Anxiety and sleep quality among front-line nurses treating first wave COVID-19 in China: The mediating role of mindfulness

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ABSTRACT

Aim: To explore anxiety, sleep quality, and mindfulness of frontline nurses at the initial epicenter of the pandemic, to examine the mediating effects of mindfulness.

Background: COVID-19 was first identified in Wuhan, China in January 2020. Nurses were at the forefront of care and treatment across hospitals in response to the pandemic.

Methods: Single site cross-sectional survey conducted in Wuhan province (China) between March and April in 2020. Quantitative analysis of survey data from N118 nurses working in the frontline COVID response. Questionnaires included: The general information questionnaire, the Self-Anxiety Scale, the Short Inventory of Mindfulness, and the Pittsburgh Sleep Quality Index.

Results: Front-line nurses' anxiety was positively associated with sleep quality and mindfulness was negatively associated with anxiety and sleep quality. Mindfulness had a mediating role on anxiety and sleep quality, with intermediary adjustment effects (ES = 0.136, 95 % CI 0.02 to 0.26), accounting for 21.9 % of the total effect ratio.

Conclusions: Anxiety causes a reduction in sleep quality and mindfulness can help with anxiety. Mindfulness strategies may help during periods of higher anxiety in the workplace; however, other factors must be considered. Further research is required on strategies for assisting nurses during periods of extreme anxiety.

Introduction

The sleep quality among nurses has been a global concern, as it is an essential factor affecting nurses' mental health and overall well-being. According to a Polish survey, a total of 47.8 % of the surveyed nurses reported insomnia (Zdanowicz et al., 2020). A national cross-sectional Internet survey of Italy found at least one in three nurses' samples (39.9 %) reported a poor self-perception quality of sleep (Di Simone et al., 2020). In mainland China, the prevalence of sleep problems among clinical nurses in general hospitals was high (55 %) (Dong et al., 2017). Sleep problems of nurses exist all over the world, and the current situation is not optimistic. When working conditions are unstable and changing during the COVID-19 outbreak, front-line nurses need to be directly involved in the care of COVID-19 patients. They are forced to work under higher workload pressure, which leads to more prominent sleep problems nurses. A meta-analysis showed that the overall prevalence of sleep disorders among nurses during COVID-19 was 43 %, suggesting that at least one in three nurses experienced sleep disorders (Al Maqbali et al., 2021). Poor sleep quality of nurses affects their overall personal health and job performance and their patients' health and treatment process (D'Ettorre et al., 2020; Giorgi et al., 2018; Gómez-García et al., 2016; Song et al., 2020). Therefore, it is crucial to identify the factors affecting the sleep quality of front-line nurses and investigate ways to improve their sleep quality in the context of the COVID-19 pandemic.

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Background

In December 2019, COVID-19 occurred in Wuhan, Hubei Province, China. The National Health Commission has included COVID-19 as a statutory infectious disease and adopted prevention and control measures for class A infectious diseases (Sohrabi et al., 2020). As the disease progressed, there was increasing evidence of interpersonal transmission, which indicated COVID-19 as highly contagious. The World Health Organization (WHO) designated COVID-19 as a Public Health Emergency of International Concern (PHEIC) (Sohrabi et al., 2020). It is now a designated global pandemic and the psychological impact on nurses worldwide is already evident. At the forefront of the outbreak, numerous medical workers rushed to Wuhan to manage the healthcare crisis. A total of 42,600 healthcare workers went to Wuhan to respond - 70 % of those were nurses. Nurses are crucial to the healthcare system, using their professional knowledge and expertise to save lives as 'brave and fearless' clinicians (Zhou et al., 2020).

COVID-19 pneumonia has a sudden onset, it is highly contagious, and the world has noted rapid increases in confirmed cases over concise periods (Lai et al., 2020). Most nurses who went to Wuhan had limited experience in intensive care and emergency response. They had significant learning curves to adapt to rapidly changing environments (Al-Dorzi & Arabi, 2017). Demands meant longer shifts, dressed in restrictive personal protective equipment (PPE) and significantly higher workloads (Cui et al., 2017).

Under the influence of such poor working conditions and tremendous psychological pressure, nurses' sleep problems are more evident and urgent to be solved. Factors influencing sleep quality of front-line nurses include sociodemographic factors, such as gender, marital status, age and educational level (Al Maqbali, 2021; Jin et al., 2021; Simonetti et al., 2021; Zhan et al., 2020); working-related factors, such as the number of patients, working years, working experience, frequency of night shifts and working area (Huang, Lei, Liu, et al., 2020; Simonetti et al., 2021; Zhan et al., 2020); psychosocial factors, such as social support, anxiety, and depression (Huang, Lei, Liu, et al., 2020; Korkmaz et al., 2020; Tu et al., 2020); personal inner qualities, such as mindfulness, and resilience (Fang et al., 2019; Labrague, 2021) and COVID-19 related factors, such as the degree of fear of COVID-19, being vaccinated, whether family members or relatives were suspected or confirmed with having COVID-19, and working with COVID-19 patients (Al Maqbali, 2021; Labrague, 2021; Tselebis et al., 2020; Zhan et al., 2020).

Anxiety is a negative emotion that affects an individual's physical and mental health. For individuals engaged in the highly stressful and demanding nursing profession, anxiety is considered as an important factor affecting work capacity, quality of care and overall health (Firew et al., 2020; Heath et al., 2019; Hofmeyer & Taylor, 2021). Some studies have found that nurses with high anxiety levels have poorer quality of life and personal health than nurses without anxiety (Pappa et al., 2020; Potas et al., 2021). Moreover, anxiety was associated with adverse work-related outcomes, including low working efficiency, increased incidence of adverse events, lower patient satisfaction, and higher turnover rates (Booker et al., 2020; Khansa et al., 2020; Mattila et al., 2021; Trougakos et al., 2020). Anxiety has also been reported to affect sleep quality among nurses. Studies have shown that anxiety can lead to sleep disorders, sleep disturbance, sleep deprivation, and insomnia among nurses (Huang et al., 2018; Karabulut et al., 2021; Nashwan et al., 2021). Although studies have shown that anxiety has many adverse effects, there is still a lack of research on the correlation between anxiety and sleep quality among Chinese nurses, especially among front-line nurses who have high pressure and risk of infection.

Mindfulness is the basic human ability to be fully present, aware of where we are and what we're doing, and not overly reactive or overwhelmed by what's happening on around us. Studies have shown that mindfulness may reduce perceived anxiety and psychological stress and thus may play a role in work-related outcomes (Ghawadra et al., 2019; Keng et al., 2011). Lack of mindfulness is associated with increased negative mood and increased burnout in nurses (Guillaumie et al., 2017; Zhao et al., 2019). Additionally, mindfulness has recently been suggested to improve sleep quality as it facilitates experiential awareness of a range of experiences, both internal (e.g., thoughts, emotions, physical sensations) and external stimuli (e.g., sight, sound). It is worth mentioning that mindfulness meditation provided an approach in developing sleep quality (Rusch et al., 2019). It is hypothesized to target multiple cognitive and emotional processes that contribute to poor sleep quality. According to the theoretical framework of mindfulness and sleep disorders, the technique of mindfulness consists of three core processes (experiential awareness, attentional control, and acceptance) that have the potential to target each of the risk factors for sleep disorders (Shallcross et al., 2019; Tang et al., 2007). Recent studies have reported that those with a high level of anxiety have relatively lower levels of mindfulness. Mindfulness is one of the most important inner consciousness of nursing staff, and it has a potential effect on alleviating negative emotions and improving sleep quality (Westphal et al., 2015). Although several studies have reported the correlation between each pair of the variables such as sleep quality, mindfulness and anxiety of front-line nurses, few studies have explored the association between all three variables together in this population. Nourian et al. conducted a survey of nurses working in COVID-19 care units and reported that mindfulness-based interventions could effectively improve sleep quality (Nourian et al., 2021). There is reason to think that protective inner awareness such as mindfulness may limit poor sleep quality when faced with pressure. Previous research has reported a significant association between levels of mindfulness and psychological well-being (Ibrahim et al., 2021), which is an important factor in improving negative mood and mental health among nurses (Serrano-Ripoll et al., 2021). Healthcare managers should recognize, consider and adequately address these aspects to reduce the risk of poor sleep quality among nurses in the context of a pandemic.

Accordingly, to achieve a better quality of life and work efficiency of front-line nurses, it is necessary to investigate the mediating role of mindfulness on the effect of anxiety on the sleep quality of front-line nurses. The research question was: Did mindfulness mediate the relationship between anxiety and sleep quality during the COVID-19 response of Chinese front-line nurses between March and April in 2020. Therefore, the purpose of this study was to reveal whether mindfulness may have a mediating effect on the relationship between anxiety and sleep quality in a cohort of front-line nurses during the pandemic response at the Wuhan epicenter. Based on existing studies and mediation analysis, we hypothesized that (H1) anxiety is related to sleep quality among front-line nurses during the COVID-19 epidemic; (H2) anxiety is related to mindfulness among front-line nurses during the COVID-19 epidemic; (H3) Mindfulness is related to sleep quality and (H4) mindfulness mediates the relationship between anxiety and sleep

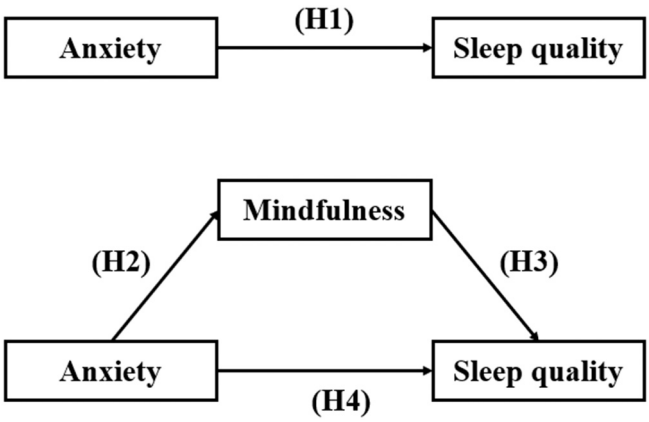

Fig. 1. Tested conceptual model. H, hypothesis.

quality. The conceptual model is depicted in Fig. 1.

Methods

Study design

This cross-sectional survey used convenience sampling to explore the relationship among anxiety, sleep quality, and mindfulness and the mediating role of mindfulness among Chinese front-line nurses from March to April 2020.

Participants and procedure

Participants were front-line nurses from COVID-19 designated hospitals in Wuhan, China. One hundred and eighteen front-line nurses who had given informed consent to participate in the study completed electronic questionnaires, which took around 15 min to complete.

Researchers sent participants a cover letter explaining the research. The cover letter describes the purpose and methods of the research, potential risks and benefits those participants can reap, and emphasizes the voluntary and confidential nature of participating in this survey. Participants were informed of their rights to anonymity and that they could withdraw at any time.

All procedures performed in this study comply with the Helsinki Declaration and its subsequent amendments or comparable ethical standards. The Ethics Committee approved this study of Yangzhou University (YZUHL2020002).

Measurements

Demographics

The research team designed the demographic information questionnaire and included 11 items in total, such as gender, age, educational level, work seniority and marital status.

Anxiety

The Self-Anxiety Scale (SAS) is a psychological scale used to measure the degree of anxiety and its changes during treatment (Zung et al., 1990). There are 20 questions with 15 increasing anxiety level questions and five decreasing anxiety questions. There are two formats, self-evaluations and clinical evaluations. This scale mainly evaluates the frequency of symptoms defined by the item, using the Likert-4 grade scoring method. The standard is: "1" means no or very little time; "4" means most or all time. Scores of the 20 items are added and multiplied by 1.25 to obtain an integer and identify standardized scores. The higher the standard score, the more severe the symptoms. Scores $<$ 50 are 'normal'; 50–59 are 'mild', 60–69 'moderate', and. Scores $>$70 are classified as 'severe' (Gao et al., 2012). Previous studies have shown that the SAS offers good reliability and internal consistency (Cronbach's α = 0.66–0.8) (Minglu et al., 2020).

Sleep quality

Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), which was used to evaluate participants' sleep quality in the last month (Buysse et al., 1989). PSQI is used to assess the sleep quality of subjects in the last month. It consists of 19 self-rated items and five other-rated items. For this study, nine self-rated items from the Pittsburgh Sleep Quality Index were selected to evaluate the subjective sleep quality of Chinese front-line nurses. The seven self-rated dimensions are composed of 18 questions, and the score of each dimension is 0–3 points. The score of each dimension is accumulated to get the Pittsburgh Sleep Quality Index score, and the score range is 0–21 points. The higher the score, the worse the subjective sleep quality of the research subjects. PSQI shows a high level of internal consistency (Mollayeva et al., 2016). Studies have shown that the internal consistency reliability of PSQI is 0.702 (Cronbach's α = 0.84).

Mindfulness

The Short Inventory of Mindfulness (SIM-C) was used to assess the level of mindfulness (Baer et al., 2006). This is a 5-point Likert scale. The scale has 12 items and three factors that assess mindfulness, conscious action, description and non-judgment. The scale uses Likert's 5-level scoring, from "completely non-conforming" to "completely conforming" to score 1 to 5 points. The higher the score of each factor, the higher the mindfulness ability. (Cronbach's α = 0.82) (Duan & Li, 2016).

Data analysis

SPSS 26.0 was used for data collection and analysis. Descriptive statistics such as mean, range, standard deviation (SD), and percentages were calculated. Appropriate parametric and non-parametric tests were applied to variables. After checking for violations of the assumptions of homoscedasticity and linearity, Pearson correlation analysis was used to explore the relationships between anxiety, sleep quality and mindfulness. Hierarchical multiple regression analysis was used to assess the ability of mindfulness and anxiety to predict sleep quality after preliminary analyses ensured no violations of normality, multicollinearity and homoscedasticity. In step 1, the aim was to verify the direct effect of anxiety on sleep quality after adjusting covariates; in step 2, the aim was to verify the mediating effect of mindfulness.

Results

Sociodemographic characteristics of front-line nurses

Demographic and working characteristics among front-line nurses are displayed in Table 1. A total of 118 front-line nurses were investigated in this study. Their average age was 32 years (SD = 5.14) and most had over five years of nursing experience. Most were women, with more than 90% holding bachelor's degrees in nursing.

Status of sleep quality, anxiety, and mindfulness

The mean scores on the anxiety scales were 49.87 (SD = 10.34). Among them, 52 front-line nurses scored $>$50 for anxiety, including 31 with mild anxiety (26.3 %), 15 with moderate anxiety (12.7 %) and 5 with severe anxiety (5.1 %). The mean score of sleep quality is 7.38 (SD = 4.04). Forty-four-point 9 % of front-line nurses had sleep problems. The mean score of mindfulness is 43.11(SD = 6.10) (Table 2).

Correlations among anxiety, mindfulness, and sleep quality

Pearson correlation analysis revealed a relationship between anxiety, sleep quality, and mindfulness. There was a significant, positive correlation between anxiety and PSQI scores (r = 0.570, N = 118, p<0.01) and a significant negative correlation between mindfulness, anxiety and sleep quality (r = −0.633, N = 118, r = −0.522, p<0.01) (Table 3).

Mediating effect of mindfulness in the relationship between anxiety and sleep quality

In order to explore the mediating role of mindfulness, we conducted mediation analysis through hierarchical multiple regression (Table 4). For anxiety, three paths were constructed, including path 1 (anxiety to mindfulness), path 2 (mindfulness to sleep quality), and path 3 (anxiety to sleep quality). Anxiety has a positive predictive effect on sleep quality, which meets the conditions of intermediary effect analysis (β = 0.622, p<0.001); Anxiety has a negative predictive effect on mindfulness (β = −0.633, p<0.001); Mindfulness has a significant impact on sleep quality (β = −0.215, p<0.001). The mindfulness mediated the association between anxiety and sleep quality when added to the model (from β = 0.622 to β = −0.215, p<0.001). Mindfulness had a mediating

Table 1
Demographic and working characteristics of front-line nurses (n = 118).

Variable		N (%)	PISQ scores, mean±*SD*	F	*P* value
Gender	Male	13 (11.0)	7.00 ±3.63	-0.360	0.720
	Female	105 (89.0)	7.43 ±4.10		
Age	≤30	51 (43.2)	7.08 ±3.93	-0.709	0.479
	>30	67 (56.8)	7.61 ±4.13		
Educational level	Junior college	8 (6.8)	8.50 ±3.78	0.810	0.419
	Undergraduate or above	110 (93.2)	7.30 ±4.06		
Work seniority	1 to <5 years	17 (14.4)	7.47 ±3.94	0.651	0.584
	5 to <10 years	43 (36.4)	7.69 ±4.13		
	10 to <15 years	40 (33.9)	7.55 ±4.28		
	>15 years	18 (15.3)	6.17 ±3.42		
Marital status	Unmarried	35 (29.7)	7.26 ±4.00	-0.216	0.829
	Married	83 (70.3)	7.43 ±4.07		
Children	Childless	42 (35.6)	7.14 ±4.27	-0.475	0.635
	Have children	76 (64.4)	7.51 ±3.92		
Family support	Low	62 (52.5)	7.03 ±3.70	0.583	0.008**
	General	51 (43.2)	7.27 ±4.22		
	High	5 (4.2)	12.8 ±2.59		
Passion for career	Low	43 (36.4)	7.39 ±3.76	0.823	0.442
	General	64 (54.2)	7.12 ±4.00		
	High	11 (9.3)	8.81 ±5.23		
Being trained	Never	29 (24.6)	7.24 ±4.32	0.448	0.640
	Before epidemic	46 (39.0)	7.04 ±3.89		
	After epidemic	43 (36.4)	7.83 ±4.05		
Working days in Wuhan	≤15	17 (14.4)	8.06 ±4.97	0.453	0.637
	16–30	56 (47.5)	7.48 ±4.03		
	≥31	45 (38.1)	7.00 ±3.71		
Perceived risk of infection	High	41 (34.7)	8.75 ±4.34	4.597	0.012*
	General	42 (35.6)	7.14 ±3.87		
	Low	35 (29.7)	6.06 ±3.42		

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

Table 2
The scores of anxiety, mindfulness and sleep quality in 118 frontline nurses.

Variables	Mean (SD)
Anxiety	49.87 (10.34)
Sleep quality	7.38 (4.04)
Mindfulness	43.11 (6.10)

Table 3
Correlation matrix of the sleep quality, mindfulness and anxiety (n = 118).

Variables	Anxiety	Sleep quality	Mindfulness
Anxiety	1.000		
Sleep quality	0.570**	1.000	
Mindfulness	-0.633**	-0.520**	1.000

** $p<0.01$.

Table 4
Mediating effects of mindfulness in nurses between anxiety status and sleep quality.

Path	Dependent variable	Independent variable	R^2	Adjusted R^2	*p*
1	Sleep quality	Anxiety	0.387	0.381	<0.001
2	Mindfulness	Anxiety	0.400	0.395	<0.001
3	Sleep quality	Anxiety, mindfulness	0.414	0.404	0.022

role on anxiety and sleep quality, with intermediary adjustment effects (ES = 0.136, 95 % CI 0.02 to 0.26), accounting for 21.9 % of the total effect ratio.

Step 1 showed a medium effect between sleep quality and anxiety (adjusted $R^2 = 0.381$, $p < 0.01$). Step 2 a medium effect between Mindfulness and anxiety (adjusted $R^2 = 0.395$, $p < 0.01$). In the final model, R squared changes after controlling for mindfulness and anxiety, showed a medium effect, suggesting mindfulness partially mediates the effects of anxiety on sleep quality.

Discussion

This study explored the relationship among sleep quality, anxiety, and mindfulness of Chinese front-line nurses, and evaluated the potential mediating role of mindfulness between sleep quality and anxiety.

This study identified poor sleep quality in front-line nurses, with 44.9 % of the participants reporting sleep problems. Compared with previous studies on conscripted front-line nurses in Wuhan, our results suggest front-line nurses experience better sleep status (Tu et al., 2020). This study was conducted in the latter stages of the COVID-19 outbreak support, when the first wave of COVID-19 in Wuhan was nearing its end. In addition, nurses will have more experience and knowledge of caring for COVID-19 patients in the later stages than they did in the early stages of the outbreak, as well as adequate logistical and social support, making them more able to cope (Huang, Lei, Xu, et al., 2020; Veitch & Richardson, 2021). However, it should not be ignored that there is still a high proportion of front-line nurses with poor sleep quality. These findings suggest how important it is to gauge sleep levels to help our future front-line – first response professionals and nurses. The finding suggests that it is necessary to study the status of sleep quality among front-line nurses, explore relevant mechanisms, and develop appropriate interventions or programs, to provide a basis for protecting front-line nurses' health, and provide a way to ensure patient safety and nursing quality.

The results from the present study revealed that sleep quality was negatively associated with mindfulness. This result is consistent with previous research, showing that sleep quality was negatively linked to mindfulness (Ghawadra et al., 2019; Ghawadra et al., 2020). Mindfulness has been shown to improve sleep quality in individuals (Liu et al., 2020). Mindfulness helps people observe ongoing physiological and psychological processes in an uncontrolled, non-judgmental way, reducing the arousal of individual dysfunction and cognitive distortion, thus making individuals calmer during sleep (Kemper et al., 2015). Individuals with high levels of mindfulness may be more receptive to the range of physical arousal, cognitive activity, and emotional experiences that precede sleep, and less likely to attempt to control and regulate

sleep processes, which can help alleviate sleep problems (Shallcross et al., 2019; Tang et al., 2007). Therefore, mindfulness is a protective factor for front-line nurses' sleep quality.

In our study, the sleep quality of front-line nurses was positively correlated with anxiety, which is consistent with previous research results (Chueh et al., 2021). The SAS scale score of front-line nurses was higher than the national norm ($p < 0.001$), which was consistent with the survey results of nurse anxiety during SARS (Su et al., 2007). The reasons are as follows: 1) COVID-19 is highly pathogenic and highly contagious. As front-line nurses against COVID-19, they are under tremendous psychological pressure at work. 2) In the front-line work, nurses' work intensity significantly improved because the lack of medical resources and insufficient human resources. 3) During the care of COVID-19 patients, the extensive use of various advanced instruments requires nurses to constantly learn new knowledge and master new technologies. 4) In the face of COVID-19 patients whose condition changes rapidly, nurses are required to carefully observe the condition, pay great attention and be highly nervous for a long time. Anxiety is an important factor affecting the sleep quality of front-line nurses. If the nurse's anxiety is not well regulated, it will lead to sleep disorders (Salari et al., 2020). In the front-line nursing work against the epidemic, nurses will have negative emotions such as depression and anxiety due to the particularity of the working environment, which will affect the quality of sleep (Sampaio et al., 2021). When the sleep quality of nurses is affected, it is not conducive to the development of nursing work (Danet Danet, 2021). This study will further analyze the mediating role of mindfulness in the relationship between anxiety and sleep quality.

The present results revealed that anxiety was negatively related to mindfulness. Gauthier et al. (2015) suggested that mindfulness is an important protective factor for mental health. Some researchers (Gilmartin et al., 2017; Taylor et al., 2016; Wersebe et al., 2018) showed that mindfulness could reduce individual anxiety, which is consistent with the finding of this study. Mindfulness emphasizes paying attention to the present moment, not judging or reacting to the perceived experience, but focusing on the present moment. When negative emotions such as anxiety occur, individuals can gradually desensitize and reduce anxiety by observing and not judging (Wang et al., 2017). Senders et al. (2014) proposed that people with a high level of mindfulness tend to use adaptive coping strategies such as collecting information, planning and seeking social support to cope with pressure and challenges.

Mindfulness mediated the relationship between the anxiety and sleep quality of front-line nurses. In other words, nurses with more serious anxiety had a lower level of mindfulness and poorer quality of sleep. Individual mindfulness has a positive effect on improving anxiety. In the current study, the mindfulness score of front-line nurses against COVID-19 was at a medium level. The analysis may be attributed to the strangeness of the working environment, the unfamiliarity with the working partners, the sense of helplessness in the face of the epidemic, and the fear of working alone on night shifts during the anti-epidemic period. These factors may lead the front-line nurses to be in a state of high pressure and tension, and they have no energy to pay attention to their feelings unconsciously. These results were supported by a Chinese study (Shen et al., 2020) that showed that individuals working in a high-pressure environment would have mental tension, anxiety, and physical discomfort. Some studies have shown that mindfulness intervention can effectively reduce individual anxiety and improve individual sleep quality (Black et al., 2015; Liu et al., 2019; Xiao et al., 2019). Therefore, if the individual has a high level of mindfulness, they can effectively solve the problem and achieve positive results. Improving the individual's mindfulness can effectively alleviate the negative impact of anxiety on sleep quality (Xu et al., 2013). The results of this study suggest that front-line nurses with a high level of mindfulness can pay more attention to their current work experience, thereby reducing negative emotions and improving the sleep quality of front-line nurses.

Implications and recommendations

This finding increases our understanding of how nurse managers can improve the sleep quality of front-line nurses. When an epidemic breaks out, everyone will have more or less negative emotions, especially the medical staff who need to face and contact patients directly. When nurses work on the front line, they often lack training or work experience in infectious disease prevention. This will bring them a heavy psychological burden, and with the heavy work tasks they face, their physical and mental conditions are not optimistic.

Overall, we found a good option for improving front-line nurses' sleep quality. Based on mindfulness and anxiety, we can make the following suggestions to the management of nurses. First, because mindfulness is developable, we suggest that the nursing managers intervene with nurses through mindfulness meditation, to pay more attention to their current work experience, thereby reducing negative emotions and work pressure, and improving nurses' sleep quality. Second, nurse managers should pay attention to employees' mental health, encourage employees to seek family support and provide psychological counseling services. Finally, the front-line medical staff is required to ensure reasonable work and rest time, to be able to relax and rest appropriately, and to have adequate sleep and food. By creating a harmonious and safe working atmosphere, we can reduce anxiety, improve sleep quality and improve the quality of nursing work.

Limitations of the study

There are limitations in this study, which evaluated nurses during the initial response period – our participants were at the forefront of the fight against COVID-19, on the brink of a global pandemic. It should be noted that correlation does not imply causality, so any conclusions should be reviewed over a longer term and further studied using a longitudinal design.

Despite these limitations, this study has revealed a significant problem. Many nurses experienced pressure and anxiety, they had difficulty sleeping and their mindfulness was lower than in the general populations (compared to current evidence).

Conclusions

The current study proves the importance of mindfulness in coping with anxiety to maintain good sleep quality. Therefore, to enhance the nurses' sleep quality, mindfulness should be considered as a variable. To be specific, promoting awareness, belief and self-efficacy are important for improving sleep quality in Chinese front-line nurses. In summary, we can conclude that mindfulness may have a mediation effect on anxiety and sleep quality. However, the problem is complex and multifactorial. Further analysis of these nurses' experiences will reveal how they managed their anxiety and uncover further variables for evaluation.

The present findings highlight mindfulness as a key path in the relationship between anxiety and sleep quality. As nurses' sleep quality is negatively associated with anxiety, any future research must focus on studying means to improve sleep quality and lower anxiety potentially benefiting both nurses and their patients. Nurses' managers must take steps to reduce anxiety and consider improving consider nursing staffs' mindfulness.

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Ethical approve

This study was approved by the Ethics Committee of Yangzhou University (YZUHL2020002).

Declaration of competing interest

No conflict of interest exits in the submission of this manuscript, and manuscript is approved by all authors for publication.

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