

Research Article

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Impact of social support on PTSD : Chain mediating effects of insomnia and anxiety

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Abstract

Objective: To reveal the chain mediating roles of insomnia and anxiety between social support and PTSD in nursing staff under the stage of COVID-19 regular pandemic prevention and control in China.

Methods: A total of 784 nurses were recruited using the convenience sampling method in Jiangsu Province, China. Demographic questionnaire, Perceived Social Support Scale, Impact of Event Scale-Revised, Generalized Anxiety Disorder-7 and Insomnia Severity Index were applied to collect data.

Results: Social support, PTSD, insomnia and anxiety were significantly correlated with each other. Insomnia and anxiety acted as chain mediators between social support and PTSD.

Conclusion: Insufficient social support may trigger PTSD through the chain mediating effects of insomnia and anxiety in nursing staff under the stage of COVID-19 regular pandemic prevention and control. Measures focusing on social support, insomnia and anxiety should be taken to reduce or even prevent PTSD in nursing staff in Chinese hospitals in similar crises in the future.

Impact statement

Chinese nurses played a vital role in combating the virus under great pressure and during the COVID-19 regular pandemic prevention and control. It's of great importance to investigate effects of insomnia and anxiety between social support and PTSD among Chinese nurses in the context of regular COVID-19 pandemic prevention and control. It could aid the hospital with interventions to ameliorate PTSD among Chinese nursing staff during COVID-19 regular pandemic prevention and control. However, studies focusing on the relationship among these variables are insufficient. The present study aimed to focus on how social support would influence PTSD in Chinese nursing staff during the period of COVID-19 regular pandemic prevention and control.

Introduction

The coronavirus disease 2019 (COVID-19) has brought about mental problems to the healthcare staff (Chew et al., 2020a; Chew et al., 2020b; Le et al., 2021; Pham et al., 2021; Tan et al., 2023), especially nurses (Dong et al., 2022). Studies suggested that the nursing staff suffered more problems from trauma-related stress during the outbreak of COVID-19 (Benfante et al., 2020; Chatzittofis et al., 2021; Chen et al., 2021a; Yunitri et al., 2022). According to recent literature in China, the incidence rate of PTSD in Chinese nurses following the outbreak of COVID-19 was 36.2% (Lai et al., 2020).

China stepped into the stage of the COVID-19 regular pandemic prevention and control on May 7, 2020 (The State Council, 2020). Therefore, the policy of national COVID-19 pandemic prevention and control was changed into regular pandemic prevention and control (Xinhua Press, 2020), resulting in an increased workload of nurses.

With the COVID-19 epidemic prevention work changing from emergency to normalization, hospitals were checkpoints for epidemic prevention and control, confronting potential risk factors and the nosocomial infection prevention and control measures will exist for a long period of time (Wu et al., 2022). The contents of nurses' jobs have changed. Excluding routine nursing work, they need to take on more responsibilities, including the strict procedure of admission of patients to hospitals and nursing services for patients from high- and medium-risk areas (Jiang et al., 2022). Moreover, constantly working under stressful environments has also resulted in pandemic fatigue among nurses (Zhang et al., 2021). Thus, though the grim situation faced by

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Chinese nurses has changed, they still work under great pressure under the stage of COVID-19 regular pandemic prevention and control.

About 16.10% of Chinese nurses from low-risk areas still experienced moderate to severe psychological pressure during the stage of COVID-19 regular pandemic prevention and control (Chen *et al.*, 2021b). Moreover, Li and colleagues found that 50.54% of the frontline nurses in Wuhan, China, reported moderate (42.21%) to severe (8.33%) levels of stress in the context of COVID-19 regular pandemic prevention and control (Wen *et al.*, 2022). Nurses' mental health was directly related to their performance quality in caring for patients and work efficiency (Mirzaei *et al.*, 2022). PTSD was an important aspect of psychological health in Chinese nursing staff exposed to COVID-19 (Lai *et al.*, 2020). Therefore, it's of great importance to investigate the influential factors of PTSD in Chinese nursing staff in the context of regular COVID-19 pandemic prevention and control.

Social support is defined as "the feeling that one is cared for and has assistance available from other people" and "that one is part of a supportive social network" (Somville *et al.*, 2016). The stress-buffering hypothesis supposes that social support plays a role in buffering stress by increasing the levels of self-efficacy and self-esteem (Cohen *et al.*, 1985). Perceived social support was positively correlated with mental well-being and could help cultivate the ability to overcome stressful events (Xu *et al.*, 2019; Huang *et al.*, 2020). According to existing literature focusing on PTSD, social support was thought to be a strong predictive factor of PTSD among adults. A meta-analysis focusing on risk factors of PTSD has shown that low level of social support was the strongest predictor of PTSD (Brewin *et al.*, 2000). Similarly, another meta-analysis conducted by Ozer and colleagues suggested a similar result (Ozer *et al.*, 2003). Moreover, Guay *et al.* reviewed numerous studies and summarized that social support played a significant role in PTSD (Guay *et al.*, 2006).

Recently, PTSD among medical staff has drawn plenty of attention from researchers. For example, it was supposed that lacking social support was a significant risk factor for PTSD among traumatized nurses from South Korea (Kim and Yeo, 2020). Besides, lacking social support was found to be a vital predictive factor of PTSD in healthcare staff fighting against the COVID-19 pandemic (d'Ettorre *et al.*, 2021).

Therefore, we could infer that those lacking social support might be more prone to PTSD among nurses under the stage of COVID-19 regular pandemic prevention and control in China.

Insomnia has been proven to be associated with PTSD of healthcare staff during the outbreak of COVID-19. Blekas and colleagues found that 73.3% of Greek healthcare professionals with PTSD reported problems of insomnia. However, only 28% of the Greek healthcare professionals without PTSD suffered from bad sleep quality (Blekas *et al.*, 2020). Yin *et al.* conducted a structural equation model and found that the sleep quality of Chinese medical staff could significantly predict PTSD symptoms (Yin *et al.*, 2021). Li *et al.* discovered that insomnia played a significant partial mediating role between being a nurse and post-traumatic stress symptoms during the outbreak of COVID-19 (Li *et al.*, 2022).

A study of Japanese daytime workers revealed that social support was an independent risk factor for insomnia (Nakata *et al.*, 2004). Besides, social support was significantly related to the increased risk of sleeping difficulties during the COVID-19 pandemic. Specifically, people with good social support reported lower risk of sleeping difficulties (Grey *et al.*, 2020). Moreover, it could be inferred from the existing literature that the protective effect of

support from organizations on sleep quality among Chinese health-care workers (Zou *et al.*, 2021) and nurses (Du *et al.*, 2022) during the outbreak of COVID-19.

Based on the studies above, insomnia may play a mediating role between social support and PTSD in Chinese nursing staff during COVID-19 regular pandemic prevention and control.

Similarly, anxiety was also found to be a predictive factor of PTSD among medical professionals during the COVID-19 pandemic (Lu *et al.*, 2021; Yin *et al.*, 2021; Yao *et al.*, 2022). For example, Lu *et al.* found anxiety symptoms of COVID-19 frontline medical staff from Taiwan, China, significantly predicted PTSD using a method of hierarchical linear regression model (Lu *et al.*, 2021). Moreover, social support had a positive effect on anxiety among 4,658 adults (Roohafza *et al.*, 2014). Another research during the COVID-19 pandemic found that sufficient social support might reduce anxiety in medical staff (Zhu *et al.*, 2020).

Hence, it is reasonable to infer that anxiety may mediate the relationship between social support and PTSD in Chinese nursing staff during COVID-19 regular pandemic prevention and control.

Insomnia and anxiety always co-occurred and were significantly associated (Jansson-Fröjmark and Lindblom, 2008; Marcks and Weisberg, 2009; Chinese Society of Neurology, 2020). Plenty of research investigated the relationship between insomnia and anxiety. Taylor *et al.* discovered that insomnia played a negative role in the elevated risk for anxiety in their review (Taylor *et al.*, 2003). Besides, subjects suffering from sleeping difficulties reported more symptoms of anxiety than those with good sleep quality (Taylor *et al.*, 2005). Moreover, participants diagnosed with insomnia suffered from higher levels of anxiety, indicating the vital role of insomnia in anxiety (Mason and Harvey, 2014; Chen *et al.*, 2017). These studies above indicated that insomnia might lead to anxiety.

Consequently, it could be inferred that insufficient social support might lead to PTSD. Besides, insomnia and anxiety were significant mediators between social support and PTSD. Chain mediating model refers to a condition that there are two or more mediators in a mediating model, which is used to study how an independent variable influences dependent variable through a series of variables. In the chain mediation model, the mediators are not independent of each other (Liu and Ling, 2009). Given existing evidence about the effect of insomnia on anxiety, we supposed that insomnia and anxiety might act as chain mediators in the association between social support and PTSD among nurses during COVID-19 regular pandemic prevention and control.

Therefore, the current study aimed to reveal the associations between social support, insomnia, anxiety, and PTSD among nurses. We hypothesized that insomnia and anxiety played chain mediating roles between social support and PTSD in nursing staff during the stage of COVID-19 regular pandemic prevention and control in China. Our research is of realistic significance and could aid the hospital with interventions to ameliorate PTSD among Chinese nursing staff during COVID-19 regular pandemic prevention and control. A chain mediation model was constructed to test our hypotheses (Figure 1). The variables in Figure 1 were listed as follows: X = Social support, Y = PTSD, M1 = Insomnia, M2 = Anxiety. Specifically, social support was the independent variable, and PTSD was the dependent variable. Insomnia and anxiety were calculated as chain mediators in the relationship between social support and PTSD among nursing staff.

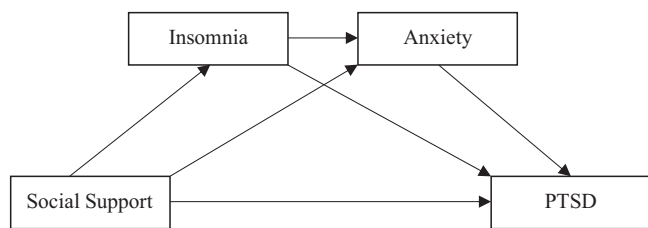


Figure 1. Hypothesized model about social support, insomnia, anxiety, and PTSD.

Methods

Participants and procedures

The current research was conducted in January 2022. Inclusion criteria: I) normal ability of speech, comprehension, and expression; II) ≥18 years old; III) working as a nurse during COVID-19 regular pandemic prevention and control. Exclusive criteria: diagnosed with psychiatric illness before. A total of 784 nurses were recruited from five tertiary hospitals using a convenience sampling method in China.

The mean age of the participants was 26.37 years with a standard deviation of 6.59. 94.4% of the nurses were female. About two in three of the respondents were married. The average working seniority was 8.81 ± 6.87 years. A detailed flowchart is shown in Figure 2.

Measures

Demographics

Demographic information (e.g., age, gender, marital status, and working seniority) of nurses was collected in this study.

Perceived social support scale (PSSS)

PSSS includes 12 items and is a classic evaluation tool for measuring the perceived social support (Zimet et al., 1988). Each item is rated from 0 (strongly disagree) to 7 (strongly agree). The highest score of the scale is 84. The scale has shown good validity and reliability and has been widely used among the Chinese

population (Mao et al., 2023a; Mao et al., 2024). In this study, the coefficient of Cronbach’s alpha was 0.968.

Insomnia severity index (ISI)

ISI is a 7-item questionnaire and a classic evaluation tool for perceived insomnia severity (Bastien et al., 2001). Each item was rated from 0 (not at all) to 4 (nearly every day). The highest score of the scale is 28. The scale has presented sufficient validity and reliability and has been widely used among the Chinese population (Mao et al., 2023b; Mao et al., 2024). In this study, the coefficient of Cronbach’s alpha was 0.927.

Generalized anxiety disorder-7 (GAD-7)

GAD-7 is a 7-item questionnaire and a classic evaluation tool for anxiety and its severity (Spitzer et al., 2006). Participants were asked to report the frequency of each item during the last 2 weeks. “Not at all,” “several days,” “more than half the days” and “nearly every day” were scored as 0, 1, 2, and 3, respectively. The highest score of the scale is 21. The scale has been widely used with excellent validity and reliability among the Chinese population (Mao et al., 2023c; Mao et al., 2024). In this study, the coefficient of Cronbach’s alpha was 0.960.

Impact of event scale-revised (IES-R)

IES-R is a 22-item and a classic evaluation tool for assessing post-traumatic stress symptoms. There are three subscales (intrusiveness, avoidance, and hyperarousal) in this scale. The highest score of the scale is 88. The cut-off of IES-R is 33 (Asif et al., 2016). The scale has shown good validity and reliability in the Chinese population (Mao et al., 2023d; Mao et al., 2024). In this study, the coefficient of Cronbach’s alpha was 0.976.”

Statistical analysis

IBM SPSS (version 21.0) was adopted to analyze the data. The significance level is set as α = 0.05, and all tests are double-tailed tests (Mao et al., 2024). Common method bias was detected by the Harman single-factor test (Mao et al., 2023b). Hence, the Harman

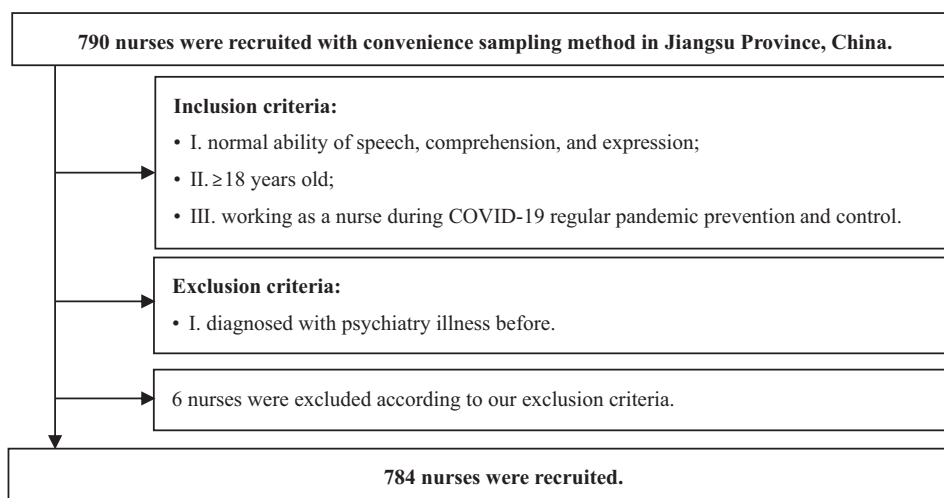


Figure 2. Flowchart of subjects’ enrollment in January 2022.

single-factor test was chosen to detect the presence of common method bias in this study. Pearson correlation analyses is a common statistical method to detect the correlations between variables (Hou et al., 2021). Therefore, we calculated the correlations among anxiety, insomnia, social support, and PTSD with Pearson correlation analyses. The Hayes SPSS macro program process (version 3.4.1, Model 6) is a good tool to detect the chain mediating model (Hayes, 2013). We adopted the Hayes SPSS macro program process (version 3.4.1, Model 6) to conduct the bootstrapped method (5000 resamples) to estimate 95% confidence interval (CI) for significance testing for mediating model (Preacher and Hayes, 2008). According to the method, the chain mediation model would be established if zero was included in 95% CI.

Results

Common method Bias test

Common method bias may appear in self-report inventory (Campbell and Fiske, 1959). Harman single-factor test was selected to detect if common method bias existed in this study (Podsakoff et al., 2003; Zhou and You, 2004). Six values with an eigenvalue more than 1 were found. The first factor accounted for a variance of 36.81% (<40%). Therefore, common method bias did not exist in the current study.

Pearson's correlation

Results of Pearson's correlation among social support, insomnia, anxiety, and PTSD (Table 1) indicated that four variables were related to each other significantly (all $P < 0.01$).

Mediating roles of insomnia and anxiety

PROCESS 3.4.1 (Model 6) was applied to test the chain mediating model (Figure 3). Studies revealed age, gender, marital status (Zhou et al., 2021) and working seniority (Goh et al., 2021) were closely related to PTSD. Therefore, demographic information (age, gender, marital status, and working seniority) was controlled as confounders.

As shown in Table 2, the direct effect was significant since the 95% CI ($-0.245 \sim -0.102$) did not contain 0. The total mediating effect was significant since 0 wasn't included in the 95% CI ($-0.382 \sim -0.260$). The indirect effect of social support on PTSD via insomnia was significant as 0 wasn't contained in the 95% CI ($-0.064 \sim -0.012$). Similar results were detected among the mediating effects of anxiety and the chain mediating effects of insomnia and anxiety.

Figure 3 shows the chain mediating effects of insomnia and anxiety in the association between social support and PTSD. As showed in Figure 3, all paths in chain mediating model were significant (** $P < 0.01$, *** $P < 0.001$). The results revealed that

the negative relationship between social support and PTSD was significant, with insomnia and anxiety partially mediating the relationship between social support and PTSD, respectively. Besides, a significant chain mediating effect of insomnia and anxiety was also detected in the current research. The total mediating effects was 64.77%.

To sum up, insomnia and anxiety played chain mediating roles between social support and PTSD among nurses during COVID-19 regular pandemic prevention and control.

Discussion

The present investigated how social support would influence PTSD among nurses during the period of COVID-19 regular pandemic prevention and control in China. The results revealed that insomnia and anxiety played chain mediating roles between social support and PTSD. As far as we know, our study is the first to focus on the effect of social support on PTSD among Chinese nursing staff via chain mediating effect of insomnia and anxiety.

We discovered social support could negatively and significantly predict PTSD, which was in line with previous research. Schnurr and colleagues investigated influencing factors of PTSD among Vietnam veterans. They found that social support played an important role in the development and maintenance of PTSD (Schnurr et al., 2004). Besides, leadership social support was supposed to be related to PTSD in pediatric oncology nursing staff (Schuster et al., 2022). Song et al. conducted a cross-sectional study on 14,825 Chinese medical staff during the outbreak of COVID-19. They found that those with insufficient social support were more likely to develop PTSD (Song et al., 2020).

Social support is a protective factor against psychological difficulties. Kerasiotis et al. suggested that social support might act as a protective factor in helping nursing staff to deal with work pressure (Kerasiotis and Motta, 2004). The coping theory supposed that social support was considered as a vital coping strategy when facing stress. Specifically, social support might have a significant effect in relieving negative influence from kinds of pressure events by solving problems and relieving negative emotions via assistance from social ties (Mo et al., 2020). Besides, the stress-buffering hypothesis supposes that social support plays a role in buffering stress by increasing the levels of self-efficacy and self-esteem (Cohen et al., 1985). Insufficient social support played a predictive role in PTSD among medical staff during the COVID-19 pandemic (d'Etterre et al., 2021). A Korean study indicated that nurses might experience more PTSD if they got lower levels of support from their managers during the COVID-19 pandemic (Bae et al., 2022). Moreover, social support was thought to be a protective factor of psychological resilience that maintained mental health and eliminated psychological barriers (Sripada et al., 2016). This may be the possible explanation for the positive effect of social support on PTSD.

As hypothesized, we demonstrated the chain mediating roles of insomnia and anxiety. Social support could influence PTSD through three paths (Figure 3). First, paths 1 and 2 indicated that insomnia and anxiety played significant mediating roles between social support and PTSD, respectively. The results indicated close relationships among insomnia, anxiety, and PTSD. Specifically, insomnia and anxiety were positively predictive factors of PTSD among nurses during COVID-19 regular pandemic prevention and control, which were in line with previous studies. For example, Yao et al. found sleep disorder and anxiety were significant mediators of PTSD in medical staff during the COVID-19 pandemic (Yao et al.,

Table 1. Results of bivariate analysis among variables

Variables	M ± SD	1	2	3	4
Social support	61.73 ± 12.70	1			
Insomnia	6.31 ± 5.27	-0.29**	1		
Anxiety	3.62 ± 4.06	-0.39**	0.44**	1	
PTSD	17.31 ± 16.09	-0.38**	0.39**	0.67**	1

Note: ** $P < 0.01$.

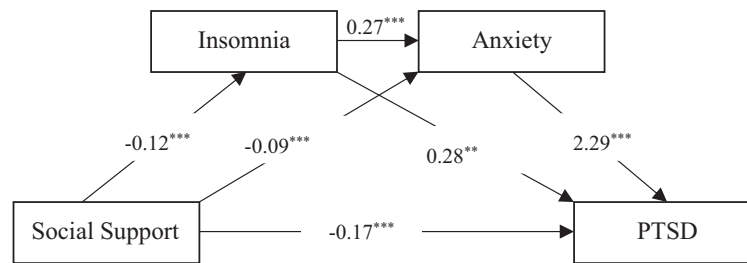


Figure 3. Chain mediating model about social support, insomnia, anxiety, and PTSD (** $P < 0.01$, *** $P < 0.001$).

Table 2. Chain mediating roles of insomnia and anxiety

	Path	Effect value	Effect size	95% CI	
				LLCI	ULCI
Mediating effects	1: Social support→Insomnia→PTSD	-0.035	7.13%	-0.064	-0.012
	2: Social support→Anxiety→PTSD	-0.207	42.16%	-0.105	-0.055
	3: Social support→Insomnia→Anxiety→PTSD	-0.076	15.48%	-0.275	-0.149
Direct effect	Social support→PTSD	-0.173	—	-0.245	-0.102
Total mediating effect		-0.318	64.77%	-0.382	-0.260
Total effect		-0.491	—	-0.574	-0.409

2022). Similarly, Yin et al. found sleep quality and anxiety were mediators of PTSD in medical staff combating against COVID-19 (Yin et al., 2021). Besides, Li and colleagues discovered that insomnia was a significant partial mediator, which explained 32.53% of the association between being a nurse and post-traumatic stress symptoms among frontline medical staff during the COVID-19 pandemic in China (Li et al., 2022). Meanwhile, anxiety symptoms of COVID-19 frontline healthcare workers from Taiwan, China were proved to be a significant predictor of PTSD (Lu et al., 2021). Moreover, social support was proven to be a predictive factor of insomnia and anxiety among Turkish medical professionals (Yılmaz et al., 2021). The same results were also observed in Chinese medical staff. Social support was negatively related to sleep quality and anxiety significantly (Xiao et al., 2020). Secondly, path 3 suggested that insomnia and anxiety acted as chain mediators in our model. Namely, insufficient social support would lead to sleep problems, which may increase the level of anxiety and then result in PTSD among nurses. However, previous studies did not classify the relationship among social support, insomnia, anxiety, and PTSD.

The current research is the first study to investigate possible mechanisms underlying the relationship between social support and PTSD of nurses during COVID-19 regular pandemic prevention and control.

Implications

The current study has several implications for the amelioration of PTSD in nursing staff after public health emergencies. Our study gave empirical evidence for the possible mechanism underlying the relationship between social support and PTSD among Chinese nursing staff. Social support could not only directly influence PTSD, but also indirectly impact PTSD through three pathways: (1) social support-insomnia-PTSD; (2) social support-anxiety-PTSD; (3) social support-insomnia-anxiety-PTSD. The results of

our research suggested to the Chinese hospital authorities the possible methods to reduce or even prevent PTSD. The nursing staff should take action concentrating on promoting sleep problems and anxiety. Prior studies revealed that cognitive behavioral therapy (CBT) and internet cognitive behavioral therapy (I-CBT) were effective in treating psychiatric symptoms (Zhang and Ho, 2017) or psychological outcomes during the COVID-19 pandemic (Ho et al., 2020; Soh et al., 2020). Therefore, CBT and I-CBT focusing on promoting sleep quality and anxiety could be taken to reduce PTSD among nurses.

Limitations

There are some limitations in our study. Firstly, the cross-sectional design adopted in the current study could not determine causal associations among variables. Longitudinal or experimental approaches are needed in the future to infer the possible causal relationships among variables. Second, our subjects were recruited using the convenience sampling method. The small sample size might limit the sample representativeness, which may limit the generalizability of the findings. Further research had better-recruited subjects with random cluster sampling and expanded the sample size to enhance the external validity. Thirdly, burnout during the COVID-19 pandemic is an important public health issue and is worthy of further study (Mao et al., 2024; Lau et al., 2022). However, burnout was not considered in the present study. Future research should consider this issue to explore the association of burnout with PTSD among nurses.

Conclusion

To conclude, the study demonstrated the chain mediating roles of insomnia and anxiety in the relationship between social support and PTSD among nursing staff during COVID-19 regular

pandemic prevention and control. The Chinese hospital authorities need to pay extra attention to nursing staff with insufficient social support to prevent and reduce PTSD. Moreover, actions targeting the reduction of insomnia and anxiety also need to be taken to reduce or even prevent PTSD in nursing staff.

Open peer review. To view the open peer review materials for this article, please visit <http://doi.org/10.1017/gmh.2024.91>.

Data availability statement. The data that support the findings of this study are available on request from the corresponding authors. The data are not publicly available due to the de-identified data possibly containing information that could compromise the privacy and safety of the research participants.

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Author contribution. Xiaofei Mao, Tianya Hou, and Weizhi Liu designed the study. Yulin Zhang, Jianguo Zhang, and Fan Zhang collected the data. Xiaofei Mao and Tianya Hou analyzed the data and drafted the manuscript. Weizhi Liu led the whole study. All the authors have read and approved the final manuscript.

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Competing interest. The authors declare no competing interests.

Ethics statement. All participants signed a written informed consent form in ethics approval and consent to participate. The study was approved by the ethics committee of Naval Medical University in accordance with the ethical standards established in the 1964 Declaration of Helsinki and its later amendments.

References

- Asif IM, Price DE, Ewing A, Rao AL, Harmon KG and Drezner JA (2016) The impact of diagnosis: Measuring the psychological response to being diagnosed with serious or potentially lethal cardiac disease in young competitive athletes. *British Journal of Sports Medicine* 50(3), 163–166. <https://doi.org/10.1136/bjsports-2015-095560>.
- Bae SY, Yoon HJ, Kim Y and Kim J (2022). Posttraumatic stress disorder and related factors among nurses working during the COVID-19 pandemic. *Journal of Nursing Management* 30(5), 1096–1104. <https://doi.org/10.1111/jonm.13615>.
- Bastien CH, Vallieres A and Morin CM (2001) Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine* 2, 297–307. [https://doi.org/10.1016/s1389-9457\(00\)00065-4](https://doi.org/10.1016/s1389-9457(00)00065-4).
- Benfante A, Di Tella M, Romeo A and Castelli L (2020) Traumatic stress in healthcare workers during COVID-19 pandemic: A review of the immediate impact. *Frontiers in Psychology* 11, 569935. <https://doi.org/10.3389/fpsyg.2020.569935>.
- Brewin CR, Andrews B and Valentine JD (2000) Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology* 68(5), 748–766. <https://doi.org/10.1037/0022-006x.68.5.748>.
- Blekas A, Voitsidis P, Athanasiadou M, Parlapani E, Chatzigeorgiou AF, Skoupra M, Syngelakis M, Holeva V and Diakogiannis I (2020) COVID-19: PTSD symptoms in Greek health care professionals. *Psychological Trauma: Theory, Research, Practice, and Policy* 12(7), 812–819. <https://doi.org/10.1037/tra0000914>.
- Campbell DT and Fiske DW (1959) Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin* 56, 81–105.
- Chatzittofis A, Karanikola M, Michailidou K and Constantinidou A (2021) Impact of the COVID-19 pandemic on the mental health of healthcare workers. *International Journal of Environmental Research and Public Health* 18(4), 1435. <https://doi.org/10.3390/ijerph18041435>.
- Chen PJ, Huang CLC, Weng SF, Wu MP, Ho CH, Wang JJ, Tsai WC and Hsu YW (2017) Relapse insomnia increases greater risk of anxiety and depression: Evidence from a population-based 4-year cohort study. *Sleep Medicine* 8, 122–129. <https://doi.org/10.1016/j.sleep.2017.07.016>.
- Chen R, Sun C, Chen JJ, Jen HJ, Kang XL, Kao CC and Chou KR (2021a) A large-scale survey on trauma, burnout, and posttraumatic growth among nurses during the COVID-19 pandemic. *International Journal of Mental Health Nursing* 30(1), 102–116. <https://doi.org/10.1111/inm.12796>.
- Chen X, Arber A, Gao J, Zhang L, Ji M, Wang D, Wu J and Du J (2021b) The mental health status among nurses from low-risk areas under normalized COVID-19 pandemic prevention and control in China: A cross-sectional study. *International Journal of Mental Health Nursing* 30(4), 975–987. <https://doi.org/10.1111/inm.12852>.
- Chew NWS, Lee GKH, Tan BY, Jing M, Goh Y, Ngiam NJH, Yeo LLL, Ahmad A, Ahmed Khan F, Napoleon Shanmugam G, Sharma AK, Komalkumar RN, Meenakshi PV, Shah K, Patel B, Chan BPL, Sunny S, Chandra B, Ong JY, Paliwal PR, Wong LYH, Sagayanathan R, Chen JT, Ying Ng AY, Teoh HL, Tsvigoulis G, Ho CSH, Ho RCM, Sharma VK (2020a) A multinational, multicentre study on the psychological outcomes and associated physical symptoms amongst healthcare workers during COVID-19 outbreak. *Brain, Behavior, and Immunity*, 88, 559–565. <https://doi.org/10.1016/j.bbi.2020.04.049>.
- Chew NWS, Ngiam JN, Tan BY, Tham SM, Tan CY, Jing M, Sagayanathan R, Chen JT, Wong LYH, Ahmad A, Khan FA, Marmin M, Hassan FB, Sharon TM, Lim CH, Mohaini MIB, Danuaji R, Nguyen TH, Tsvigoulis G, Tsiodras S, Fragkou PC, Dimopoulou D, Sharma AK, Shah K, Patel B, Sharma S, Komalkumar RN, Meenakshi RV, Talati S, Teoh HL, Ho CSH, Ho RCM and Sharma VK (2020b) Asian-Pacific perspective on the psychological well-being of healthcare workers during the evolution of the COVID-19 pandemic. *BJPsych Open* 6(6):e116. <https://doi.org/10.1192/bjo.2020.98>.
- Chinese Society of Neurology, Chinese Society of Sleep Disorders and Chinese Society of Neuropsychology and Behavioral Neurology (2020) Expert consensus on the diagnosis and treatment of insomnia with depression and anxiety in Chinese adults. *Chinese Journal of Neurology* 53(8), 564–574.
- Cohen S and Wills TA (1985) Stress, social support, and the buffering hypothesis. *Psychological Bulletin* 98(2), 310–357.
- d’Ettorre G, Ceccarelli G, Santinelli L, Vassalini P, Innocenti GP, Alessandri F, Koukopoulos AE, Russo A, d’Ettorre G and Tarsitani L (2021) Post-traumatic stress symptoms in healthcare workers dealing with the COVID-19 pandemic: A systematic review. *International Journal of Environmental Research and Public Health* 18(2), 601. <https://doi.org/10.3390/ijerph18020601>.
- Dong Y, Yeo MC, Tham XC, Danuaji R, Nguyen TH, Sharma AK, Rn K, Pv M, Tai MS, Ahmad A, Tan BY, Ho RCM, Chua MCH and Sharma VK (2022). Investigating psychological differences between nurses and other health care workers from the Asia-Pacific region during the early phase of COVID-19: Machine learning approach. *JMIR Nursing* 5(1), e32647. <https://doi.org/10.2196/32647>.
- Du J, Liu Z, Zhang X, Shao P, Hua Y, Li Y, Lang H and Ni C (2022) Occupational stress and insomnia symptoms among nurses during the outbreak of COVID-19 in China: The chain mediating effect of perceived organizational support and psychological capital. *Frontiers in Psychiatry* 13, 882385. <https://doi.org/10.3389/fpsyg.2022.882385>.
- Goh KK, Jou S, Lu ML, Yeh LC, Kao YF, Liu CM and Kan BL (2021) Younger, more senior, and most vulnerable? Interaction effects of age and job seniority on psychological distress and quality of life among firefighters. *Psychological Trauma: Theory, Research, Practice and Policy* 13(1):56–65. <https://doi.org/10.1037/tra0000662>.
- Grey I, Arora T, Thomas J, Saneh A, Tohme P and Abi-Habib R (2020) The role of perceived social support on depression and sleep during the COVID-19 pandemic. *Psychiatry Research* 293, 113452. <https://doi.org/10.1016/j.psychres.2020.113452>.
- Guay S, Billette V and Marchand A (2006) Exploring the links between posttraumatic stress disorder and social support: Processes and potential research avenues. *Journal of Traumatic Stress* 19(3), 327–338. <https://doi.org/10.1002/jts.20124>.

- Hayes AF (2013) *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. New York, NY: Guilford Press.
- Ho CS, Chee CY and Ho RC (2020). Mental health strategies to combat the psychological impact of coronavirus disease 2019 (COVID-19) beyond paranoia and panic. *Annals of the Academy of Medicine, Singapore* **49**(3), 155–160.
- Hou T, Yin Q, Xu Y, Gao J, Bin L, Li H, Cai W, Liu Y, Dong W, Deng G and Ni C (2021) The mediating role of perceived social support between resilience and anxiety 1 year after the COVID-19 pandemic: Disparity between high-risk and low-risk nurses in China. *Frontiers in Psychiatry* **12**, 666789. <https://doi.org/10.3389/fpsy.2021.666789>.
- Huang Y, Wu R, Wu J, Yang Q, Zheng S and Wu K (2020) Psychological resilience, self-acceptance, perceived social support and their associations with mental health of incarcerated offenders in China. *Asian Journal of Psychiatry*, **52**, 102166. <https://doi.org/10.1016/j.ajp.2020.102166>.
- Jansson-Fröjmark M and Lindblom K (2008) A bidirectional relationship between anxiety and depression, and insomnia? A prospective study in the general population. *Journal of Psychosomatic Research* **64**(4), 443–449. <https://doi.org/10.1016/j.jpsychores.2007.10.016>.
- Jiang Z, Wang S, Shen Z, Zhao X, Wang F, Chen Y, Qiao Y, Wei T, Dong P, Ding S and Yang X (2022) Nurses' experience of work stress related to COVID-19 regular prevention and control in China: A qualitative study. *Journal of Nursing Management* **30**(2), 375–383. <https://doi.org/10.1111/jonm.13528>.
- Kerasiotis B and Motta RW (2004) Assessment of PTSD symptoms in emergency room, intensive care unit, and general floor nurses. *International Journal of Emergency Mental Health* **6**(3), 121–33.
- Kim SJ and Yeo JH (2020) Factors affecting posttraumatic stress disorder in south Korean trauma nurses. *Journal of Trauma Nursing* **27**(1), 50–57. <https://doi.org/10.1097/JTN.0000000000000482>.
- Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, Wu J, Du H, Chen T, Li R, Tan H, Kang L, Yao L, Huang M, Wang H, Wang G, Liu Z and Hu S (2020) Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Network Open* **3**(3), e203976. <https://doi.org/10.1001/jamanetworkopen.2020.3976>.
- Lau SSS, Ho CCY, Pang RCK, Su S, Kwok H, Fung SF and Ho RC (2022) Measurement of burnout during the prolonged pandemic in the Chinese zero-COVID context: COVID-19 burnout views scale. *Frontiers in Public Health* **10**, 1039450. <https://doi.org/10.3389/fpubh.2022.1039450>.
- Le XTT, Nguyen QT, Onyango B, Nguyen QN, Pham QT, Ta NTK, Nguyen TT, Le HT, Vu LG, Hoang MT, Vu GT, Latkins CA, Ho RCM and Ho CSH (2021) Perception toward exposure risk of COVID-19 among health workers in Vietnam: Status and correlated factors. *Frontiers in Public Health* **9**, 589317. <https://doi.org/10.3389/fpubh.2021.589317>.
- Li L, Wang X, Tan J, Li J and Yuan Y (2022) Influence of sleep difficulty on post-traumatic stress symptoms among frontline medical staff during COVID-19 pandemic in China. *Psychology Health & Medicine* **27**(9), 1924–36. <https://doi.org/10.1080/13548506.2021.1981411>.
- Liu S S and Ling W S (2009) Multiple mediation models and their applications. *Psychological Science* **32**(2), 433–435. (Published in Chinese).
- Lu MY, Ahorsu DK, Kukreti S, Strong C, Lin YH, Kuo YJ, Chen YP, Lin CY, Chen PL, Ko NY and Ko WC. (2021) The prevalence of post-traumatic stress disorder symptoms, sleep problems, and psychological distress among COVID-19 frontline healthcare workers in Taiwan. *Frontiers in Psychiatry* **12**, 705657. <https://doi.org/10.3389/fpsy.2021.705657>.
- Marcks BA and Weisberg RB (2009) Co-occurrence of insomnia and anxiety disorders: A review of the literature. *American Journal of Lifestyle Medicine* **3** (4), 300–309. <https://doi.org/10.1177/1559827609334681>.
- Mao X, Dong W, Zhang J, Zhang F, Deng W, Li Z and Hou T (2023a) Mental health status and its associated factors among female nurses in the normalization of COVID-19 epidemic prevention and control in China. *Frontiers in Public Health* **10**, 1088246. <https://doi.org/10.3389/fpubh.2022.1088246>.
- Mao X, Lin X, Liu P, Zhang J, Deng W, Li Z, Hou T and Dong W (2023b) Impact of insomnia on burnout among Chinese nurses under the regular COVID-19 epidemic prevention and control: Parallel mediating effects of anxiety and depression. *International Journal of Public Health* **68**, 1605688. <https://doi.org/10.3389/ijph.2023.1605688>.
- Mao X, Zhang F, Wei C, Li Z, Huang C, Sun Z, Zhang J, Deng W, Hou T and Dong W (2023c) The impact of insomnia on anxiety and depression: A longitudinal study of non-clinical young Chinese adult males. *BMC Psychiatry* **23**(1), 360. <https://doi.org/10.1186/s12888-023-04873-y>.
- Mao X, Luo P, Li F, Zhang F, Zhang J, Deng W, Li Z, Hou T and Dong W (2023d) PTSD of Chinese nurses in the normalisation of COVID-19 pandemic prevention and control: Prevalence and correlates. *Journal of Global Health* **13**, 06033. <https://doi.org/10.7189/jogh.13.06033>.
- Mao X, Hou T, Wang H, Tang Y, Ni C, Zhang Y, Zhang J, Deng W, Chen L, Wang X, Li Z, Jia Y, Dong W and Qian X (2024) Status and influencing factors of nurses' burnout: A cross-sectional study during COVID-19 regular prevention and control in Jiangsu Province, China. *Global Mental Health* **11**, e54. <https://doi.org/10.1017/gmh.2024.42>.
- Mason EC and Harvey AG (2014) Insomnia before and after treatment for anxiety and depression. *Journal of Affective Disorders* **168**, 415–421. <https://doi.org/10.1016/j.jad.2014.07.020>.
- Mirzaei A, Molaei B and Habibi-Soola A (2022) Post-traumatic stress disorder and its related factors in nurses caring for COVID-19 patients. *Iranian Journal of Nursing and Midwifery Research* **14**, 27(2), 106–111. https://doi.org/10.4103/ijnmr.ijnmr_456_20.
- Mo PKH, Chen X, Lam EHK, Li J, Kahler CW and Lau JTF (2020) The moderating role of social support on the relationship between anxiety, stigma, and intention to use illicit drugs among HIV-positive men who have sex with men. *AIDS and Behavior* **24**(1), 55–64. <https://doi.org/10.1007/s10461-019-02719-x>.
- Nakata A, Haratani T, Takahashi M, Kawakami N, Arito H, Kobayashi F and Araki S (2004) Job stress, social support, and prevalence of insomnia in a population of Japanese daytime workers. *Social Science & Medicine* **59**(8), 1719–1730. <https://doi.org/10.1016/j.socscimed.2004.02.002>.
- Ozer EJ, Best SR, Lipsey TL and Weiss DS (2003) Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analysis. *Psychological Bulletin* **129**(1), 52–73. <https://doi.org/10.1037/0033-2909.129.1.52>.
- Pham QT, Le XTT, Phan TC, Nguyen QN, Ta NKT, Nguyen AN, Nguyen TT, Nguyen QT, Le HT, Luong AM, Koh D, Haoang MT, Pham HQ, Vu LG, Nguyen TH, Tran BX, Latkin CA, Ho CSH and Ho RCM (2021) Impacts of COVID-19 on the life and work of healthcare workers during the nationwide partial lockdown in Vietnam. *Frontiers in Psychology* **12**, 563193.
- Preacher KJ and Hayes AF (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods* **40**, 879–891. <https://doi.org/10.3758/brm.40.3.879>.
- Podsakoff PM, Mackenzie SB, Lee JY and Podsakoff NP (2003) Common method biases in behavioral research: A critical review of the literature and recommended remedies. *The Journal of Applied Psychology* **88**(5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>.
- Roohafza H R, Afshar H, Keshтели A H, Mohammadi N, Feizi A, Taslimi M and Adibi P (2014) What's the role of perceived social support and coping styles in depression and anxiety? *Journal of Research in Medical Sciences* **19**(10), 944–949.
- Schnurr, PP, Lunney CA and Sengupta A (2004) Risk factors for the development versus maintenance of posttraumatic stress disorder. *Journal of Traumatic Stress* **17**, 85–95. <https://doi.org/10.1023/B:JOTS.0000022614.21794.f4>.
- Schuster M, Berbert L, Meyer S and Dwyer PA (2022) The impact of psychological capital and workplace social support on pediatric oncology nurses' Post Traumatic Stress Disorder (PTSD) symptomatology. *Journal of Pediatric Hematology/Oncology Nursing* **39**(4), 231–342. <https://doi.org/10.1177/275>.
- Somville FJ, De Gucht V and Maes S (2016) The impact of occupational hazards and traumatic events among Belgian emergency physicians. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, **24**(1), 59. <https://doi.org/10.1186/s13049-016-0249-9>.
- Spitzer RL, Kroenke K, Williams JB and Löwe B (2006) A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine* **166**(10), 1092–1097. <https://doi.org/10.1001/archinte.166.10.1092>.
- Soh HL, Ho RC, Ho CS and Tam WW (2020) Efficacy of digital cognitive behavioural therapy for insomnia: A meta-analysis of randomised controlled trials. *Sleep Medicine* **75**, 315–325. <https://doi.org/10.1016/j.sleep.2020.08.020>.
- Song X, Fu W, Liu X, Luo Z, Wang R, Zhou N, Yan S and Lv C (2020) Mental health status of medical staff in emergency departments during the coronavirus disease 2019 pandemic in China. *Brain, Behavior, and Immunity* **88**, 60–65. <https://doi.org/10.1016/j.bbi.2020.06.002>.

- Sripada RK, Lamp KE, Defever M, Venners M and Rauch SA (2016) Perceived social support in multi-era veterans with posttraumatic stress disorder. *The Journal of Nervous and Mental Disease* **204**(4), 317–320. <https://doi.org/10.1097/NMD.0000000000000476>.
- Tan YQ, Wang Z, Yap QV, Chan YH, Ho RCM, Hamid ARAH, Landaluce-Olavarria A, Pellino G, Gauhar V, Chand M, Wroclawski ML, Hameed BZ, Ling SK, Sengupta S, Gallo G, Chiu PK, Tanidir Y, Tallada MPV, Garcia BN, Colleoni R, Abiddin ZAZ, Campi R, Esperto F, Carrion D, Elterman D, Chung ASJ, Ng ACF, Moschini M, Rivas JG, Mayol J, Teoh JY and Chiong E (2023) Psychological health of surgeons in a time of COVID-19: A global survey. *Annals of Surgery*, **277**(1), 50–56. <https://doi.org/10.1097/SLA.0000000000004775>.
- Taylor DJ, Lichstein KL and Durrence HH (2003) Insomnia as a health risk factor. *Behavioral Sleep Medicine* **1**(4), 227–247. https://doi.org/10.1207/S15402010BSM0104_5.
- Taylor DJ, Lichstein KL, Durrence HH, Reidel BW and Bush AJ (2005) Epidemiology of insomnia, depression, and anxiety. *Sleep* **28**(11), 1457–1464. <https://doi.org/10.1093/sleep/28.11.1457>.
- The State Council (2020) Guiding opinions on novel coronavirus pneumonia epidemic prevention and control work by the State Council. Available at http://www.gov.cn/zhengce/content/2020-05/08/content_5509896.html (accessed 16 Aug 2023).
- Wen L, Shen M, Zhang M, Liu W, Liu Z and XianYu Y (2022) Psychological stress and job burnout of frontline nurses in Wuhan in the context of normalized pandemic prevention and control for COVID-19—a cross-sectional study. *Tobacco Regulatory Science* **8**(1), 59–74.
- Wu Q, Li D, Yan M and Li Y (2022) Mental health status of medical staff in Xinjiang Province of China based on the normalisation of COVID-19 epidemic prevention and control. *International Journal of Disaster Risk Reduction* **74**, 102928. <https://doi.org/10.1016/j.ijdrr.2022.102928>.
- Xiao H, Zhang Y, Kong D, Li S and Yang N (2020) The effects of social support on sleep quality of medical staff treating patients with coronavirus disease 2019 (COVID-19) in January and February 2020 in China. *Medical Science Monitor* **26**, e923549. <https://doi.org/10.12659/MSM.923549>.
- Xinhua Press (2020) Latest Developments in Epidemic Control on May 8. Available at http://english.www.gov.cn/news/topnews/202005/08/content_WS5eb4914cc6d0b3f0e949729c.html (accessed 16 Aug 2023).
- Xu Q, Li S and Yang L (2019) Perceived social support and mental health for college students in mainland China: The mediating effects of self-concept. *Psychology, Health & Medicine* **24**(5), 595–604. <https://doi.org/10.1080/13548506.2018.1549744>.
- Yao Z, Xie X, Bai R, Li L, Zhang X, Li S, Ma Y, Hui Z and Chen J (2022) The impact of eating behaviors during COVID-19 in health-care workers: A conditional process analysis of eating, affective disorders, and PTSD. *Heliyon* **8**(10), e10892. <https://doi.org/10.1016/j.heliyon.2022.e10892>.
- Yilmaz M, Kırac Y and Sahin MK (2021) Sleep quality and related factors in a sample of Turkish healthcare workers during the COVID-19 pandemic: A cross-sectional study. *International Journal of Clinical Practice* **75**(11), e14813. <https://doi.org/10.1111/ijcp.14813>.
- Yin Q, Chen A, Song X, Deng G and Dong W (2021) Risk perception and PTSD symptoms of medical staff combating against COVID-19: A PLS structural equation model. *Frontiers in Psychiatry* **12**, 607612. <https://doi.org/10.3389/fpsy.2021.607612>.
- Yunitri N, Chu H, Kang XL, Jen HJ, Pien LC, Tsai HT, Kamil AR and Chou KR (2022) Global prevalence and associated risk factors of posttraumatic stress disorder during COVID-19 pandemic: A meta-analysis. *International Journal of Nursing Studies* **126**, 104136. <https://doi.org/10.1016/j.ijnurstu.2021.104136>.
- Zhang MW and Ho RC (2017) Moodle: The cost effective solution for internet cognitive behavioral therapy (I-CBT) interventions. *Technology and Health Care* **25**(1), 163–165. <https://doi.org/10.3233/THC-161261>.
- Zhang N, Liu C, Lu J and Cheng J (2021) Investigation on mental health status of frontline medical staff in Taiyuan city under the condition of COVID-19 normalization. *Journal of Preventive Medicine Information* **37**(8), 1126–1130 +1135 (in Chinese).
- Zhou YG, Shang ZL, Zhang F, Wu LL, Sun LN, Jia YP, Yu HB and Liu WZ (2021). PTSD: Past, present and future implications for China. *Chinese Journal of Traumatology* **24**(4), 187–208. <https://doi.org/10.1016/j.cjtee.2021.04.011>.
- Zhou H and You LR (2004) Statistical remedies for common method biases. *Advances in Psychological Science* **6**, 942–950.
- Zhu W, Wei Y, Meng X and Li J (2020) The mediation effects of coping style on the relationship between social support and anxiety in Chinese medical staff during COVID-19. *BMC Health Services Research* **20**, 1007. <https://doi.org/10.1186/s12913-020-05871-6>.
- Zimet GD, Dahlem NW, Zimet SG and Farley GK (1988) The multidimensional scale of perceived social support. *Journal of Personality Assessment* **52** (1), 30–41. https://doi.org/10.1207/s15327752jpa5201_2.
- Zou X, Liu S, Li J, Chen W, Ye J, Yang Y, Zhou F and Ling L (2021) Factors associated with healthcare workers' insomnia symptoms and fatigue in the fight against COVID-19, and the role of organizational support. *Frontiers in Psychiatry* **12**, 652717. <https://doi.org/10.3389/fpsy.2021.652717>.