectively. Stress status was divided into 3 groups: very, less, low. In the case of disability level, it is divided into two groups: severe (level 1 to level 3) and light (level 4 to level 6) and disability

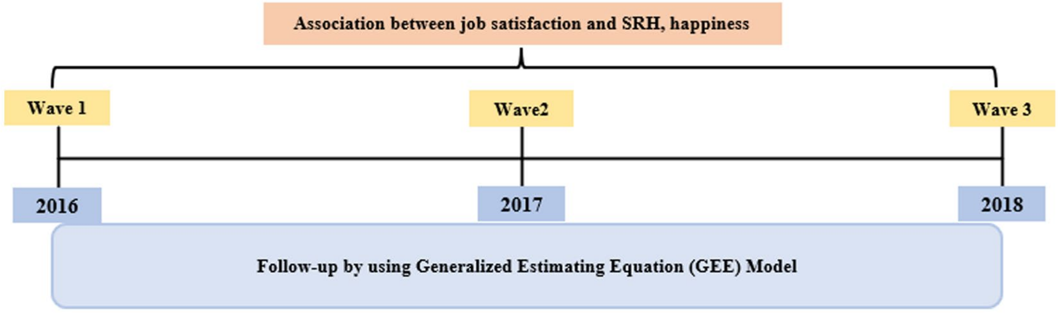

FIGURE 1
The study timeline.

type was also divided into two groups: physical disability and other based on the number of samples of the disabled.

Analytical approach and statistics

Chi-square test, *t*-test, ANOVA and generalized estimating equation (GEE) model were used to investigate the association between job satisfaction and SRH and happiness. The differences between the characteristics of the respondents were examined using the chi-square test. value of $p < 0.05$ was considered statistically significant. Participants who responded repeatedly three times were included in the study, and all variables (independent, dependent, and control variables) were measured three times. Therefore, a generalized estimating equation (GEE) model was used to examine the association between job satisfaction and happiness, SRH. The GEE model was used to analyze the variation within individuals of repeated measurement variables (30, 31). For the analysis using the GEE model, the SAS procedure "PROC GENMOD" was used, and the best model was selected by checking the working correlation structure (32, 33). Analyses with GEE were expressed as odds ratio (OR) and 95% confidence interval (CI). All statistical analyses were performed using SAS statistical software package version 9.4 (SAS Institute Inc., Cary, NC, United States).

Results

Prevalence of SRH and happiness

Table 1 displays the descriptive statistics of all variables at baseline (2016). Of the 1,637 research subjects included in our study, the prevalence of poor SRH was 28.3% (464 participants) (Table 1). Of the total sample, 48.2% (13 participants) of those with low job satisfaction (< 20) had poor SRH and 15.5% (43 participants) of those with very high job satisfaction (> 39) had poor SRH. Mean score of happiness was 6.471 (SD: 1.479). Of the total sample, mean score of happiness in mental health of those with low job satisfaction (< 20) had 5.370 (SD: 1.418) and mean score of happiness in mental health of those with very high job satisfaction (> 39) had 7.198 (SD: 1.373).

Association between job satisfaction and SRH and happiness

Table 2 shows the results of the panel data analysis using GEE model, which investigated the association between job satisfaction and SRH, Happiness. After adjusting for all of these confounders, odds ratio of poor SRH of those with low job satisfaction (< 20) was 3.497 times [odds ratio (OR): 3.497, 95% Confidence Interval (CI): 1.960–6.239, value of $p < 0.0001$], medium job satisfaction (20–29) was 2.671 times (OR: 2.671, 95% CI: 2.116–3.371, value of $p < 0.0001$) and high job satisfaction (30–39) was 1.398 times (OR: 1.398, 95% CI: 1.131–1.727, value of *p*: 0.0002) higher compared with those with very high job satisfaction (> 39). In terms of happiness, estimate of those with low job satisfaction (< 20) was – 0.291 points lower (*B*: -0.291, 95% CI: −0.354,-0.227, value of *p*: <0.0001), medium job satisfaction (20–29) was −0.182 points lower (*B*: -0.182, 95% CI: −0.200,-0.164, value of *p*: <0.0001) and high job satisfaction (30–39) was −0.076 points lower (*B*: -0.076, 95% CI: −0.089,-0.062, value of *p*: <0.0001) compared with those very high job satisfaction (> 39) (Table 2).

Association between overall job satisfaction and SRH and happiness

Table 3 adjusted for socioeconomic status and health status and risk behaviors variables. After adjusting for all of these confounders, odds ratio of poor SRH of those with "Very dissatisfied" was 5.158 times (OR: 5.158, 95% CI: 1.740–15.290, value of *p*: 0.003), "Unsatisfied" was 2.643 times (OR: 2.643, 95% CI: 1.510–4.626, value of *p*: 0.001) higher compared with those with "Very satisfied." In terms of happiness in mental health, estimate of those with "Very dissatisfied" was – 0.327 lower (*B*: -0.327, 95% CI: −0.437,-0.217, value of $p < 0.0001$), "Unsatisfied" was – 0.266 lower (*B*: -0.266, 95% CI: −0.307,-0.225, value of $p < 0.0001$) compared with "Very satisfied" (Table 3).

Discussion

The purpose of this study was to investigate the effects of job satisfaction on the SRH and happiness of PWD working in South Korea. We conducted a longitudinal analysis using data obtained between 2016 and 2018, the 2nd wave of the Panel Survey of Employment for the Disabled.

Our results indicated that as job satisfaction evaluated according to factors such as salary, job stability, the nature of job, etc., decreased, the negative SRH of PWD increased, and levels of happiness that affected their mental health deteriorated. This tendency was consistent with general job satisfaction measured using a single item, resulting in negative SRH and diminished happiness.

The finding that the job satisfaction of PWD is related to SRH as well as happiness, affecting their mental health is consistent with the results of previous studies with non-PWD (24–26). Research investigating the relationship between job satisfaction and individual happiness and health levels is actively being conducted (34, 35). According to a study conducted in Denmark, analyzing the relationship between job satisfaction and SRH (SRH) among 3,727 participants, it was found that the likelihood of reporting negative SRH was 1.78 times higher in individuals who experienced employment insecurity. Additionally, among groups with limited employment opportunities, the SRH of women was found to worsen by 2.13 times (36). Furthermore, according to previous research analyzing the quality of life and happiness among PWD in Korea (25), it was found that for PWD, an increase of one unit in job satisfaction and well-being was associated with a 0.52-point increase in happiness and a 0.25-point increase in quality of life.

As a result of these factors, Korea has established legal safeguards such as mandatory employment of disabled individuals. However, the scale and enforceability of these measures are not significant, and there is a prevailing negative attitude toward hiring PWD within the corporate culture. Consequently, the job satisfaction of PWD (including employment stability, salary, and work environment) is classified as a key influencing factor on their personal happiness (37). Specifically, the mandatory employment system for disabled individuals in Korea requires companies to employ 2–3% of their total workforce as disabled employees. However, the actual disability employment rate is 1.92%,

TABLE 1 General characteristics of subjects included for analysis at baseline.

	Total		Self-rated health					Happiness		
			Poor		Good		*p*-value			*p*-value
	N	%	*N*	%	*N*	%		Mean	SD	
Job satisfaction							<0.0001			<0.0001
<20	27	1.7	13	48.2	14	51.9		5.370	1.418	
20–29	411	25.1	179	43.6	232	56.5		5.788	1.518	
30–39	921	56.3	229	24.9	692	75.1		6.587	1.350	
>39	278	17.0	43	15.5	235	84.5		7.198	1.373	
Gender							0.0004			0.826
Male	1,240	75.8	324	26.1	916	73.9		6.452	1.484	
Female	397	24.3	140	35.3	257	64.7		6.526	1.464	
Age							<0.0001			0.282
15–29	241	14.7	49	20.3	192	79.67		6.564	1.645	
30–39	513	31.3	98	19.1	415	80.9		6.601	1.392	
40–49	529	32.3	160	30.3	369	69.8		6.474	1.445	
50–59	246	15.0	102	41.5	144	58.5		6.203	1.530	
>59	108	6.6	55	50.9	53	49.1		6.231	1.457	
Residential region							0.4497			0.468
Metropolitan	341	20.8	101	29.6	240	70.4		6.441	1.602	
Urban	416	25.4	125	30.1	291	70.0		6.505	1.395	
Rural	880	53.8	238	27.1	642	73.0		6.465	1.470	
Marital status							<0.0001			<0.0001
Married	908	55.5	242	26.7	666	73.4		6.678	1.403	
Single	546	33.4	139	25.5	407	74.5		6.347	1.523	
Divorce, separated	183	11.2	80	45.4	100	54.6		5.803	1.484	
Smoking status							0.4773			0.022
Current smoker	475	29.0	129	27.2	346	72.8		6.244	1.504	
Former smoker	367	22.4	113	30.8	254	69.2		6.572	1.508	
Nothing	795	48.6	222	27.9	573	72.1		6.559	1.438	
Alcohol consumption							<0.0001			0.857
Drinker	951	58.2	226	23.8	725	76.2		6.435	1.485	
Former drinker	258	15.8	102	39.5	156	60.5		6.527	1.471	
Nothing	426	26.1	135	31.7	291	68.3		6.514	1.473	
Stress status							<0.0001			<0.0001
Hardly feel	195	11.9	30	15.4	165	84.6		7.246	1.400	
Moderate	529	32.3	111	21.0	418	79.0		6.712	1.295	
Almost feel a lot	913	55.8	323	35.4	590	64.6		6.165	1.510	
Disability grade							0.1789			0.387
1–3	414	25.3	128	30.9	286	69.1		6.426	1.505	
4–6	1,223	74.7	336	27.5	887	72.5		6.485	1.471	
Disability type							0.5894			0.398
Physical disability	946	57.8	273	28.9	673	71.1		6.536	1.452	
Other	691	42.2	191	27.6	500	72.4		6.380	1.512	
Total	1,637	100.0	464	28.3	1,173	72		6.471	1.479	

*Hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, cardiovascular disease, cerebrovascular disease, arthritis.

TABLE 2 **Effect of job satisfaction on self-rated health and happiness.**

	Self-rated health				Happiness			
	OR	95% CI		*P*-value	*B*	95% CI		*P*-value
Job satisfaction								
<20	3.497	1.960	6.239	<0.0001	-0.291	−0.354	−0.227	<0.0001
20–29	2.671	2.116	3.371	<0.0001	−0.182	−0.200	−0.164	<0.0001
30–39	1.398	1.131	1.727	0.002	−0.076	−0.089	−0.062	<0.0001
>39	1.000				ref			
Gender								
Male	0.761	0.626	0.926	0.006	0.002	−0.014	0.017	0.820
Female	1.000				ref			
Age								
15–29	0.168	0.117	0.243	<0.0001	0.082	0.053	0.112	<0.0001
30–39	0.234	0.176	0.311	<0.0001	0.056	0.032	0.080	<0.0001
40–49	0.366	0.281	0.476	<0.0001	0.047	0.023	0.071	<0.0001
50–59	0.584	0.445	0.767	0.000	0.016	−0.009	0.041	0.210
>59	1.000				ref			
Residential region								
Metropolitan	0.915	0.760	1.102	0.349	−0.005	−0.019	0.010	0.518
Urban	1.074	0.909	1.268	0.401	0.010	−0.003	0.023	0.127
Rural	1.000				ref			
Marital status								
Married	0.531	0.430	0.654	<0.0001	0.099	0.080	0.119	<0.0001
Single	0.818	0.631	1.061	0.130	0.017	−0.006	0.041	0.144
Divorce, separated	1.000				ref			
Smoking status								
Current smoker	1.087	0.882	1.338	0.435	−0.010	−0.026	0.006	0.226
Former smoker	1.038	0.839	1.284	0.730	0.003	−0.013	0.019	0.718
Nothing	1.000				ref			
Alcohol consumption								
Drinker	0.686	0.565	0.834	0.000	−0.008	−0.024	0.007	0.294
Former drinker	1.115	0.891	1.396	0.341	−0.002	−0.020	0.017	0.861
Nothing	1.000				ref			
Stress status								
Hardly feel	0.303	0.228	0.403	<0.0001	0.129	0.112	0.147	<0.0001
Moderate	0.527	0.452	0.614	<0.0001	0.050	0.038	0.062	<0.0001
Almost feel a lot	1.000				ref			
Disability grade								
1–3	1.414	1.193	1.676	<0.0001	−0.006	−0.020	0.008	0.396
4–6	1.000				ref			
Disability type								
Physical disability	1.337	1.146	1.559	0.000	0.006	−0.007	0.018	0.370
Other	1.000				ref			
Year								
2016	1.196	1.012	1.415	0.036	−0.017	−0.031	−0.004	0.011
2017	0.929	0.781	1.105	0.404	0.003	−0.011	0.016	0.671
2018	1.000				ref			

TABLE 3 **Effect of Overall satisfaction on self-rated health and happiness.**

	Self-rated health					Happiness			
	OR	95% CI		*P*-value		*B*	95% CI		*P*-value
Overall satisfaction with current job									
Very unsatisfied	5.158	1.740	15.290	0.003		−0.327	−0.437	−0.217	<0.0001
Unsatisfied	2.643	1.510	4.626	0.001		−0.266	−0.307	−0.225	<0.0001
Usually	1.406	0.846	2.340	0.189		−0.161	−0.193	−0.128	<0.0001
Satisfied	0.817	0.490	1.360	0.437		−0.058	−0.089	−0.026	0.000
Very satisfied	1.000					ref			
Gender									
Male	0.774	0.636	0.942	0.011		0.001	−0.015	0.016	0.934
Female	1.000					ref			
Age									
15–29	0.159	0.110	0.229	<0.0001		0.085	0.056	0.115	<0.0001
30–39	0.221	0.166	0.294	<0.0001		0.063	0.039	0.087	<0.0001
40–49	0.354	0.272	0.460	<0.0001		0.051	0.027	0.074	<0.0001
50–59	0.570	0.434	0.749	<0.0001		0.020	−0.005	0.045	0.112
>59	1.000					ref			
Residential region									
Metropolitan	0.917	0.762	1.104	0.362		−0.004	−0.018	0.010	0.588
Urban	1.095	0.927	1.294	0.284		0.009	−0.005	0.022	0.198
Rural	1.000					ref			
Marital status									
Married	0.522	0.424	0.644	<0.0001		0.102	0.083	0.122	<0.0001
Single	0.812	0.626	1.053	0.116		0.023	0.000	0.046	0.054
Divorce, separated	1.000					ref			
Smoking status									
Current smoker	1.098	0.891	1.353	0.379		−0.013	−0.029	0.003	0.118
Former smoker	1.066	0.862	1.319	0.554		0.000	−0.017	0.016	0.958
Nothing	1.000					ref			
Alcohol consumption									
Drinker	0.678	0.557	0.824	<0.0001		−0.006	−0.021	0.010	0.484
Former drinker	1.089	0.869	1.364	0.460		0.000	−0.018	0.018	0.992
Nothing	1.000					ref			
Stress status									
Hardly feel	0.297	0.223	0.395	<0.0001		0.128	0.111	0.146	<0.0001
Moderate	0.514	0.441	0.599	<0.0001		0.055	0.043	0.066	<0.0001
Almost feel a lot	1.000					ref			
Disability grade									
1–3	1.429	1.206	1.695	<0.0001		−0.008	−0.021	0.006	0.273
4–6	1.000					ref			
Disability type									
Physical disability	1.312	1.125	1.530	0.001		0.009	−0.003	0.021	0.132
Other	1.000					ref			
Year									
2016	1.180	0.997	1.396	0.054		−0.017	−0.030	−0.004	0.012
2017	0.923	0.776	1.098	0.366		0.004	−0.010	0.017	0.590
2018	1.000					ref			

falling short of the legally mandated allocation rate (37). According to a report by the Korea Employment Agency for the Disabled, the societal atmosphere creates significant challenges for PWD to engage in work activities. Even for those who are able to participate in work, they often find themselves in unsatisfactory work environments, where the focus is solely on performing work activities without ensuring a conducive working environment (38). In contrast, Japan, Germany, and the United States have shown higher disability employment rates compared to Korea, with rates of 2.3, 4.6, and 31.4%, respectively. Moreover, in terms of disability-related welfare expenditure as a percentage of GDP, Korea's expenditure stands at 0.3%, while Japan (0.6%), Germany (1.3%), and the United States (1.0%) demonstrate a more established social safety net, indicating the need for legal and institutional development targeting disabled individuals in Korea (38).

Thus, job satisfaction may play an important role in increasing positive SRH and happiness, affecting mental health, even for PWD. The relationship among job satisfaction, SRH, and happiness or well-being has been largely investigated for non-PWD and few studies have examined this same multivariate relationship for PWD. Thus, the results of this study, indicating that job satisfaction of PWD is closely related to physical and mental health, are important.

This study has some limitations. First, we were not able to identify a complete causal relationship, although we calculated the GEE model using the panel survey data of employment for PWD. To improve the quality of life of PWD, the possible existence of a solid causal relationship should be investigated in future studies. In a similar vein, it will be necessary to examine which factors of job satisfaction are stronger predictors of good quality of life. If greater job satisfaction of PWD improves SRH and happiness, it will be important to work to increase it. There is no concrete definition of job satisfaction as it is a complicated and multidimensional construct to which many factors are linked (39). Therefore, it is difficult to determine which is the strongest factor related to job satisfaction and help PWD to feel more satisfied with their jobs.

In fact, job security, one of the factors used to assess job satisfaction in this study, has shown mixed results for non-PWD. While Hellgren and Sverke (2003) (40) found that job insecurity had a negative effect on the mental but not physical health of workers, Burgard, Brand, and House (2009) (41) found that job insecurity had a stronger association with poorer SRH but not with mental health. Thus, it might be necessary to examine which factors of job satisfaction are associated with better SRH and happiness for PWD. Additionally, demographic and health risk variables of PWD were measured by a self-report survey and thus, the data used in this study can potentially be affected by misrepresentation. Furthermore, it is necessary to measure SRH and happiness more accurately from various perspectives because the variables used in this study were assessed based on a single item in the panel data. in future research, there is a need to utilize objective measures that reflect various perspectives on SRH or mental health (such as PHQ-9 for depression, CES-D for cognitive function). Finally, we attempted to adjust a range of variables using the second wave panel survey of employment for PWD, but most likely we failed to consider all variables which potentially affect health status. There also might have been undetected confounding variables. Lack of such information may have resulted in underestimations or miscalculations in some results of this study.

Although this study may have some Strength, we did find a significant association between job satisfaction of PWD in South Korea and their SRH and happiness, respectively. The results of this study might serve as a foundation for improving the quality of life of PWD in South Korea.

Conclusion

The results of a longitudinal analysis from the panel data showed that the job satisfaction of PWD negatively associated with SRH as well as happiness in mental health. The findings of this study, consistent with previous research (10, 25, 34, 35), demonstrate that job satisfaction among PWD influences mental health factors, particularly subjective mental health and happiness, which are part of the measurement of quality of life.

To the best of our knowledge, this study is the first of its kind conducted in low-coverage Asian countries targeting PWD. Consequently, it enables us to understand the impact of job satisfaction among PWD in Asia on their SRH and happiness. Furthermore, while previous studies have demonstrated that improving job satisfaction among PWD enhances their quality of life, this study specifically identifies the positive impact of job satisfaction on SRH and happiness.

This study, therefore, suggests that increasing job satisfaction of PWD possibly leads to decreased negative SRH and to increased happiness, resulting in better quality of life. Furthermore, it suggests the establishment of systemic, policy-oriented measures to enhance the employment opportunities for disabled individuals and create an inclusive working environment that aligns with their respective job responsibilities by cooperating between labor authorities and public health authorities. Through this, it is anticipated that the current low employment rate of disabled individuals in Korea can gradually increase, leading to an improvement in happiness-related indicators and economic indicators.

Data availability statement

Publicly accessible data were analyzed in this study. This data can be found here: https://edi.kead.or.kr/ENG_Contents.do?cmd=_004A&mid=108.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants OR patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

YLL designed this study, performed statistical analysis, and drafted the manuscript. JMY contributed to drafted the manuscript. J-HK conceived, designed, and directed the overall study. All authors contributed to the article and approved the submitted version.

Conflict of interest

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

Publisher's note

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How is music listening purpose related to stress recovery? – two preliminary studies in men and women

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Introduction: Studies have suggested that listening to music can reduce psychological and biological responses to a stressor. However, it is unclear whether music has the same effect on stress recovery. According to field studies, people commonly use music in daily life for the specific purpose of relaxation. We explored whether individuals who generally use music for relaxation purposes show improved recovery from an acute stressor.

Methods: In two independent studies, twenty-seven healthy female participants ($M_{\text{age}} = 24.07$) (Study 1) and twenty-one healthy male participants ($M_{\text{age}} = 23.52$) (Study 2) were separated into two groups based on their frequency of using music for relaxation purposes (low vs. high). All participants underwent a lab-based psychosocial stress test. Subjective stress levels were measured using visual analogue scales. Salivary cortisol and salivary alpha-amylase were measured to assess endocrine and autonomic stress responses, respectively. Subjective stress levels and saliva samples were measured nine times throughout the stress induction and recovery procedure. Chronic stress levels were assessed using the Perceived Stress Scale and the Screening Scale of Chronic Stress.

Results: No significant differences were observed in subjective stress levels, salivary alpha-amylase activity, or cortisol concentration between the two groups in either of the two studies. Further analyses revealed that among male participants, increased use of music for relaxation purposes was related to more chronic stress levels ($t\ (10.46) = 2.45$, $p = 0.03$, $r = 0.60$), whereas female participants exhibited a trend in the opposite direction ($t\ (13.94) = -1.92$, $p = 0.07$, $r = 0.46$).

Discussion: Contrary to our expectations, the results indicate that habitual music listening for relaxation purposes is not associated with improved recovery from a stressor. However, due to the small sample size, future exploration is necessary to enhance the statistical power of the results of the study.

KEYWORDS

cortisol, music, relaxation, salivary alpha-amylase, stress recovery

1. Introduction

Stress is a common phenomenon in all industrialized societies (Hassard et al., 2018). It arises when an individual perceives his/her resources as insufficient to cope with the demands of the environment (Lazarus and Folkman, 1984) and encompasses a variety of negative emotional and physiological reactions, which potentially overwhelm the individual's capacity to deal with a stressor (McEwen and Akil, 2020). It is important to distinguish between acute stress and chronic stress (McEwen, 2004): While acute stress is ubiquitous and considered an adaptive process to help individuals survive in a complex environment (McEwen and Akil, 2020), chronic stress has been shown to threaten both physical and mental health (McEwen, 1998).

As a complex process resulting from an organism being challenged by potentially threatening stimuli, stress consists of an immediate stress "reactivity" as well as a "recovery" phase, which starts after the cessation of the stressful stimulus. Stress recovery is a process that helps the individual to recover from the loss of equilibrium or balance, to regain homeostasis, and to readjust to the environment after exposure to stress (Ulrich et al., 1991; de la Torre-Luque et al., 2017b). This process is complementary to the stress response and shares the same biochemical basis. The stress process is regulated by two major systems, the hypothalamic–pituitary–adrenal (HPA) axis and the autonomic nervous system (ANS). The HPA axis exerts its effects through endocrine signals, and the most commonly used indicator of HPA activity is cortisol. Due to the quick and non-invasive nature of saliva collection, salivary cortisol is nowadays widely used as a biomarker in stress studies (Strahler et al., 2017). The ANS includes both the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS), and salivary alpha-amylase (sAA) has been increasingly used as an index for ANS activity in recent years (Nater and Rohleder, 2009).

Various methods have been explored to prevent or mitigate the harmful effects of stress on health. However, the focus has primarily been on stress reduction rather than stress recovery. Among these, music listening was widely used as an intervention due to its cost-efficiency, non-invasiveness, easy deployment, and lack of side effects (Wuttke-Linnemann et al., 2020). Both laboratory and field studies have revealed beneficial effects of music in terms of reducing stress (Thoma et al., 2013; Linnemann et al., 2015, 2016, 2018), but research on music with relation to stress recovery is scarce.

In the first study to examine an effect of music on stress recovery, Khalfa et al. (2003) observed that music listening after an acute laboratory stressor reduced cortisol levels more rapidly compared to a silence condition. Later studies also reported a positive impact of music on cardiovascular processes (de la Torre-Luque et al., 2017a,b) and improved mood (Radstaak et al., 2014; Koelsch et al., 2016) during the recovery phase. There is currently no unified operational definition of stress recovery. Khalfa et al. (2003) compared the cortisol concentration levels at different measurement points after the stress test in different groups separately. This method is able to depict the trajectory in each group after the stress test, but it failed to compare the overall differences among all measurements and between groups. Thoma et al. (2013) defined the difference between the peak values after the stressor and the first baseline value after the stressor as recovery. Other studies have conducted between-group analyzes of variance comparisons, but due to the limited number of measurement points, they were only able to compare intergroup differences in stress levels after the stress test, failing to provide an overall description of the trajectory during the stress recovery phase (Labbé et al., 2007; Groarke and Hogan, 2019; Groarke et al., 2020). In a study by Koelsch et al. (2016), repeated measures MANOVA was used with time points as a within-subject factor and stimulus conditions as between-subject factors. They reported generally higher cortisol levels in the music listening group during the recovery phase, suggesting a poorer recovery from stress compared to the control group. This method tested the overall differences between groups over time. In our current research, we decided to use the method from Koelsch et al. (2016) to test the general differences in stress levels between different groups throughout the stress induction and stress recovery phases over time.

Performing an activity with the specific purpose of improving stress recovery can be an important factor in the effectiveness of stress management interventions. According to three-pronged model of habit proposed by Wood and Rünger (2016), music listening for relaxation purpose can potentially influence stress recovery through the formation of music listening habits, even in the absence of actual music listening behavior. In line with this model, individuals who frequently engage in music listening as a means of relaxation and recovery may develop a habit where stress itself acts as a contextual cue that triggers the desire to listen to music for the purpose of recovery. Once the habit is formed, this contextual cue automatically activates the corresponding mental representation of the habit, which encompasses various sensory and perceptual features. Mentally simulating the music in this way may elicit a similar recovery effect as actually listening to the music. Besides, it is suggested that relaxing music is characterized by positive valence and low arousal (Sandstrom and Russo, 2010), including calming melodies and evoking positive emotions. If individuals mentally activate such music in response to the contextual cue, they may experience benefits in stress recovery. Additionally, the model suggests that by observing their own habitual responses, individuals are likely to infer their underlying goals. Consequently, when individuals who habitually listen to music for relaxation purpose realize that they have such music playing in their minds, it may strengthen their motivation to recover, thereby aiding in their stress recovery process. Therefore, when assessing the possible influence of music listening on stress recovery, the purpose for listening to music may be an important moderating factor.

Qualitative and quantitative studies have explored the purposes of music listening. Greasley and Lamont (2011) found that listening to music for pleasure and for relaxation were the most frequent reasons that participants reported in their daily life. In a diary study conducted by van Goethem and Sloboda (2011), the affect regulation function of music was investigated. Results revealed that individuals employed music for a range of purposes, encompassing relaxation, distraction, active coping, introspection, venting, and rational thinking. Among these purposes, relaxation was found to be the most reported. Juslin et al. (2008) found that the music listening purposes were related to specific emotional states. For example, listening to music with the purpose to relax was related to calm-contentment emotion, while the purpose to influence their feelings was related to sadness-melancholy emotion. The paper of Linnemann et al. (2015) was the first evidence that the stress-reducing effect of music listening was modulated by the purpose of music listening. They tracked the stress levels of a group of university students in daily life. Students were asked to report their stress levels and music listening behavior four times a day for 2 weeks. The results showed that music listening was related to lower subjective stress levels. At the same time, when the participants had listened to music for relaxation purposes, they showed lower subjective stress levels and lower cortisol concentrations compared to listening to music for other purposes. The findings imply that the purpose of relaxation may have a significant role in the stress management process compared to other purposes. However, this field study lacked strict control of potentially confounding variables. For instance, the study relied on retrospective assessment of stress prior to the measurements, without actively inducing a standardized stressor. This lack of controlled stress induction makes it challenging to regulate the level of evoked stress and capture the stress recovery phase. Furthermore, in daily life, there are various distractions that may influence the stress recovery process, potentially attenuating the influence of music and music listening purposes. Additionally, when collecting biomarkers such as cortisol and sAA, physical activities can significantly impact their levels. Given that physical activities are unavoidable in daily life settings, these biomarkers may not accurately reflect stress levels. These issues can be addressed through the implementation of a controlled laboratory environment. Based on the positive relationships observed in the ambulatory assessment study between listening to music for relaxation purposes and both subjective and biological stress outcomes we assume that habitual music listening for relaxation purpose helps train subjective and biological stress recovery and forms individuals' behavior modes. The benefits of music listening may even extend to situations where individuals are unable to listen to music. Therefore, we hypothesized that individuals who habitually listen to music for relaxation may find it easier to recover from stress compared to those who do not.

As we identified a lack of studies that tested whether habitual music listening for relaxation purposes might benefit stress recovery, we analyzed existing data from two separate projects, which had different research aims to the present work. These projects implemented lab-based settings to control for potentially confounding variables. Both subjective and biological stress responses were measured, and we explored how habitual purpose of music listening was related to stress recovery. Based on previous findings, we hypothesized that habitually listening to music for relaxation purposes would be positively related to stress recovery. More specifically, we assumed that the more frequently individuals listen to music for relaxation purposes, the stronger their stress recovery will be, as measured by subjective stress levels as well as cortisol and sAA levels. Furthermore, we examined whether music listening for relaxation purposes was related to chronic stress levels.

2. Study 1

The data of Study 1 stem from a large project exploring the comprehensive effects of music on laboratory-induced stress (data not published yet). The project was approved by the ethics committee of the University of Vienna (reference number 00508). All of the participants provided informed consent before taking part in the experiment.

2.1. Materials and methods

2.1.1. Participants

Previous research has indicated gender differences in HPA axis responses to stress (Kirschbaum et al., 1999) and music effects on stress-related systems (Nater et al., 2006), with women responding to both stress and music in a more sensitive manner. Therefore, this study only included female participants. The inclusion criteria were female sex, body mass index (BMI) between 18 and 25 kg/m^2, age between 20 and 30 years, sufficient German-language ability, a regular menstrual cycle, and no pregnancy or breast-feeding. The tests were scheduled during the follicular period of participants' menstrual cycle. To control for potentially confounding factors, the following exclusion criteria were applied: self-reported or diagnosed stress-related mental disorders; other diagnosed somatic disorders known to affect either the HPA axis or ANS; use of hormonal contraceptives, psychoactive substances or excessive consumption of alcohol or tobacco that might affect the HPA axis or ANS; being a professional or amateur-level musician; regularly practicing relaxation or mindfulness methods; hearing deficits. The inclusion and exclusion criteria were screened in a telephone interview prior to the lab appointment.

The larger project encompassed four conditions, which were researcher-selected music condition, participant-selected music condition, relaxing nature sound condition and silent control condition. A total of 105 participants ultimately completed the experiments. Study 1 used the participants from the control condition, which contained 27 participants.

2.1.2. Measures

Participants' demographic information was collected during the telephone screening. To gather information on music listening behavior, we employed the Music Preference Questionnaire (MPQ)-R (Nater et al., 2005a). To assess the participants' use of music for relaxation purposes, participants were asked to rate the item "How frequently do you listen to music in order to relax?" on a 5-point Likert scale (1 = "never" to 5 = "very often"). None of the participants rated this item with a score of 1 (i.e., never listening to music for relaxation purposes). The remaining ratings were as follows: four participants rated 2, four rated 3, seven rated 4, and 12 participants provided a rating of 5 (i.e., listening to music for relaxation purposes very often). Given that no participant indicated never listening to music for relaxation purposes, and the sample size for each group was too small to conduct analyzes of variance (ANOVAs), two groups were formed for the subsequent t-tests: Participants who rated this item with 2 or 3 were allocated to the low-frequency group ($n = 8$) and participants were rated it with 4 or 5 were allocated to the high-frequency group ($n = 19$).

In the current study, both subjective stress levels and biological markers of stress were analyzed as dependent variables. Salivary cortisol concentration and sAA activity were analyzed from saliva samples, reflecting HPA axis and ANS activity, respectively. Saliva was collected in SaliCaps© (IBL-Tecan, Hamburg, Germany) using the passive drool method. Participants were asked not to speak or swallow for 2 minutes after completing an active swallow and to subsequently transfer the saliva collected in the mouth into a tube using a straw. After collection, saliva samples were stored in a freezer (−30°C) until biochemical analysis. Subjective stress levels were measured on a visual analog scale (VAS), with participants asked at each time point to rate "How stressed do you feel at this moment?" on a line from 0 to 100.

To control for the potential impact of chronic stress, participants also completed the German version of the Perceived Stress Scale (PSS) (Klein et al., 2016) to reflect their stress levels within the last month, and the Screening Scale of Chronic Stress (SSCS) (Schulz et al., 2004) to reflect their stress levels within the last 3 months.

2.1.3. Design and procedure

We used a between-subject design to compare stress recovery between female participants who frequently listen to music for relaxation purposes (high-frequency group) and those who do not (low-frequency group). Salivary cortisol, sAA, and subjective stress levels were measured to assess stress recovery after the Trier Social Stress Test (TSST) (Kirschbaum et al., 1993). The TSST has been shown to evoke a moderate level of stress in laboratory environments and to effectively activate the HPA axis and ANS (Kirschbaum et al., 1993; Nater et al., 2005b; Thoma et al., 2013). The specific procedure is described below.

Participants who met the above-mentioned criteria were invited to the lab to undergo the TSST. To control for the fluctuation of hormone levels at different time points throughout the day, the experiment was implemented in the afternoon hours, starting from 14:00. Prior to the lab appointment, participants were asked to refrain from intensive physical exercise for 24 h, from drinking alcohol or caffeinated drinks for 48 h, and from brushing their teeth, chewing gum or eating for at least an hour.

Upon arrival at the lab, participants were briefly informed about the experimental procedure and signed the informed consent form. Next, they completed the MPQ, PSS and SSCS. As the dependent variables were measured several times during the experiment, participants were also instructed on how to use VAS to report their subjective feeling of stress and how to collect saliva samples. Each participant completed nine VAS measures and saliva sample collections during the whole procedure.

Figure 1 demonstrates the workflow of study 1. After an adaptation period of 30 min, at the first time point (T1), participants provided the first saliva sample and completed a VAS. This procedure to measure stress levels was repeated at each time point throughout the experiment. Ten minutes before the TSST, participants were led into the test room, where two trained “interviewers” were seated at a table with a clearly visible video camera installed. Participants were told that they were going to undergo a mock job interview. Following these instructions, the participants completed the second stress measurement (VAS and saliva sample; T2), followed by a preparation and anticipation period of 10 min. Immediately before the TSST, stress levels were measured again (T3). The TSST paradigm consists of a speech task and a mental arithmetic task. In the present study, participants were required to give a five-minute speech for a job application and then count backwards out loud from 2,043 in increments of 17, starting again in the case of any mistakes. At the end of the arithmetic task, participants completed the fourth stress measurement (T4) and were then led back to the relaxation room, where they sat on a reclining chair for 10 min to calm down. Before getting up from the chair, the next stress measurement was conducted (T5). After this, participants were asked to sit at a desk, where they read magazines which had no emotionally arousing contents. The final four stress measurements were taken 20 min (T6), 30 min (T7), 45 min (T8), and 60 min (T9) after the TSST.

At the end of the entire experimental procedure, participants were debriefed and received monetary compensation for their participation.

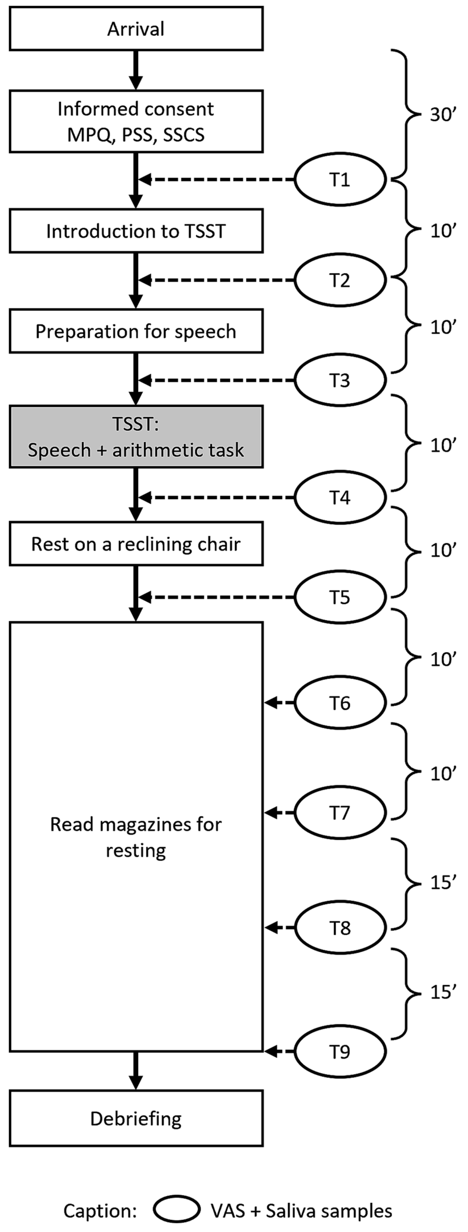

FIGURE 1
The workflow of Study 1.

2.1.4. Data analysis

The data analyzes were performed using JASP software (version 0.17.1). A repeated measures mixed ANOVA was employed to examine the stress-inducing effect of TSST, stress recovery after TSST, differences between the low-and high-frequency groups, and the interaction effects. Time point was treated as a within-subject factor, while the frequency of listening to music for relaxation was considered as a between-subject factor. In the presence of significant main effects, *post hoc* tests were conducted using Bonferroni correction. T-tests were utilized to assess differences in chronic stress levels between the low-and high-frequency groups. The normality of the data was assessed using the Shapiro–Wilk test, and homogeneity of variance was examined using Levene’s test. Greenhouse–Geisser procedure was applied to correct for violations of the sphericity assumption. Statistical significance was determined at $p \leq 0.05$. All tests were two-tailed.

TABLE 1 Sample characteristics for Study 1.

Characteristic	HF		LF		*t* (*df*)	*p*	*r*
	Mean (SD)	*n*	Mean (SD)	*n*			
Age (years)	24.00 (2.40)	19	24.25 (1.98)	8	−0.28 (15.97)	0.78	0.07
BMI	21.35 (1.97)	19	21.37 (1.85)	8	−0.02 (14.05)	0.98	0.01
PSS	21.68 (3.28)	19	24.25 (3.11)	8	−1.92 (13.94)	0.07.	0.46
SSCS	17.74 (6.20)	19	19.88 (8.10)	8	−0.67 (10.63)	0.52	0.20

SD, standard deviation; n, valid cases; HF, high-frequency group; LF, low-frequency group; BMI, body mass index; PSS, Perceived Stress Scale, SSCS, Screening Scale of Chronic Stress. *p* was calculated from two-tailed t-test; $^{*}p < 0.05$.

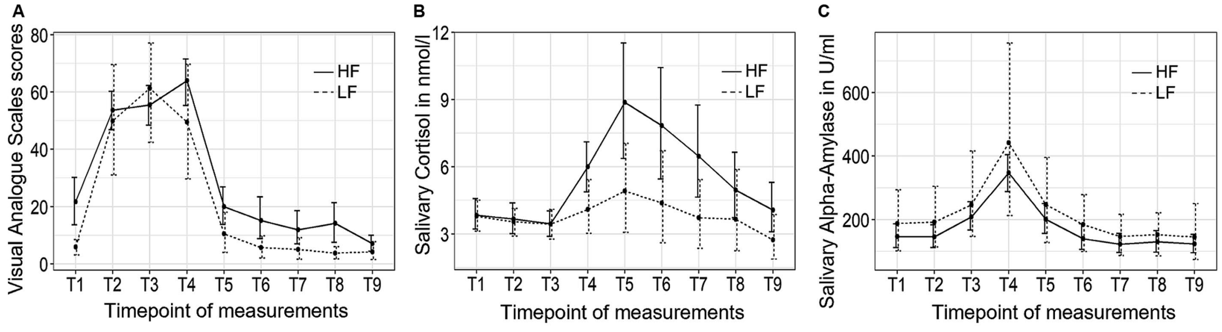

FIGURE 2
The trajectory of visual analog scale (VAS) scores **(A)**, salivary cortisol concentrations **(B)**, and salivary alpha-amylase activity **(C)** throughout the experimental procedure in Study 1. HF refers to the high-frequency group and LF refers to the low-frequency group.

2.2. Results

Complete data were collected from 27 participants (mean age = 24.07 years, SD = 2.25 years; mean BMI = 21.36, SD = 1.90). One participant did not provide sufficient saliva for analysis at T3. The cortisol data from this single time point were removed from the analysis. The mean PSS score was 22.44 (SD = 3.39, range = 16–29) and the mean SSCS score was 18.37 (SD = 6.73, range = 4–34). The demographic variables and chronic stress scores were compared between the high-frequency and the low-frequency group (Table 1). There were no significant differences between the groups regarding the demographic variables. The two groups did not significantly differ regarding SSCS scores or PSS scores, although the low-frequency group exhibited a trend towards higher PSS scores when compared to the high-frequency group (t (13.94) = −1.92, $p = 0.07$, $r = 0.46$).

Figure 2 depicts the trajectory of the three independent variables over time for the two groups. The VAS stress scores exhibited significant changes over time (F (3.28, 81.89) = 60.54, $p < 0.001$, $\eta^2 = 0.60$). However, no significant group-by-time interaction effect or group differences were observed. *Post hoc* tests revealed that the participants experienced a rise in subjective stress levels immediately after the introduction to the TSST (T2), followed by a decrease back to baseline 10 min (T5) after the conclusion of the TSST.

The salivary cortisol concentration demonstrated significant changes over time (F (1.32, 31.72) = 7.70, $p < 0.01$, $\eta^2 = 0.10$). There were no significant group-by-time interaction effect or group differences in cortisol concentration between the high-frequency group and the low-frequency group, and no group differences were found at any of the time points. Bonferroni tests revealed that the participants experienced an increase in cortisol concentration 10 min after the conclusion of the TSST (T5), and did not return to baseline level until 30 min (T7) after the completion of the TSST.

Finally, sAA activity exhibited significant changes over time (F (2.44, 60.98) = 23.62, $p < 0.001$, $\eta^2 = 0.23$). There were no significant group-by-time interaction effects or group differences observed. *Post hoc* tests revealed that sAA activity reached its peak value at the end of the TSST (T4) and returned to baseline levels 10 min (T5) after the TSST.

2.3. Summary of Study 1

The findings from Study 1 did not support our initial hypothesis. Contrary to our expectations, the subjective stress levels, cortisol concentration and sAA activity during the recovery phase did not significantly differ between the two groups. These findings suggest that the frequency of habitual music listening for relaxation purposes might not be related to stress recovery among female participants. Participants who listened to music less frequently for relaxation purposes exhibited higher PSS scores (reflecting the last month), though this was not statistically different.

3. Study 2

The data of Study 2 stem from a large project exploring the impact of group size on the effectiveness of the Trier Social Stress Test for Groups (TSST-G) (von Dawans et al., 2011) (data not published yet). The project was approved by the ethics committee of the University of Vienna (reference number 00309). All participants provided informed consent prior to the experiment.

3.1. Materials and methods

3.1.1. Participants

The sample for Study 2 comprised men only. The inclusion criteria were age 18–35 years, a BMI of 18-28 kg/m^2, and sufficient German-language ability. To control for confounding effects, we applied the same exclusion criteria as in Study 1.

The larger project for Study 2 included both male and female participants undergoing the TSST in group sizes of 1, 3 and 5, respectively. A convenience sample size of 20 was expected for each condition. As Study 1 only included female participants due to previous studies having reported gender differences in HPA axis responses to stress and music, we decided to complement these data with data from male participants in Study 2. Ultimately, 62 male participants completed the experiments. We used the data from the male participants who underwent the TSST in the group size of 1, consisting of 21 participants. Since we did not collect music listening-related data from female participants in Study 2, these were excluded from the analysis.

3.1.2. Measures

The music listening behavior measures and stress measures were the same as in Study 1. In response to the item "How frequently do you listen to music in order to relax?," none of the participants gave a rating of 1 (i.e., never listening to music for relaxation purposes), three participants provided a rating of 2, two participants provided a rating of 3, seven participants provided a rating of 4, and nine participants gave the maximum rating of 5 (i.e., listening to music for relaxation purposes very often). Again, participants with ratings of 2 or 3 were allocated to the low-frequency group ($n = 5$) and those with ratings of 4 or 5 were allocated to the high-frequency group ($n = 16$).

3.1.3. Design and procedure

The general design and procedure of Study 2 were similar to Study 1 but with some modifications. While Study 2 also encompassed nine time points for both subjective and biological stress measures, the assignment of these time points was not exactly the same as in Study 1.

Figure 3 demonstrates the workflow of study 2. Upon arrival at the lab, a 30-min adaptation period took place, followed by T1, which consisted of the first saliva sample collection and the VAS to assess baseline stress levels (T1). Next, the participants were introduced to the TSST and asked to prepare for the task. Directly before the TSST, the next stress measurement took place (T2). The third measurement occurred after the speech part of the TSST (T3) and the fourth measurement after the mental arithmetic task, which represented the end of the TSST (T4). The participants were then led back to the relaxation room, where they were provided with magazines without emotionally arousing contents and asked not to talk. During the recovery period, further stress measurements were taken 10 min (T5), 20 min (T6), 30 min (T7), 45 min (T8), and 60 min (T9) after the TSST, corresponding to Study 1.

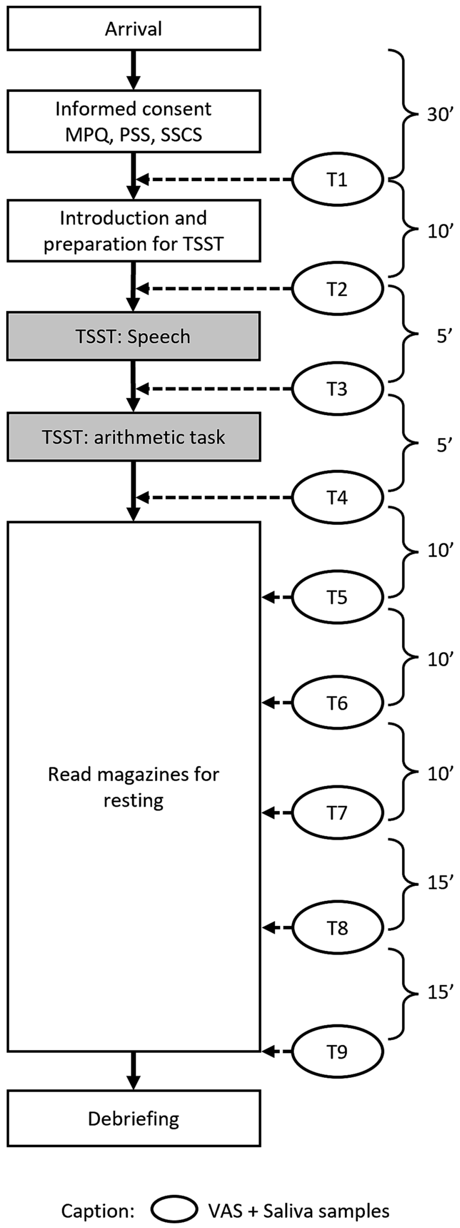

FIGURE 3
The workflow of Study 2.

3.1.4. Data analysis

The analytical procedure was the same as in Study 1.

3.2. Results

Complete datasets were available from 21 participants (mean age = 23.52 years, SD = 3.71 years; mean BMI = 23.22, SD = 1.63). One participant did not complete the VAS at T5 and T6. Cortisol measurements were missing for one participant at T2 and for another participant at both T3 and T4. There were no missing data for the sAA measurements. The missing data were excluded from the analyzes. In addition, there was one missing value on the PSS and one missing value on the SSCS. The mean PSS score was 12.15 (SD = 5.93, range = 5–24) and the mean SSCS score was 13.20 (SD = 8.33, range = 2–31). The demographic variables and chronic stress scores were compared between the high-frequency and the low-frequency group (Table 2). There were no significant differences between the groups regarding the demographic variables.

The high-frequency group showed significantly higher PSS scores compared to the low-frequency group (t (10.46) = 2.45, $p = 0.03$, $r = 0.60$). With regard to SSCS scores, there was no significant difference between the high-frequency group and the low-frequency group.

TABLE 2 Sample characteristics for Study 2.

Characteristic	HF		LF		*t* (*df*)	*p*	*r*
	Mean (SD)	*n*	Mean (SD)	*n*			
Age (years)	23.81 (3.82)	16	22.60 (3.58)	5	0.65 (7.11)	0.54	0.24
BMI	23.00 (1.64)	16	23.93 (1.56)	5	−1.15 (7.04)	0.29	0.40
PSS	13.19 (6.09)	16	8.00 (2.94)	4	2.45 (10.46)	0.03*	0.60
SSCS	14.60 (8.48)	15	9.00 (6.96)	5	1.47 (8.34)	0.18	0.45

SD, standard deviation; n, valid cases; HF, high-frequency group; LF, low-frequency group; BMI, body mass index; PSS, Perceived Stress Scale, SSCS, Screening Scale of Chronic Stress. *p* was calculated from two-tailed t-test; *$p < 0.05$.

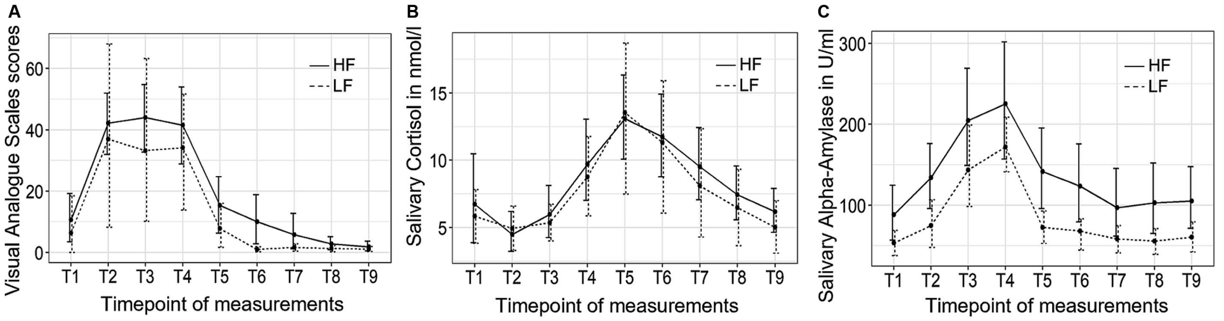

FIGURE 4
The trajectory of visual analog scale (VAS) scores **(A)**, salivary cortisol concentrations **(B)**, and salivary alpha-amylase activity **(C)** throughout the experimental procedure in Study 2. HF refers to the high-frequency group and LF refers to the low-frequency group.

Figure 4 depicts the trajectory of the three independent variables over time for both groups. The VAS stress scores exhibited significant changes over time (F (3.06, 55.03) = 17.28, $p < 0.001$, $\eta^2 = 0.37$). However, no significant group-by-time interaction effect or group differences were observed. *Post hoc* tests indicated an immediate increase in subjective stress levels following the introduction to the TSST (T2), which subsequently decreased back to baseline levels 10 min (T5) after the completion of the TSST.

The salivary cortisol concentration exhibited significant changes over time (F (2.25, 38.25) = 29.50, $p < 0.001$, $\eta^2 = 0.27$). However, no significant group-by-time interaction effect or group differences were observed. Bonferroni tests revealed that the cortisol concentration started to significantly increase at the end of the TSST (T4) and reached its peak 10 min after the TSST (T5), and did not return to baseline levels until 45 min (T8) after the completion of the TSST.

Finally, the sAA activity exhibited significant changes over time (F (2.49, 47.29) = 10.88, $p < 0.001$, $\eta^2 = 0.13$). However, no significant group-by-time interaction effect or group differences were observed. *Post hoc* tests revealed that the sAA activity increase until it reached its peak value at the end of the TSST (T4) and returned to baseline levels 10 min (T5) after the TSST.

3.3. Summary of Study 2

The findings of Study 2, examining male participants, likewise failed to support the hypothesis. There were no significant differences observed in subjective stress levels, cortisol concentration and sAA activity during the recovery phase between the two groups. These findings suggest that the frequency of habitual music listening for relaxation purposes might not be related to stress recovery among male participants. The frequency of listening to music for relaxation purposes was moderately related to chronic stress, insofar as higher chronic stress levels correlated with a higher frequency of listening to music for relaxation purposes for the PSS scores (reflecting the last month) but not for the SSCS scores (reflecting the last 3 months).

4. General discussion

The aim of the current studies was to investigate whether habitual music listening for relaxation purposes was related to better stress recovery. However, the findings were contrary to our hypothesis. Further analyzes revealed that the purpose of listening to music for relaxation showed different relations to chronic stress levels and acute stress reactions.

4.1. Relaxation purposes and stress recovery

Listening to music for relaxation purposes did not appear to benefit stress recovery as expected. In the current study, none of the stress measurements exhibited significant differences between the low-frequency and high-frequency groups in either of the studies. Our findings differ from the study conducted by Linnemann et al. (2015), where they found that listening to music for relaxation purposes yielded lower salivary cortisol concentrations. However, it is important to note that their study had a different experimental setup, involving actual music listening behavior. Furthermore, their focus was on stress levels rather than stress recovery. In studies specifically examining the effects of actual music listening on stress recovery, Khalfa et al. (2003) found that hearing music resulted in a cessation of cortisol increase after stress, while Koelsch et al. (2016) found that music was associated with overall higher cortisol levels compared to a control condition. These patterns diverge from our findings and suggest that the influence of habitual music listening for relaxation purpose and actual music listening on stress may differ. It is worth exploring the potential combined effects of purpose and actual music listening, which calls for further investigation.

4.2. Relaxation purposes and chronic/acute stress

Fancourt et al. (2014) suggested that music listening might have different effects on chronic stress and acute stress. Accordingly, the effect of the music listening purpose may also vary depending on the type of stress. To further explore the relation between relaxation purpose and stress levels, we took ongoing chronic stress into consideration. The results revealed that among male participants, an increased utilization of music for relaxation purposes was associated with higher levels of chronic stress, while female participants exhibited a nearly significant trend in the opposite direction. In the study by Linnemann et al. (2015), listening to music for the purpose of relaxation was not related to chronic stress levels. The study conducted by Linnemann et al. (2015) did not include men. In contrast, the present study conducted separate tests for male and female participants. Moreover, female participants underwent the stress test during the follicular phase, when estrogen and progesterone levels were low. The varying hormone levels could possibly explain the different recovery patterns observed between genders in the current study. However, it is important to acknowledge the limitation of a small sample size in the current study, necessitating further testing of these results among a larger group.

5. Limitations

While the present study is the first to specifically explore the effect of listening to music for relaxation purposes on stress recovery, several limitations need to be considered.

First, the study was a secondary analysis using data from two projects that were not designed to address the current research questions. Further studies specifically designed to investigate this topic should be conducted. Moreover, the sample sizes might have limited the range in our variables of interest. For example, in the MPQ, none of the participants reported never listening to music for relaxation purposes, and we had to form two groups based on the 5-point responses to this MPQ item. In addition, the data used in this paper came from individuals under restrictive inclusion and exclusion criteria, which limits the generalizability of the results. Furthermore, the sample consisted of young adults only. As music tastes and stress levels might vary between different age groups (Aldwin et al., 1996; LeBlanc et al., 1996), further investigations in more diverse populations are needed. Furthermore, this study solely examined the influence of the habitual listening to music for relaxation purposes on stress recovery in the absence of actual music listening. In real-life situations, it is difficult to entirely separate the act of listening to music from the purpose of obtaining relaxation. Under the circumstance of listening to music, the role of relaxation purpose on stress recovery may vary. Future studies should consider incorporating the actual music listening behavior in the investigations.

6. Implications

The present findings suggest that frequently listening to music for the purpose of relaxation does not substantially facilitate stress recovery. While listening to music for relaxation purposes might be helpful in a stressful situation itself, it may not support better coping with stress in situations in which music listening is not possible. Future studies might further investigate the effect of frequently listening to music for relaxation purposes on (other) coping strategies, which influence the ability to relax after a stressor. Since the present findings might partially suggest that chronically stressed persons more frequently listen to music for relaxation purposes, future studies should shed light on this possible relationship in larger samples.

The current findings may benefit clinical practice. While music has demonstrated a beneficial effect in many healthcare environments (Finn and Fancourt, 2018), this effect might not generalize to situations in which music listening is not possible. Depending on the target situation of an intervention, combining music listening with other, more generalizable coping strategies would be advisable.

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 Vienna Ethics Committee. 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

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

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Conflict of interest

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

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Effect of emotional freedom technique on the fear of childbirth in Iranian primiparous women: a randomized controlled trial

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Background: Fear of childbirth is one of the main causes of women's emotional difficulty experienced in the perinatal period, especially those having their first child.

Objective: The aim of this study was to investigate the effect of emotional freedom technique (EFT) on the fear of childbirth among primiparous women in Ahvaz, Iran.

Materials and methods: This randomized clinical trial was conducted on 116 primiparous women. The participants were randomly divided into intervention ($n = 58$) or control ($n = 58$) groups. The intervention group received daily stimulation of certain points in their body for 12 weeks using EFT. The fear of childbirth was measured at the beginning of the study and 12 weeks after the intervention using the Wijma Delivery Expectancy/Experience Questionnaire (WDEQ-A) and at the first postpartum visit with WDEQ-B. Data were analyzed using independent t-test, paired t-test, Chi-square or Fisher's exact test, and analysis of covariance (ANCOVA).

Results: After intervention, the mean score of fear of childbirth in the intervention group decreased from 49.39 ± 8.21 to 40.42 ± 13.43 ($p < 0.0001$), while the same rate in the control group increased from 49.47 ± 9.06 to 52.09 ± 7.73 ($p = 0.002$). The mean score of fear of childbirth after delivery in the control group (45.88 ± 7.10) was higher than that in the intervention group (27.13 ± 5.08) ($p < 0.0001$).

Conclusion: Based on the findings of this study, EFT can be considered as an effective method to reduce the fear of childbirth score in primiparous women.

KEYWORDS

fear of childbirth, primiparous, emotional freedom technique (EFT), Wijma Delivery Expectancy/Experience, WDEQ-B

1 Introduction

Although pregnancy is associated with positive feelings about the baby, it is mostly accompanied with anxiety, stress and fear of childbirth (Wijma, 2003). According to a systematic review, the prevalence of intensive fear of childbirth in women around the world is 14%, with primiparous and multiparous women accounting for 16 and 12%, respectively (O'Connell et al., 2017). In Europe, the overall prevalence of intensive fear of childbirth is 11%, which is 11.4% for primiparous women and 11% for multiparous women (Lukasse et al., 2014). In Australia, the overall prevalence of intensive fear of childbirth is 24, and 31.5% of primiparous women report severe fear (Toohill et al., 2014). Fear of childbirth has been reported differently in developing countries. For example, a study in Malawi showed that 41 and 20% of pregnant women reported moderate and high fear of childbirth, respectively (Khwepeya et al., 2018). Another study in Southern Ethiopia showed that the prevalence of fear of childbirth is 24.2%, and women with the negative experience from previous pregnancy had a higher rate of fear (Aynalem and Eneye, 2021). A study in Iran showed that 77.2% of pregnant women had mild or moderate fear of childbirth, 18.5% had clinical and 4.3% had severe fear of childbirth (Alijani et al., 2019).

Mental stress during pregnancy and childbirth can be associated with adverse outcomes and consequences such as miscarriage, nausea and vomiting, pre-eclampsia, and premature birth. Furthermore, fear of childbirth may persist in the postpartum stage and leave an unpleasant experience of childbirth (Alehagen et al., 2001). According to a previous study, preterm birth almost is twice among women who experienced stress in their pregnancy in comparison to women who did not have (Lilliecreutz et al., 2016). A longitudinal study showed that higher maternal blood leptin was significantly associated with respiratory distress, low birth weight, lower head circumference, and low APGAR score in neonates (Rabiepoor et al., 2019). Another study showed that women with higher anxiety score during pregnancy had more uterine artery resistance index that in turn can deteriorate blood flow of uterus (Fisk and Glover, 1999). In addition, the hypoxia caused by the decrease in blood flow to the pelvic muscles in response to the fear-induced increase in serum catecholamine and cortisol levels can lead to increased pain in mothers. Women who experience excessive fear during pregnancy are at risk of emotional imbalance after giving birth, which can negatively affect their relationship with their baby (Areskog et al., 1983; Lederman, 1990). Also, fear of labor pains and feeling alone during pregnancy are predictive factors of pain and suffering during childbirth and may increase the risk of emergency cesarean section (Ryding et al., 1998) and elective cesarean section (Waldenström et al., 2006). In 1985, the World Health Organization (WHO) urged that there be no justification for a cesarean rate of higher than 10–15% in any region of the world (Chalmers, 1992). The reason why the WHO recommends to avoid unnecessary cesarean section is that, like any surgery, caesarean sections are associated with short- and long-term risks which can extend many years beyond the current delivery and affect the health of the woman, her child, and future pregnancies, and that these risks are higher in women with limited access to comprehensive obstetric care" (World Health Organization, 2023).

Studies have estimated the prevalence of cesarean section to be 50–60% in Iran, which is 3–4 times higher than that recommended by the WHO (Badiee et al., 2013). Negative experiences with last delivery may persuade pregnant women to resort to elective cesarean section (Størksen et al., 2015). However, there is evidence suggesting that fear of childbirth among primiparous women is higher than in multiparous women (Shakarami et al., 2021), and that such fear is the most common reason for having a cesarean section (Negahban and Ansari, 2009) even though complications of cesarean sections are far more frequent than those of natural childbirths.

Therefore, treatment of fear of childbirth should be a priority in order to reduce the risk of having an unpleasant experience of childbirth, reduce cesarean section rate, and improve the mental health of mothers (Delavar and Alizadeh, 2014). Several methods such as hypnosis, exercise, and cognitive-behavioral interventions with or without medications have been used to reduce the fear of childbirth (O'Connell et al., 2019).

Emotional freedom technique (EFT) is one of the alternative medicine treatments which is a combination of elements of cognitive-behavioral therapy, exposure therapy, and somatic stimulation of acupuncture points (Church, 2014; Stapleton et al., 2017). Physiological examination of the clinical effects of EFT has shown that this technique is associated with the regulation of cortisol, beneficial changes in gene expression, and regulation of the autonomic nervous system activity (Church et al., 2012, 2020).

The effect of EFT has been investigated in studies in different areas. For example, Church et al. found that EFT clearly reduced the level of cortisol, which in turns improved depression, anxiety and other psychological disorders (Church et al., 2018). According to Lane, the physiological mechanisms of the response to reduced stress and relaxation include a decrease in the secretion of stress hormones such as cortisol, an increase in the secretion of endogenous opioids, and as a result the decrease of fear in the amygdala (Lane, 2009). EFT has been reported to be effective in many other areas such as the treatment of disorders such as generalized or specific anxiety, morbid fears, depression, post-traumatic stress disorder, chronic pain, and addiction (Church, 2013). However, no research has so far been conducted on the effect of EFT on the fear of childbirth in Iran. Therefore, this research was conducted with the aim of investigating the effective of EFT on the fear of childbirth among primiparous women in Ahvaz, Iran. We hypothesized that EFT could reduce the fear of childbirth among primiparous women.

2 Methods

This study is a parallel randomized controlled trial on 116 primiparous pregnant women with fear of childbirth who were randomly divided into EFT and control (Sham therapy) groups. The study was approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (Ref. ID: IR.AJUMS.REC.1400.192). Also, the protocol of this study was registered in the Iranian Registry of Clinical Trials (Ref. ID: IRCT20210622051671N1). All participants provided written informed consent before data collection. The women were recruited in this study based on the following criteria: minimum elementary education, age 18 to 40 years, gestational age 28 to 30 weeks, primiparity, and obtaining a score greater than 37 from the Wijma Delivery Expectancy Questionnaire (WDEQ-A), which indicates moderate fear of childbirth. Women with the following criteria were excluded from the study: suffering from chronic diseases such as heart disease, high blood pressure, and diabetes, history of abortion, placenta previa, suffering from mental illnesses during the past year, taking psychoactive drugs, drug addiction, smoking, and pregnancy complications such as pre-eclampsia, hemorrhage, intrauterine death, and premature birth.

Data collection was started in November 2021 and completed in March 2022.

2.1 Sample size

According to the objectives of the research and assuming a power of 80%, $\alpha = 0.05$, $s1 = s2 = 17.43$ and $d = 10$, the sample size was determined using the following formula:

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2 \left(s_1^2 + s_2^2\right)}{(d)^2}$$

Assuming a 20% attrition rate, the number of participants in each group of intervention and Sham therapy was 58.

2.2 Randomization

Participants who scored above 37 in the WDEQ-A were included in the study. The method of assigning women to the intervention or control groups was based on block randomization with a block size of 6 and an allocation ratio of 1:1. The randomization list was prepared by a statistician (EM). The codes assigned to the eligible women were placed in sealed envelopes by someone who was not involved in the study and was not aware of the research objectives. The envelops were then given to the clerk in health centers. In this way, neither the researcher nor the participants were aware of group allocation until the commencement of the study. This study was single blind, meaning that the researcher was aware of which group received the intervention, but participants were not aware of grouping.

2.3 Setting

The lead researcher visited two public health centers in Ahvaz city and screened pregnant women based on the inclusion/exclusion criteria. A total of 200 women were examined, of whom 116 who met the inclusion criteria were randomly assigned into EFT and control groups. Primiparous women who attended to Public Health Centers No. 2 and 3 in the west of Ahvaz were screened based on the inclusion criteria. Women who met inclusion criteria and received a score more than 37 from Wijma-A questionnaire were requested to fill-out the demographic questionnaire.

2.4 Instruments

In this study, a demographic questionnaire and the Wijma Delivery Expectancy/Experience Questionnaire (W-DEQ) versions A and B were used to collect the data. The demographic questionnaire contained questions about age, gestational age, the woman's and her husband's educational attainment and occupation, and economic status.

W-DEQ-A is a questionnaire used to assess women's fear of the childbirth. This questionnaire has 33 questions in six dimensions of "lack of positive anticipation (questions number 2, 19, 25 and 27)," "fear (questions number 3, 6, 7, 8, 11, 12 and 15)," "lack of self-efficacy (questions number 4, 5, 10, 13, 14, 16, 17, 20, 22, 23)," "loneliness (questions number 1, 9 and 29)," "concerns for the child (questions number 30, 32, 33)," and "negative appraisal (questions number 18, 21, 26, 28)." Questions 24 and 31 are not classified in any category, but they are taken into account when calculating the total score. The questions are scored based a six-point Likert scale (from 0 to 5). Some of the questions are affirmatively worded and some are negatively worded. The minimum total score obtained is 0 and the maximum score is 165. A score less than or equal to 37 means a mild fear level, a score of 38–65 suggest a moderate fear, and a score of 66–84 represents severe fear. The cut-off score is 85, which means that scores 85 and above prove clinical fear (Wjma et al., 1998).

The construct validity of this questionnaire and its reliability were confirmed in Abedi et al.'s study (Abedi et al., 2016). WDEQ-B has 33 questions in six sub-scales, and each question is scored from 0 to 5. It is similar to the A version in terms of scoring and cut-off point. They are different only in terms of the time point of assessment (the A version is used before delivery while the B version is used after delivery).

2.5 Intervention

The EFT included the following steps:

1. Identifying the problem that caused the person to be upset (e.g., fear of childbirth) and scoring or measuring the severity of that problem.
2. Expressing an emphatic sentence (in relation to the person's problem and self-acceptance) along with tapping the parts of the face and body with the tips of the fingers, which is known as correction (i.e., arrangement of the energy system).

These points include: the edge of the hand (the fleshy part of the outer edge of the hand that is used in karate to break objects), the beginning of the eyebrows (above the side of the nose), the side of the eyes (on the bone of the outer side of the eye), under the eyes (on the cheek and 2–3 cm below the eyeball), under the nose (in the short distance between the nose and the upper lip), chin (the distance between the depression of the chin and the lower lip), the beginning of the clavicle (at the intersection of the sternum, the clavicle and the first rib, 2.5 cm towards the navel from the U-shaped slit) and under the arm (10 cm from the armpit to the bottom), above the head (if an imaginary line is drawn from one ear to the other ear and another from the nose to the back of the neck, this point will be right at the intersection of these two lines; Figure 1).

In order to learn and master the principles of EFT, the lead researcher participated in a workshop held by an expert in EFT.

In groups of maximum 10 women, the participants in the intervention group received EFT training on how to manipulate the correct points in one session. In this training session, this technique was illustrated using a short training video, and the researcher ensured the correctness of manipulating the points (this training video was prepared by the training institute).[1] Also, an approved educational brochure (to help the participants in the correctly use of this method)

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[1] www.eftbylili.com, www.emofree.com

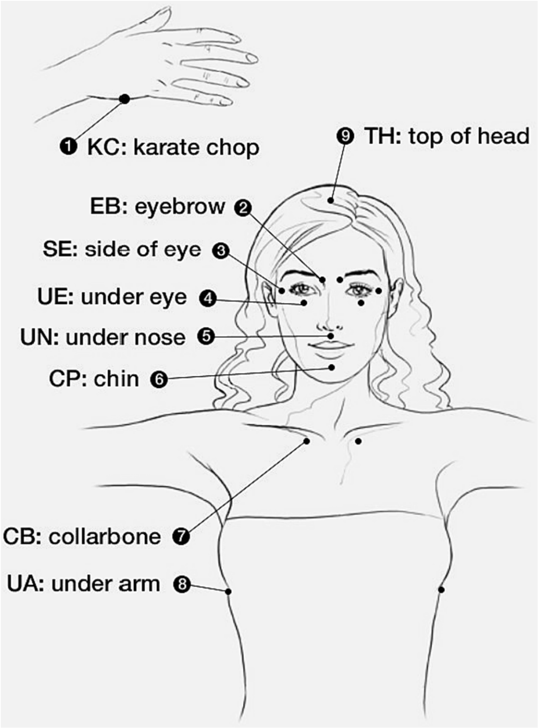

FIGURE 1
EFT points.

which was based on the standard instructions and EFT website was provided to the participants to use at home. Based on the initial research design, two face-to-face training sessions were supposed to be held, but due to the start of the COVID-19 pandemic and the subsequent home quarantine, only one face-to-face session was held for the participants.

The participants were recommended to do this technique every morning in order to improve their mood throughout the day. In addition, they were advised to use this technique during the day whenever they felt stressed out and afraid. While tapping, the women were asked to use positive statements and to accept themselves despite all the problems they had. In the next 10 weeks, the participants were followed up (on a weekly basis) by phone calls in order to check the regular implementation of this method (i.e., sending audio files on tapping techniques three times a week and answering the mothers' questions) in accordance with the principles taught in the face-to-face training session. The participants' questions were answered through phone calls and text messages. The women were asked to use affirmative sentences when tapping the EFT points.

Likewise, a face-to-face training session was held for the control group, but it included false points (i.e., elbow bumps, chin bumps, eye bumps, nose bumps, foreheads, and arms). All participants were asked to follow these instructions until the end of pregnancy. In order to abide by ethical consideration, women in the control group were given a pamphlet about right points at the end of the study.

2.6 Follow up

We recruited women at 28–30 gestational age and followed them up for 10 weeks for measuring fear of childbirth before delivery. Women also followed up to 2 weeks after delivery for measuring fear of childbirth after delivery. Women in the intervention group received a phone call three times a week to ensure the correct use of EFT.

In the last prenatal visit (39–40 weeks), the fear of childbirth after intervention was assessed using WDEQ-A. For measuring fear of childbirth after delivery the WDEQ-B was given to the mothers (both as Google doc file and hard copy) to be completed at home after delivery. In the first postpartum visit (first 10 days after delivery) the completed questionnaires were checked by the lead researcher and in case of any unanswered question, the mothers were requested to provide answers to those questions.

2.7 Outcomes

- Fear of childbirth before delivery.
- Fear of childbirth after delivery.

2.8 Statistical analysis

Data analysis was done using SPSS version 20. The quantitative variables were reported using mean and standard deviation, and qualitative variables, using frequency (percentage). The normality of quantitative variables was assessed by the Shapiro–Wilk test. The comparison of qualitative variables in the two groups was done by Chi-square or Fisher's exact tests. Comparison of the quantitative variables between two groups was performed using the independent samples *t*-test. Paired samples *t*-test was used for comparing the quantitative variables' changes in each group. Effect of intervention on posttest outcome measures were examined using analysis of covariance (ANCOVA), adjusting for pretest scores. The significance level of the tests was considered as 0.05.

3 Results

In this study, 58 women were included in each group (intervention and control) and all of them completed the study (Figure 2). The demographic characteristics of the participants are listed in Table 1. The mean age of the mothers was 22.11 ± 3.73 years, and their mean gestational age was 29.15 ± 0.77 weeks. According to the results of Table 1, the two groups had no statistically significant differences in terms of demographic factors ($p > 0.05$).

Table 2 shows the difference between the mean score of the components of WDEQ-A before and after intervention in the intervention and control groups. The mean score of lack of positive anticipation in the intervention group decreased from 7.72 ± 2.43 before the intervention to 6.86 ± 2.75 after intervention, which was not significantly different compared to the control group ($p = 0.34$). The mean score of fear in the intervention group fell from 13.60 ± 2.28 before the intervention to 10.95 ± 5.74 after intervention ($p = 0.001$), which was significantly different compared with the control group ($p = 0.003$). The mean score of lack of self-efficacy in both groups increased significantly. Results of independent *t*-test and ANCOVA did not show any significant difference between the two groups in this regard ($p = 0.222$). The mean score of loneliness in the intervention group rose from 3.08 ± 1.12 to 3.42 ± 2.51, which was not significantly

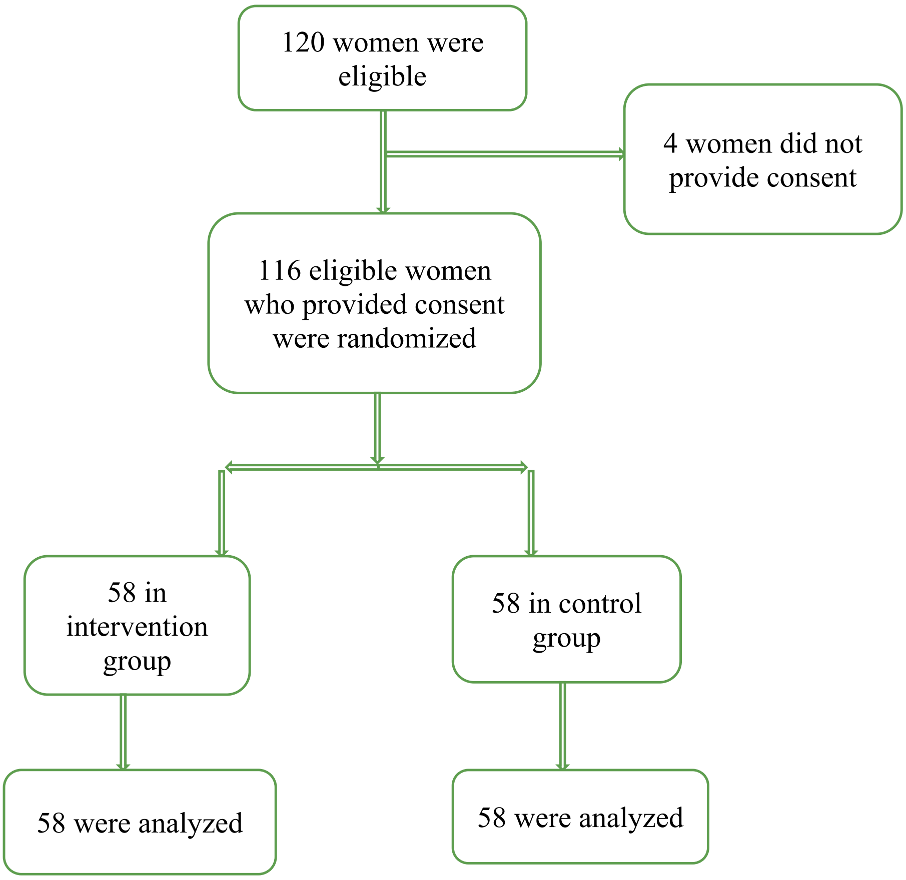

FIGURE 2
Flow-diagram of recruitment and retention of participants in the study.

TABLE 1 Demographic characteristics of the studied women in the intervention and control groups.

Variables		Mean ± SD				Value of *p*
		Intervention (*n* = 58)	Control (*n* = 58)	Statistics	*df*	
Mother's age (year)		22.14 ± 3.70	22.06 ± 3.78	−0.12	120	0.904*
Gestational age (week)		29.13 ± 0.76	29.16 ± 0.77	0.23	120	0.815*
		N (%)				
Educational attainment	High school	20 (32.8)	27 (44.3)	2.68	2	0.261**
	High school diploma	37 (60.7)	28 (45.9)			
	University degree	4 (6.6)	6 (9.8)			
Husband's educational attainment	High school	8 (13.1)	17 (27.9)	6.64	3	0.084**
	High school diploma	51 (83.6)	39 (63.9)			
	University degree	1 (1.6)	4 (6.6)			
Occupation	Housewife	57 (93.4)	57 (93.4)	0.00	1	>0.99**
	Employed	4 (6.6)	4 (6.6)			
Husband's occupation	Office clerk	16 (26.2)	16 (26.2)	0.00	1	>0.99**
	Self-employed	45 (73.8)	45 (73.8)			
Does your income cover your expenses	Not at all	1 (1.6)	0 (0)	3.48	2	0.175**
	Moderately	55 (90.2)	50 (82.0)			
	Good	5 (8.2)	11 (18.0)			

*Independent *t*-test or Man–Whitney test. **Chi-square test or Fisher exact test.

TABLE 2 Comparison of the mean score of the dimensions of WDEQ-A before and after intervention in the intervention and control groups.

Studied variables	Intervention (n = 58)	Control (n = 58)	value of p*	$t(df)$	p −value***	Statistic (df)
Mean ± SD						
Lack of positive anticipation						
Before	7.72 ± 2.43	7.21 ± 2.46	0.254	−1.14 (120)	0.060	3.54 (1)
After	6.86 ± 2.75	7.29 ± 2.11	0.340	0.95 (120)		
p**	0.032	0.642				
$t(df)$	2.20 (60)	−0.46 (60)				
Fear						
Before	13.60 ± 2.28	13.01 ± 2.37	0.164	−1.39 (120)	0.003	8.80 (1)
After	10.95 ± 5.74	12.85 ± 2.04	0.016	2.43 (74.98)		8.80 (1)
p**	0.001	0.448				
$t(df)$	3.58 (60)	0.76 (60)				
Lack of self-efficacy						
Before	10.52 ± 3.63	10.55 ± 3.18	0.958	0.053 (120)	0.222	1.41 (1)
After	13.47 ± 8.32	12.11 ± 2.87	0.230	−1.20 (74.12)		
p**	0.019	<0.0001				
$t(df)$	−2.41 (60)	−0.76 (60)				
Loneliness						
Before	3.08 ± 1.12	3.22 ± 1.17	0.481	0.70 (120)	0.588	0.29 (1)
After	3.43 ± 2.51	3.65 ± 0.96	0.508	0.66 (77.20)		
p**	0.338	<0.0001				
$t(df)$	−0.96 (20)	−4.79 (60)				
Concerns for the child						
Before	7.39 ± 1.36	7.52 ± 1.47	0.612	0.50 (120)	<0.0001	169.74 (1)
After	3.86 ± 1.46	7.78 ± 2.11	<0.0001	11.89 (106.86)		
p**	<0.0001	0.343				
$t(df)$	21.62 (60)	−0.95 (60)				
Negative appraisal						
Before	3.31 ± 2.32	4.49 ± 3.95	0.001	0.05 (120)	0.007	39.40 (1)
After	3.13 ± 3.44	4.75 ± 1.61	0.001	5.88 (95.82)		
p**	0.742	0.562				
$t(df)$	0.33 (60)	−0.58 (60)				
The overall score						
Before	49.39 ± 8.21	49.47 ± 9.06	0.958	0.05 (120)	<0.0001	39.40 (1)
After	40.42 ± 13.43	52.09 ± 7.73	<0.0001	5.88 (95.82)		
p**	<0.0001	0.002				
$t(df)$	4.67 (60)	−3.32 (60)				

The fear of childbirth was measured before intervention (weeks 28–30) and after intervention (weeks 39–40) of pregnancy. *Independent t-test; **Paired t-test; ***ANCOVA.

different compared to the control group ($p = 0.508$). The mean score of concerns for the child in the intervention group increased from 1.36 ± 7.39 to 3.86 ± 1.46 ($p < 0.0001$), which showed a significant difference between the two groups based on independent t-test and ANCOVA ($p < 0001$). Finally, the mean score of negative appraisals before intervention in the control and intervention groups was 4.49 ± 3.95 and 3.31 ± 2.32, respectively ($p = 0.001$), which changed to 4.75 ± 1.61 and 3.13 ± 3.44, respectively after intervention ($p = 0.001$). Despite the lack of significant changes within the groups, the difference between the two groups was significant using ANCOVA test ($p = 0.007$). The mean overall score of fear of childbirth in the intervention group decreased from 49.39 ± 8.21 to 40.42 ± 13.43 ($p < 0.0001$), while the mean overall score of fear of childbirth in the control group increased from 49.47 ± 9.06 to 52.09 ± 7.73 ($p = 0.002$).

Table 3 shows the difference in the mean score of the dimensions of WDEQ-B after delivery in the intervention and control groups. In all dimensions of fear of childbirth including lack of positive anticipation, fear, lack of self-efficacy, loneliness, concerns for the

TABLE 3 Comparison of the mean score of the dimensions of WDEQ-B in the intervention and control groups.

Studied variables	Intervention (*n* = 58)	Control (*n* = 58)	*t* (*df*)	Value of *p**
Mean ± SD				
Lack of positive anticipation	6.96 ± 1.19	8.62 ± 1.08	8.01 (120)	<0.0001
Fear	10.18 ± 1.61	18.45 ± 3.31	17.51 (86.97)	<0.0001
Lack of self-efficacy	0.77 ± 1.10	8.31 ± 2.04	25.35 (92.09)	<0.0001
Loneliness	0.49 ± 0.84	3.29 ± 1.08	15.88 (113.42)	<0.0001
Concerns for the child	3.77 ± 1.08	2.34 ± 1.15	−7.03 (120)	<0.0001
Negative appraisal	0.42 ± 0.97	0.13 ± 0.78	−1.84 (114.80)	0.068
Overall score	27.13 ± 5.08	45.88 ± 7.10	16.77 (108.70)	<0.0001

Fear of childbirth after delivery was measured up to two weeks after delivery. *Independent *t*-test.

child, except negative appraisal, the score of the intervention group was significantly lower than that of the control group ($p < 0.0001$). The mean overall score of fear of childbirth after delivery in the control and intervention groups was 45.88 ± 7.10 and 27.13 ± 5.08, respectively, indicating a significant difference ($p < 0.0001$). No side effects were reported by participants in intervention or control groups.

4 Discussion

This study was conducted to investigate the effect of EFT on the fear of childbirth in primiparous women. The results showed that the mean score of fear, concerns for the child, negative appraisal, and the overall score of Wijma-A were significantly improved in the intervention group compared to the control group. However, the two groups were not significantly different regarding lack of positive anticipation, lack of self-efficacy, and loneliness. The scores of all dimensions of Wijma-B except for negative appraisal were improved significantly in the intervention group compared to the control group.

EFT has been successfully used in treatment of various mental and physical disorders including depression, anxiety, phobias, post-traumatic stress disorder, irritable bowel syndrome, and obesity, proving to be effective usually within 1–10 sessions (Wells et al., 2003; Baker and Siegel, 2010). We could not find any study to investigate the effect of EFT on the dimensions of W-DEQ, but there are a number of studies that evaluated the effect of EFT on the stress, anxiety and fear of expectant mothers.

In a study on 120 pregnant women, for instance, Vural et al. investigated the role of EFT and conscious breathing in reducing fear of childbirth. They used the Subjective Units of Distress Scale and Wijma-B for measuring fear of childbirth. Their results showed that both types of intervention, namely EFT and conscious breathing, reduced the level of fear of childbirth, but the former had more profound and permanent effects (Vural and Aslan, 2019). Another study by Mardjan et al. was conducted in 2016 in Indonesia on 38 teenage pregnant women suffering from anxiety. Their study was aimed at investigating the effect of EFT on anxiety and cortisol levels, and they used Taylor Manifest Anxiety Scale (TMAS) and cortisol blood test for measuring anxiety level. Their results showed that EFT significantly contributes to the reduction of anxiety level and blood cortisol level by 57 and 43%, respectively, and that it indirectly affects the mother's readiness for childbirth (Mardjan et al., 2018). In 2015, in a semi-quasi study with a pre-test-post-test design and control group in Tehran, Ghamsari et al. investigated the effect of EFT on perceived stress and tolerance of 30 pregnant women. They found that the experimental group's scores on perceived stress significantly decreased while there was a significant increase in their scores of tolerance (Ghamsari and Lavasani, 2015). In Yuniarti et al. (2016) investigated the effect of EFT on the level of cortisol, immunoglobulin E, and the anxiety among pregnant women. Primiparous women who used this technique were more relaxed when facing childbirth (Yuniarti et al., 2016). Our results are in line with the above studies. The exact mechanism for stress and fear reduction of EFT is not clear, but evidence showed that improvement in physical parameters such as heart rate variability, hearth coherence, blood pressure, and level of cortisol, that all of them are predisposing factors for stress and anxiety, may play a main role in stress and fear reduction (Bach et al., 2019). Also, as EFT has almost similar mechanism to mindfulness, one of the underlying factors of stress reduction of both techniques is attention to present moments and monitor and acceptance (Lindsay et al., 2018).

Studies have shown that a high level of fear of childbirth before childbirth can persist for a long time after childbirth and that such fear is associated with the development of symptoms of post-traumatic stress disorder (Wijma et al., 1997). In their study on the fear of childbirth before, during and after childbirth, Alehagen et al. found that women with fear before childbirth are more likely to have fears during the active stage of labor and after childbirth (Alehagen et al., 2006). Screening to identify a high level of fear of childbirth during pregnancy can provide appropriate treatment for women with a high level of fear, possibly by reducing the risk of negative consequences in the future, both psychologically and obstetrically (Zar et al., 2001). Evidence from our study show that using EFT in the third trimester could reduce the fear of childbirth in postpartum women.

In Iran systematic efforts are being made in health centers to minimize the anxiety and fear of primiparous mothers, including counseling and pregnancy exercise under the supervision and guidance of an authorized midwife (Baker and Siegel, 2010). Of course, this sometimes makes it difficult for the mother to arrange her time to go to health centers and receive services (Roland-Price and Chamberlain, 2002). EFT enables mothers to do this technique either under the supervision of a teacher or independently at home without time limits and with the best possible results (Baker and Siegel, 2010).

Although, in the present study, the intervention based on EFT improved fear, concerns for the child, negative appraisal, and the overall score of Wijma-A, it failed to improve scores in the scales "lack of positive anticipation," "lack of self-efficacy," and "loneliness".

Satisfaction with childbirth is related to a variety of psychological factors which include, but are not limited to, sense of personal control and whether health providers and family are meeting the women's expectations (Goodman et al., 2004). Therefore, it is likely that the EFT could not improve all these dimensions. Furthermore, the participants in the present study were primiparous and may had deeper fear of childbirth compared to women who already had other pregnancies, and this might have hindered their ability to overcome to any unanticipated situation happened around the time of labour and to experience a sense of self-efficacy making the improvement of the scales 'lack of positive anticipation' and 'lack of self-efficacy difficult. Finally, physical and mental changes that occur during pregnancy might alienate a person from herself and the society around her (Rokach, 2004), and, although EFT could reduce feeling of loneliness to some extent, the changes did not reach a significant level.

The hypothesis of this study that EFT could significantly reduce the fear of childbirth was confirmed by our results. The results of this study can therefore be used by policy makers and health providers to improve the mental condition of primiparous women and to improve the quality of childbirth preparation classes.

4.1 Strengths and limitations

This study has some strengths. First, it included a rigorous randomization of the sample in the two groups which eliminated selection bias and a design that allowed direct comparison between the two interventions. Second, a perspective design which assessed fear of childbirth before and after delivery (not only before it). Third, an adequate sample size was used in this study which was *a priori* calculated performing a power analysis. Finally, allocation to either group was not disclosed to participants, and interventions were similar (using sham therapy in the control group) enough to minimize the performance bias in women, and groups were comparable in terms of socio-demographic characteristics.

However, this study was not without limitations. First, we did not measure the cortisol level before and after the intervention. If we had, we could have come up with a better understanding of the role of EFT. Second, due to the spread of COVID-19 and the subsequent home quarantine, we were able to hold only one face-to-face training session. Third, the psychological effect of COVID-19 along with the home quarantine was not measured as a confounding factor affecting the women's mental state and level of fear and anxiety. Fourth, recruitment was done only in two centers which might have created a selection bias in terms of participants' education, age, and SES. Finally, the exclusion and inclusion criteria limited the study population. Therefore, future studies are recommended to replicate this study with a larger and more diverse population. Based on the strengths and limitations of the present study, further studies are advised to measure the cortisol level, rule out other causes of psychological disorders such as anxiety and depression, or be conducted in a multi-center design.

5 Conclusion

The results of this study showed that a 12-week EFT program can reduce the mean score of fear of childbirth in primiparous Iranian women, and this reduction is maintained even after delivery. It is recommended to use this technique in childbirth preparation classes to improve the mental health of these mothers.

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 Ahvaz Jundishapur University of Medical Sciences. 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

SE, KH, PA, and EM were contributed to design of the study, equally contributed to data analyzing, and interpretation. SE collected the data. SE and PA prepared the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

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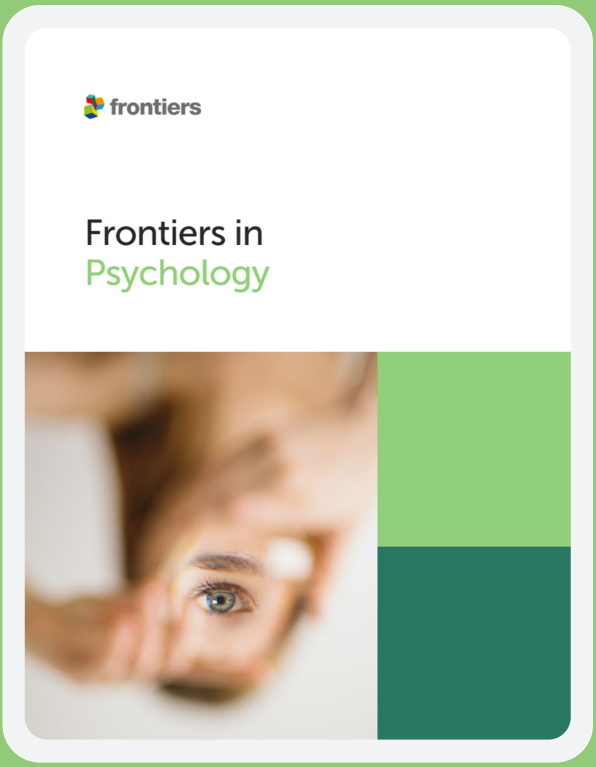

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