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Burnout and post-traumatic stress disorder symptoms among medical staff two years after the COVID-19 pandemic in Wuhan, China: Social support and resilience as mediators

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ABSTRACT

Background: Evidence on the relationship between burnout and post-traumatic stress disorder (PTSD) is limited. We aimed to evaluate the association between burnout and PTSD symptoms among medical staff two years after the coronavirus disease 2019 (COVID-19) pandemic in Wuhan, China, and explore the mediating roles of social support and psychological resilience.

Methods: A multicenter survey was conducted online from January to March 2022 among healthcare professionals from six general hospitals. Hierarchical linear regression was used to detect the predictors of PTSD symptoms. Structural equation modeling (SEM) was used to analyze the pathways from burnout to PTSD symptoms.

Results: Hierarchical linear regression showed that burnout, social support, and psychological resilience were significant predictors of PTSD symptoms among medical staff. In the SEM, the standardized total effect of burnout on PTSD symptoms was 0.336(bias-corrected 95 % confidence interval [0.303, 0.367], $P < 0.001$). Social support and psychological resilience partially mediated the relationship between burnout and PTSD symptoms (indirect effects accounted for 22.3 % of the total effect).

Limitations: Owing to the cross-sectional design, only clues to causal explanations can be provided.

Conclusions: Burnout has significant direct and indirect effects on PTSD symptoms. Furthermore, social support and psychological resilience might be effective ways to reduce the impact of burnout on PTSD symptoms in medical staff after a major public health outbreak.

1. Introduction

The coronavirus disease 2019 (COVID-19) was first reported in Wuhan, China in 2019. On January 30, 2020, the World Health Organization declared it a public health emergency of international concern (World Health Organization, 2005). Mental health consequences

associated with major public health events are major health issues that must urgently be addressed (Chen et al., 2020; Zhou et al., 2021a, 2021b). During a major public health event, medical staff are often faced with multiple stressors, such as concerns about their physical health, distress in a high-pressure work environment, and the loss of loved ones and friends (Wu et al., 2021; Bell and Wade, 2021).

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Post-traumatic stress disorder (PTSD) is a common and complex psychiatric disorder resulting from major public health events (Rogers et al., 2020). COVID-19 poses a stress reaction to medical staff due to high infection, high mortality, and gaps in effective treatment or treatment guidelines (Wang et al., 2020). In addition, fear of infection, economic stress, and discomfort associated with quarantine greatly increase the risk of PTSD among medical staff (Chamaa et al., 2021). An epidemiological survey of medical staff and public service workers revealed that 27.7 % of the participants reported PTSD symptoms during the COVID-19 outbreak (Johnson et al., 2020). Studies have shown that PTSD symptoms and levels can fluctuate over time (Bryant et al., 2013; Brier et al., 2020). Therefore, it is essential to monitor and explore in detail the predictors of PTSD symptoms among medical staff during the pandemic.

Burnout is a common occupational phenomenon caused by the accumulation of long-term occupational stress, which leads to emotional exhaustion, cynicism, and reduced personal accomplishments (Maslach et al., 2001). The risk of burnout was high before the outbreak of the COVID-19 pandemic (Chirico et al., 2021b). Chirico et al. found that burnout was an even more serious occupational health issue and that people with high workloads, such as teachers and medical professionals, were at a high risk of burnout (Chirico et al., 2021a; Gualano et al., 2021). Previous studies have also shown that burdensome workplace stress increases the risk of workplace violence and thus the level of burnout (Chirico et al., 2022b; Chirico et al., 2022c; Lasalvia et al., 2021). Burnout exacerbates chronic work stress among, increases turnover intention, and also decreases the quality of health care and care (Chirico and Leiter, 2022a).

The acute traumatic stress of COVID-19 may compound with the chronic stress of burnout, greatly exacerbating the individual's intense fear, helplessness, or horror, leading to the onset and development of PTSD among medical staff (Restauri and Sheridan, 2020). In recent years, some studies have shown that burnout is a significant predictor of PTSD symptoms in firefighter and police populations, and the higher the level of burnout, the more severe the PTSD symptoms (Jo et al., 2018; Ogińska-Bulik and Juczyński, 2021). However, studies that corroborate the association between burnout and PTSD are limited, especially among the medical staff. Although previous studies have provided preliminary evidence that burnout may be a significant predictor of PTSD (Jo et al., 2018; Ogińska-Bulik and Juczyński, 2021), few studies focused on mediators between burnout and PTSD. Therefore, in the context of the COVID-19 pandemic, continued exploration of potential mediating variables between burnout and PTSD is needed.

Social support is an important interpersonal resource that is an important influencing factor that contributes to improved mental health outcomes following a disaster (Kaniasty and Norris, 2008; Birkeland et al., 2021). At the same time, psychological resilience is considered an important personal trait for adapting well in the face of adversity (Hyun et al., 2021). For example, Kshtriya et al. found that low social support can enhance PTSD symptoms in first responders with high occupational stress (Kshtriya et al., 2020). Lee et al. suggested that subjects with high psychological resilience can alleviate the toxic effects of previous trauma on PTSD symptoms (Lee et al., 2020). In addition, social support and resilience have been shown to reduce the negative consequences of burnout (Nituica et al., 2021; Rogers et al., 2016). Notably, previous studies failed to further measuring the mediating role of social support and resilience in the relationship between burnout and PTSD symptoms.

Given the limited original investigation and urgent public health implications, we aimed to systematically examine the relationship between burnout, social support, psychological resilience, and PTSD symptoms among medical staff two years after the COVID-19 pandemic. We proposed the following hypotheses: (1) burnout can predict PTSD symptoms, (2) social support can mediate the relationship between burnout and PTSD symptoms, and (3) psychological resilience can mediate the relationship between burnout and PTSD symptoms (Appendix Fig. 1).

2. Methods

2.1. Design and participants

This multicenter cross-sectional study was conducted via an online survey platform ("SurveyStar," Changsha Ranxing Science and Technology, Shanghai, China) from January 15 to March 31, 2022. To ensure the accuracy and validity of the data, we set up intelligent logical checks in a computer backend system to identify and reject invalid questionnaires. In addition, each participant was eligible to fill out the questionnaire only once. All questionnaires were distributed by the hospital management staff.

The sampling process in this study consisted of two stages. In the first stage, six hospitals in Wuhan, China, were randomly selected using the simple random sampling principle. In the second stage, an online questionnaire was distributed to the medical staff of the six selected hospitals through hospital administration departments. Finally, 3531 medical staff members were recruited from six general hospitals in the Wuhan Province for the questionnaire survey. A total of 3455 valid questionnaires were collected, with an effective rate of 97.85 %. All recruited participants were medical staff (including doctors, nurses, and other healthcare professionals) who were at least 18 years old and had worked in clinical settings during the COVID-19 pandemic.

The study adhered to the principles of the Declaration of Helsinki. All the participants were asked to read and sign an electronic informed consent form before accessing the link to complete the questionnaire. Additionally, we randomly assigned a participant number to each medical staff member to ensure anonymity. This study was approved by the Research Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China (number: 2021-IEC-A006).

2.2. Measurements

2.2.1. General information

A general demographic characteristics questionnaire was developed based on a literature review. The main variables included age, sex, marriage, education, sleep status, any other major traumatic events in life except for COVID-19, and occupation-related variables (type of occupation, years of working, monthly income, shift work, and any occupational exposure during COVID-19).

2.2.2. Maslach Burnout Inventory-General Survey (MBI-GS)

The Chinese version of the MBI-GS was used to assess burnout symptoms among medical staff. Cronbach's alpha coefficient for the MBI-GS was 0.85, which is widely used as a measure of burnout (Chirico and Leiter, 2022b; Li and Shi, 2003). It is the only scale that can assess all three dimensions of burnout in medical staff: emotional exhaustion (EE, five items), cynicism (CY, four items), and reduced personal accomplishment (PA, six items), with a total of 15 items (Chirico et al., 2022c). Respondents used a 7-point scale from 0 (never) to 6 (every day) to respond to each item. Burnout scores were calculated based on the criterion of the weighted average score developed by Kalimo et al.: Burnout score = 0.4*average score of EE + 0.3*average score of CY + 0.3*average score of PA. The degree of burnout was divided into three levels according to the score: no burnout (0–1.49), moderate burnout (1.50–3.49), and severe burnout (3.50–6.00) (Kalimo et al., 2003). According to this criterion, a score of 1.49 upwards and medical staff were considered to have burnout. In this study, the Cronbach's alpha of the MBI-GS was 0.906.

2.2.3. Multidimensional Scale of Perceived Social Support (MSPSS)

The MSPSS was used to survey participants' social support. It consists of three dimensions of support from family, friends, and others, with a total of 12 items. The MSPSS used a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The total score was 12–84, with

the score representing the level of perceived social support (Zimet et al., 1988). The reliability and validity of the Chinese version of the MSPSS have been validated in the Chinese population with a Cronbach's alpha of 0.89 (Chou, 2000). In this study, the Cronbach's alpha was 0.97.

2.2.4. The 10-item Connor-Davidson Resilience Scale (CD-RISC-10)

The CD-RISC-10 was used to measure resilience in the medical staff. It is a refinement from the original 25-item Resilience Scale (CD-RISC) and has good reliability and validity. Each item was scored from 0 (not at all correct) to 4 (almost completely correct) using a 5-point Likert scale. The total score ranges from 0 to 40, with higher scores representing higher psychological resilience of the subject (Campbell-Sills and Stein, 2007). In the Chinese population, the Cronbach's alpha of the CD-RISC-10 was 0.91 (Wang et al., 2010). In this survey, the Cronbach's alpha of the scale was 0.97.

2.2.5. PTSD checklist for DSM-5 (PCL-5)

The PCL-5 was used to evaluate PTSD symptoms, and the Cronbach's alpha of the Chinese version of the scale was 0.91. The PCL-5 consists of four symptom clusters: re-experiencing (B criterion), avoidance (C criterion), negative alterations in cognition or mood (D criterion), and arousal (E criterion). It includes 20 items with a total score of 0–80, and each item is scored from 0 (not at all) to 3 (extremely). The higher the PTSD score, the more severe are the PTSD symptoms. A cut-off score of ≥ 33 indicates PTSD (Blevins et al., 2015; Wang et al., 2015). In the current sample, the Cronbach's alpha for the PCL-5 scale was 0.97.

2.3. Statistical analysis

The data were analyzed using SPSS software (version 21.0; SPSS Inc., Chicago, IL, USA) and AMOS 23.0 (IBM Corporation, Armonk, NY, USA). The value of $P < 0.05$ (two-tailed) was considered statistically significant. Based on the normality criterion proposed by Curran et al. (1996) (i.e., skewness ≤ 2 ; kurtosis ≤ 7), we first checked whether all variables conformed to a normal distribution. The assumption of normality was met for all variables in this study. In addition, we used Harman's one-factor test to check for common method bias in this study (Podsakoff et al., 2003). The results showed that the first factor accounted for 23.74 % of the total variance (< 40 % threshold value). Therefore, no significant common method bias exists in this study.

Descriptive analyses were performed using frequencies and percentages for categorical variables and means \pm standard deviations (SD) for continuous variables, respectively. Independent samples *t*-tests and one-way ANOVA were used to compare the differences in PTSD symptoms between categorical variables. Pearson correlation analysis was applied for the preliminary analysis of correlations among key continuous variables (burnout, social support, psychological resilience, and PTSD symptoms). Hierarchical multiple regression analysis was used to incorporate independent variables ($P < 0.05$) in the univariate analysis to explore factors associated with PTSD symptoms.

Structural equation modeling (SEM) was conducted to further test the relationship between burnout, social support, psychological resilience, and PTSD symptoms using the maximum likelihood method. A bias-corrected bootstrap (5000 replicates) was applied to estimate 95 % corrected confidence intervals for direct and indirect effects (Preacher and Hayes, 2008). The evaluation metrics for the model fit were as follows: the value of χ^2/df was < 5 , the goodness of fit index (GFI), Tucker-Lewis index (TLI), incremental fit index (IFI), comparative fit index (CFI) were above 0.90, and the root mean square error of approximation (RMSEA) was less 0.08 (Hu and Bentler, 1999).

3. Results

3.1. Descriptive and correlation analysis

Among the 3455 participants, the weighted average score of the MBI-

GS was 2.17 (SD = 1.37), and the average score of PCL-5 was 19.00 (SD = 15.74). In addition, 67.09 % and 19.88 % of medical staff fulfilled the criteria for burnout and PTSD two years after the outbreak of the COVID-19 pandemic, respectively (Fig. 1). The general characteristics of the participants and their relationships with the PTSD symptom scores are shown in Table 1. Among the participants in this study, the ages ranged from 18 to 62 years, with a mean age of 33 years (SD = 6.91); 83.1 % were female, and 80.53 % were nurses. Two years after the COVID-19 outbreak, 418 (12.1 %) participants reported experiencing a major traumatic event other than COVID-19. Medical staff with burnout had higher PTSD symptom scores than those without burnout ($t = 13.398$; $P < 0.001$) (Fig. 2). However, there were no significant differences in PTSD symptom scores across age, marital status, educational level, and average monthly income ($P > 0.05$). The detailed results of the descriptive and difference analyses are presented in Table 1.

Table 2 presents the results of the correlation analysis of the key study variables. The correlations between all variables and their dimensions were significant. The Pearson correlation analysis showed that all three dimensions of burnout were positively correlated with overall burnout ($P < 0.001$). In addition, the results showed that all four dimensions of PTSD were positively correlated with overall PTSD, with the highest correlation being negative alterations in cognition or mood ($r = 0.952$, $P < 0.001$). Burnout was positively and significantly associated with PTSD symptoms ($r = 0.335$, $P < 0.001$). Social support and psychological resilience were weakly positively correlated; however, this association was statistically significant ($r = 0.094$, $P < 0.001$). Social support and psychological resilience were negatively and significantly associated with burnout and PTSD symptoms, respectively ($P < 0.001$). All correlation coefficients between the variables are shown in Table 2. The results of the correlation analysis verify that Hypothesis 1 is valid.

3.2. Hierarchical multiple regression analysis

The results of the hierarchical multiple regression analysis are summarized in Table 3. First, we included only demographic variables such as sex, sleep status, occupation, years of work, night shift, and occupational exposure (statistically significant variables in the univariate analysis), accounting for 5.0 % of the variance in PTSD symptoms. Second, burnout was added to the model and was positively associated with PTSD symptoms, explaining 17.9 % of the variance ($\beta = 4.126$, $P < 0.001$). Third, social support and psychological resilience explained 11.5 % of the variance. After adding social support and psychological resilience, the regression coefficient (β) for the association between burnout and PTSD symptoms decreased but remained significant ($\beta = 3.347$, $P < 0.001$). The results of the hierarchical multiple regression provide a basis for further validation of the more complex relationships between variables using SEM.

3.3. Mediation effect models

The SEM analysis results for social support and psychological resilience between burnout and PTSD symptoms are shown in Table 4. According to the model fit index, the model constructed in this study fitted well ($\chi^2/df = 3.878$, GFI = 0.993, TLI = 0.994, IFI = 0.996, CFI = 0.996, and RMSEA = 0.029). The bootstrap test confirmed that the effect sizes of each path were significant (the bias-corrected 95 % confidence interval for the direct and indirect effects did not contain 0). The results indicated that burnout is positively associated with PTSD symptoms. The standardized direct predictive effect of burnout on PTSD symptoms was 0.261 (bias-corrected 95 % confidence interval [0.232, 0.290], $P < 0.001$). The indirect effects were as follows: in the burnout-social support-PTSD symptoms pathway, the indirect effect was 0.048 (bias-corrected 95 % confidence interval [0.033, 0.063], $P < 0.001$); and in the pathway of burnout, psychological resilience-PTSD symptoms, the indirect effect was 0.027 (bias-corrected 95 % confidence interval [0.020, 0.0365], $P < 0.001$). Social support and psychological resilience play a

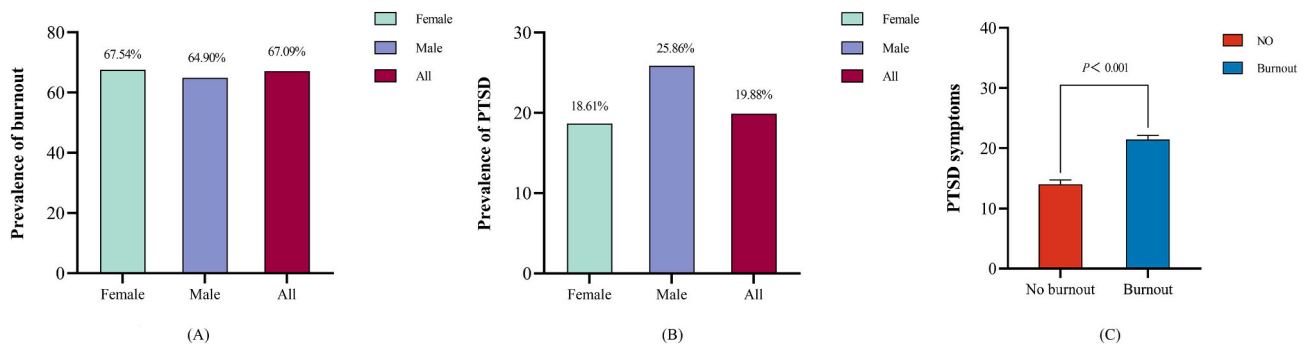


Fig. 1. Burnout and PTSD symptoms among medical staff two years after the COVID-19 outbreak

Note: PTSD, posttraumatic stress disorder; (A) Prevalence of burnout among medical staff; (B) Prevalence of PTSD among medical staff; (C) Differences in PTSD symptoms among medical staff with and without burnout; P calculated by t -test analysis.

mediating role between burnout and PTSD symptoms, and social support and psychological resilience buffer the effect of burnout on PTSD symptoms (Hypothesis 3). Social support and psychological resilience played a partially mediating role with a mediating effect of 22.3 %. Fig. 2 shows a visualization of this structural equation model.

4. Discussion

To the best of our knowledge, this multicenter study is the first to examine the structural relationships between burnout and PTSD symptoms among Chinese medical staff. Overall, the prevalence of burnout and PTSD among medical staff was 67.09 % and 19.88 %, respectively, two years after the outbreak of the COVID-19 pandemic in Wuhan, China. Consistent with these hypotheses, this study shows that burnout is positively associated with PTSD symptoms in medical staff after a major public health event. Furthermore, consistent with the mediating relationship hypothesis, the positive predictive effect of burnout on PTSD symptoms is reduced by the buffering effect of social support and psychological resilience. Identifying predictors and analyzing pathways of effect after a major public health event benefits the assessment of the psychological impact of the outbreak on medical staff, while preventing the onset and development of subsequent PTSD symptoms.

The prevalence of both burnout (67.09 %) and PTSD (19.88 %) among medical staff was high two years after the outbreak of the COVID-19 pandemic in Wuhan, China. A meta-analysis of the global prevalence of PTSD during the pandemic found that the prevalence of PTSD among medical staff was 17.23 % (Yunitri et al., 2022). Similar results were observed for the prevalence of burnout among respondents in this survey. The combined prevalence of burnout among medical staff during the COVID-19 pandemic was 37 %, significantly lower than the 67.09 % in this study (Aymerich et al., 2022). One possible explanation for these results is that Wuhan was the first city to experience the COVID-19 outbreak. Hence, COVID-19 caused severe psychological long-term distress to local medical staff, even two years after the outbreak. Consistent with previous studies, medical staff were expected to present psychological challenges in areas severely affected by major public health events (Chirico et al., 2021c; Shultz et al., 2015; Pappa et al., 2020).

As predicted, burnout was significantly positively associated with PTSD symptoms. This finding supported a previous study from the beginning of the pandemic, which showed that the higher the levels of burnout, the more severe the PTSD symptoms (Johnson et al., 2020). Combined with the results of other studies, the symptoms of burnout and PTSD are distinct, but intersect (Restauro and Sheridan, 2020). Traumatic events or chronic stress in the workplace may not directly cause PTSD but work on burnout through stress accumulation, leading to a significant increase in PTSD symptoms (Kim et al., 2019; Ham et al., 2022). Therefore, any initiative that contributes to the mitigation of burnout may be helpful in preventing PTSD.

This study builds on previous literature and reveals that social support and psychological resilience can mitigate the effects of burnout on PTSD symptoms. The conservation of resources (COR) theory was introduced to understand the potential mechanisms of social support and psychological resilience to alleviate the impact of burnout on PTSD symptoms in medical staff. According to the COR theory, individuals can maintain their mental health by acquiring, maintaining, or nurturing beneficial resources (i.e., higher psychological resilience and social support) to counteract some of the negative effects of stressors (Hobfoll, 1989). Research has also shown that social support and psychological resilience are strongly associated with acute stress disorders in college students during the COVID-19 pandemic. Furthermore, social support and psychological resilience can help college students adapt to stress and further alleviate their acute stress disorder symptoms (Ye et al., 2020).

Social support and psychological resilience are central factors in the treatment of PTSD (Bakic and Ajdukovic, 2019; Rakesh et al., 2019). Our study further elucidated that higher levels of social support and psychological resilience might be helpful for medical staff to reduce PTSD symptoms after the outbreak of the COVID-19 pandemic. The mediating mechanisms of social support and psychological resilience offer the following insights to address the psychological challenges faced by medical staff. First, in the early stages of public health emergencies, governments and organizations should respond quickly, implementing occupational health surveillance and workplace health promotion programs to early diagnosis of burnout and prevention of PTSD and suicide rates, and pay attention to the crossover and overlap between different psychological distress phenomena (Chirico et al., 2022b). Second, during the pandemic, families and work organizations should provide timely assistance based on spirituality and social support to promote the well-being of medical staff (Chirico, 2021). Finally, long-term psychological interventions should be implemented to nurture and improve the psychological resilience of individuals to recover from stress and achieve post-traumatic personal growth.

We acknowledge that there are some limitations in generalizing the findings. First, this study is cross-sectional and can only provide clues for causal explanations. Therefore, future studies should consider a longitudinal follow-up approach to further elucidate the causal relationships between different variables. Second, there may have been some sampling bias in this study, particularly because male medical staff may have been relatively underrepresented in this sample. Third, existing studies have shown that COVID-19 is a major public health event that causes adverse stimuli and psychological reactions. It is also a traumatic event that triggers PTSD in individuals (Blekas et al., 2020; Greene et al., 2021; Zhou et al., 2021a, 2021b). However, compared with most typical PTSD, COVID-19 is still a current, ongoing event. Therefore, considering PTSD measures as simply measuring the level of PTSD needs to be interpreted with caution. Finally, the indirect effect sizes for social support and psychological resilience on burnout and PTSD symptoms,

Table 1
Demographic characteristics of the participants and univariate analysis for the factors associated with PTSD symptoms (*N* = 3455).

Variables	N (%)	Post-traumatic stress disorder		
		Mean (SD)	<i>t/F</i>	<i>P</i>
Sex			3.819	<0.001
Male	584(16.9)	21.26 (17.19)		
Female	2871 (83.1)	18.54 (15.39)		
Age (years old)			0.663	0.575
18–24	882(25.5)	18.56 (16.54)		
25–34	2159 (62.5)	19.05 (15.43)		
35–44	372(10.8)	19.88 (15.54)		
>44	42(1.2)	18.12 (15.70)		
Marital status			1.065	0.287
Single/divorced/widowed	884(25.6)	18.51 (15.83)		
Married	2571 (74.4)	19.17 (15.70)		
Education level			1.267	0.282
Below bachelor's degree	276(8.0)	18.21 (16.49)		
Bachelor's degree	2549 (73.8)	18.88 (15.60)		
Master degree and above	630(18.2)	19.82 (15.94)		
At least 6–8 h/day of sleep			7.015	<0.001
Yes	2038 (59.0)	17.45 (15.63)		
No	1417 (41.0)	21.24 (15.63)		
Type of occupation			4.167	0.016
Doctor	609(17.6)	20.66 (16.31)		
Nurse	2782 (80.5)	18.63 (15.51)		
Other	64(1.9)	19.27 (18.91)		
Years of working			2.775	0.040
≤2	368(10.7)	17.84 (16.85)		
3–10	1597 (46.2)	18.47 (15.25)		
11–15	815(23.6)	19.92 (15.54)		
>15	675(19.5)	19.78 (18.40)		
Average monthly income (Yuan)			1.459	0.224
<5000	380(11.0)	18.32 (17.10)		
5000–9999	1679 (48.6)	18.62 (15.72)		
10,000–14,999	1058 (30.6)	19.51 (15.29)		
≥15,000	338(9.8)	20.07 (15.59)		
Night shift			2.827	0.005
Yes	2726 (78.9)	19.39 (15.85)		
No	729(21.1)	17.54 (15.23)		
Occupational exposure			6.156	<0.001
Yes	534(15.5)	22.84 (16.08)		
No	2921 (84.5)	18.30 (15.57)		
Experiencing other traumatic events			9.518	<0.001
Yes	418(12.1)	25.78 (16.51)		
No	3037 (87.9)	18.07 (15.40)		

Notes: PTSD, posttraumatic stress disorder; SD, Standard Deviations.

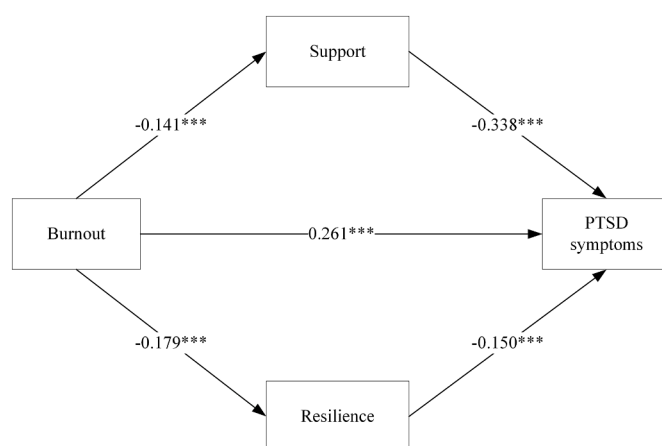


Fig. 2. The mediating role of social support and psychological resilience in the relationship between burnout and PTSD symptoms.

Notes: PTSD, posttraumatic stress disorder; ***. *P*<0.001.

respectively, were not high, even though this indirect effect was shown to be significant. The relationship and pathways between burnout and PTSD are complex, and the limitations of this study again suggest that examining alternative pathways between burnout and PTSD symptoms is necessary in future studies.

Despite these limitations, this study extends the literature on the direct and indirect associations between burnout and PTSD symptoms among Chinese medical staff. The results of our study also contribute to a better understanding of the critical role of social support and psychological resilience in alleviating PTSD symptoms among Chinese medical staff. In a major public health emergency, medical staff are both rescuers and survivors. Our study highlights that the prevalence of burnout and PTSD among medical staff remains unpromising over time, two years after the COVID-19 outbreak in Wuhan, China. It is urgent that we address the challenges of the COVID-19 pandemic on the mental health of medical staff. Hence, this study has theoretical and practical implications. Government or hospital administrators could use these findings to adopt systematic clinical interventions for medical staff.

5. Conclusions

This study confirmed that there is a significantly positive association between burnout and post-traumatic stress symptoms two years after the COVID-19 pandemic outbreak, and social support and psychological resilience played an independent mitigating role. More specifically, this could contribute an important empirical reference value for the development of clinical interventions for PTSD symptoms among medical staff during major public health emergencies. Enhancing social support for medical staff and improving their psychological resilience might be an effective intervention to alleviate post-traumatic stress symptoms in follow-up interventions.

Ethics statement

This study was approved by the Research Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China. All methods in this study are in line with the principles of the Institutional Research Committee and the Helsinki declaration. Informed consent was obtained from all participants.

Table 2
Means, standard deviations (SD) and Pearson correlations (N = 3455).

Correlation	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Burnout- Total scale ^a	2.12	1.36	1.000													
2. Burnout- EE	10.37	8.15	0.834**	1.000												
3. Burnout- CY	6.86	6.24	0.812**	0.620**	1.000											
4. Burnout- PA	16.59	11.06	0.736**	0.375**	0.545**	1.000										
5. Social support- Total scale	69.45	13.01	-0.141**	-0.120**	-0.116**	-0.090**	1.000									
6. Social support- Family	23.13	4.52	-0.133**	-0.109**	-0.084**	-0.061**	0.961**	1.000								
7. Social support- Friends	23.37	4.56	-0.127**	-0.108**	-0.103**	-0.082**	0.940**	0.869**	1.000							
8. Social support- Others	22.93	4.56	-0.129**	-0.110**	-0.105**	-0.077**	0.948**	0.892**	0.830**	1.000						
9. Psychological Resilience	27.33	9.44	-0.179**	-0.163**	-0.177**	-0.129**	0.094**	0.089**	0.082**	0.091**	1.000					
10. PTSD- Total scale	19.05	15.83	0.335**	0.344**	0.300**	0.239**	0.388**	-0.369**	-0.357**	-0.376**	-0.228**	1.000				
11. PTSD symptoms- B	6.01	4.69	0.297**	0.301**	0.265**	0.208**	0.316**	-0.304**	-0.304**	-0.308**	-0.218**	0.895**	1.000			
12. PTSD symptoms- C	2.21	2.11	0.265**	0.270**	0.230**	0.189**	-0.211**	-0.198**	-0.209**	-0.160**	0.810**	0.749**	1.000			
13. PTSD symptoms- D	5.53	5.74	0.317**	0.333**	0.282**	0.224**	0.408**	-0.408**	-0.390**	-0.390**	0.952**	0.772**	0.718**	1.000		
14. PTSD symptoms- E	5.29	4.872	0.314**	0.318**	0.287**	0.230**	-0.384**	-0.362**	-0.372**	-0.362**	0.915**	0.712**	0.633**	0.859**	1.000	

Notes: PTSD, posttraumatic stress disorder; SD: Standard Deviations.

^a Weighted average score of Burnout.

** P < 0.01.

Table 3

The hierarchical linear regression analysis for PTSD symptoms (N = 3455).

Variables	Post-traumatic stress disorder		
	Step1(β)	Step2(β)	Step3(β)
Sex (Ref: Male)			
Female	-1.505	-1.741*	-0.642
At least 6–8 h/day of sleep (Ref: Yes)			
No	3.159***	2.914***	2.031***
Type of occupation (Ref: Nurse)			
Doctor	1.497	1.592*	0.757
Others	1.535	1.417	1.122
Years of working (Ref: ≤2)			
3–10	0.423	0.266	0.125
11–15	1.878	1.285	1.156
>15	2.669*	2.156*	1.826*
Night shift (Ref: No)			
Yes	1.878**	1.566*	1.558*
Occupational exposure (Ref: No)			
Yes	3.029***	2.880***	1.240
Experiencing other traumatic events (Ref: No)			
Yes	6.557***	6.325***	5.469***
Burnout			
Social support			
Psychological Resilience			
F	18.138***	68.215***	110.017***
R ²	0.050	0.179	0.294
Δ R ²	0.050	0.129	0.115

Notes: PTSD, posttraumatic stress disorder.

* P < 0.05.

** P < 0.01.

*** P < 0.001.

Table 4

Total, direct, and indirect effects of burnout on PTSD symptoms (N = 3455).

Effects	Paths	Standardized estimates	Bootstrap
			Bias-corrected 95%CI
Direct	Burnout → PTSD symptoms	0.261***	0.232 to 0.290
	Burnout → Social support	-0.141***	-0.182 to -0.100
	Burnout → Psychological resilience	-0.179***	-0.213 to -0.142
	Social support → PTSD symptoms	-0.338***	-0.368 to -0.308
	Psychological resilience → PTSD symptoms	-0.150***	-0.181 to -0.119
Indirect	Burnout → Social support → PTSD symptoms	0.048***	0.033 to 0.063
	Burnout → Psychological resilience → PTSD symptoms	0.027***	0.020 to 0.036
Total	Burnout → PTSD symptoms	0.336***	0.303 to 0.367

Notes: PTSD, posttraumatic stress disorder.

*** P < 0.001.

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CRedit authorship contribution statement

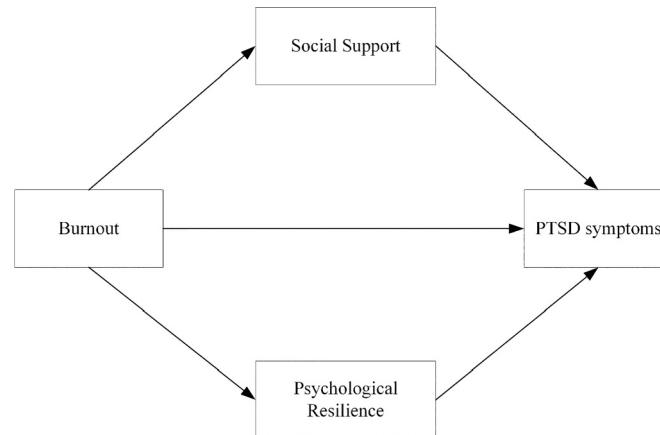
Yifang Liu: Conceptualization, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Li Zou:** Investigation, Writing – review & editing. **Shijiao Yan:** Methodology, Formal analysis. **Pu Zhang:** Formal analysis, Visualization. **Jun Zhang:** Formal analysis, Data curation. **Jing Wen:** Investigation. **Jing Mao:** Visualization. **Longti Li:** Investigation, Data curation, Writing – review & editing.

Ying Wang: Investigation, Methodology, Data curation. **Wenning Fu:** Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Conflict of interest

The authors declare that they have no competing interests.

Appendix A



Appendix Fig. 1. Theoretical model.

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