

Original Research

## Association between Posttraumatic Stress Symptoms and Resilience in Frontline Healthcare Workers during the COVID-19 Pandemic in Vietnam

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### Abstract

The COVID-19 pandemic has placed a considerable burden on frontline healthcare workers (HCWs), thus increasing their vulnerability to developing posttraumatic stress disorder (PTSD). Our study aimed to examine the relationship between possible PTSD symptoms and resilience



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and identify associated factors with possible PTSD symptoms among Vietnamese frontline HCWs during the COVID-19 pandemic in 2021. We conducted a cross-sectional study across medical facilities at three administrative levels: provincial, district, and commune levels of Vietnam's healthcare service and management systems. The Item of Event Scale-Revised (IES-R) and Brief Resilience Scale (BRS) were used to measure possible PTSD symptoms and psychological resilience accordingly. In the sample of 763 HCWs, two-thirds were women, their median age was 34, and nearly half were nurses. 15.9% of HCWs reported having possible PTSD symptoms. Several variables, including COVID-19 concerns: worried about being infected with COVID-19, lacking personal protective equipment (PPE), about an uncontrollable pandemic, feeling lonely about being isolated from family, and resilience capacity were statistically significant with having possible PTSD symptoms. Multiple logistic regression showed that reused PPE, concerns about lacking PPE, and low levels of resilience were significantly associated with an increased likelihood of possible PTSD symptoms. It is suggested that greater priority should be given to improving healthcare plans to mitigate HCWs' PTSD symptoms and improve their resilience trait.

### **Keywords**

Posttraumatic stress disorder; resilience; healthcare workers; COVID-19 pandemic; Vietnam

## **1. Introduction**

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), has created an unprecedented global health crisis. Since COVID-19 was declared a pandemic by the World Health Organization (WHO), it has caused over 771 million infections and nearly 7 million fatalities as of October 2023 [1, 2]. Consequently, the COVID-19 pandemic has presented numerous challenges for healthcare systems worldwide, including a significant strain on healthcare workers (HCWs) who were at the forefront of the response to the virus. The nature of HCWs, involving direct interaction with infected individuals, exposed them to a higher risk of virus exposure and elevated stress levels, potentially leading to posttraumatic stress disorder (PTSD) [3].

PTSD is a severe mental health condition that can develop after exposure to a traumatic event, such as the COVID-19 pandemic [4]. Previous studies have found that HCWs experienced high stress, anxiety, and burnout levels during the pandemic [5-7], notably higher than the rates observed in the general population [8, 9]. In addition, it was also indicated that HCWs who worked on the frontline during the COVID-19 pandemic had higher rates of depression, anxiety, and PTSD compared with those who did not work during the pandemic [10, 11]. Nonetheless, a multitude of characteristics has been noted as potential risk factors for PTSD in HCWs, including being female, being nurses [11], having high anxiety and depression symptoms [12], and directly caring for COVID-19 patients [13]. Furthermore, a higher risk of PTSD among HCWs has also been linked to factors related to the workplace, such as limited access to personal protective equipment (PPE) and suspected or confirmed COVID-19 [14].

Vietnam has experienced four waves of the COVID-19 pandemic [15]. As Vietnam steadily recovers from the pandemic, it is essential to understand the long-term psychological impacts of

COVID-19 and how resilience may affect an individual's ability to overcome these challenges. Assessing the resilience capacity of HCWs is one potential solution to address this issue [16, 17]. Resilience is a critical factor influencing individuals' ability to manage stress and maintain mental health [18]. It can be defined as the aptitude to efficiently confront various threats and the self-assured belief that one can overcome tensions, apply effective coping strategies, sustain emotional stability, and utilize individual characteristics to recover from stressful events [18].

Resilience has been conceptualized in different ways and assessed by various tools, including the Connor-Davidson Resilience Scale (CD-RISC) [19] and the Brief Resilience Scale (BRS) [20]. While the CD-RISC captures a multidimensional aspect of resilience, examining how an individual's internal, social, and environmental resources can help them manage stress and adversity, the BRS captures a unidimensional aspect of strength, revolving around an individual's ability to bounce back or recover from stress [19, 20]. However, for this study's context, the BRS's concise nature and focus on immediate resilience made it a more suitable tool for this study, offering a clear and direct assessment of stress recovery abilities among participants facing the hardships of the COVID-19 crisis. There have been many studies that indicated the protective role of resilience against PTSD among HCWs worldwide during the COVID-19 pandemic [21-23]. Among Italian medical staff and emergency workers, it is suggested that HCWs could reduce their stress levels as well as the intrusive aspects of trauma by stopping themselves from having negative thoughts and emotions [21]. Among Mexican HCWs, receiving resilience training regularly and allowing HCWs to take frequent breaks regarding resting physically and emotionally acted as buffers against PTSD [22].

Additionally, among Chinese HCWs, a high total psychological resilience score was considered a protective factor for PTSD [23]. Although many studies worldwide have looked at the resilience ability of HCWs during COVID-19, not much research examines Vietnamese frontline HCWs' resilience to PTSD. A previous cross-sectional study did mention Vietnamese HCWs' resilience capacity but mainly discussed its negative impact on depression, anxiety, and stress of HCWs during the fourth wave of COVID-19 [24]. Given the limited research on these topics, this study aimed to examine the association between resilience and some other factors with possible PTSD symptoms among Vietnamese HCWs during the COVID-19 pandemic.

## **2. Materials and Methods**

### **2.1 Study Design**

This study was a secondary data analysis from the project entitled "*Evaluation and Forecasting of Human Health Resources to Respond to COVID-19 in Vietnam between 2021 and 2022 Effectively*". The Ministry of Health assigned the ministerial-level project to Hanoi Medical School to assess human resources needs for epidemic prevention and control in Vietnam, particularly during the COVID-19 pandemic. The project was a cross-sectional study using mixed methods, including qualitative and quantitative research, collecting a part of the mental health data of HCWs working at several medical and training facilities in 7 provinces in Vietnam. The provinces were Hanoi, Bac Ninh, Bac Giang, Nghe An, Dak Lak, Binh Duong, and Kien Giang, which were seriously affected by the COVID-19 pandemic.

The present study utilized baseline data from this investigation to evaluate HCWs' mental well-being, specifically about possible symptoms of PTSD and factors related to possible PTSD symptoms.

The research project was approved by the Scientific Committee Board School of Preventive Medicine and Public Health, Hanoi Medical University (No 756/QĐ-ĐHYHN). After a clear explanation of the survey, written informed consent was obtained from all participants. Respondents could refuse to participate in and withdraw from the interview at any time. Confidentiality and data security were assured using codes of participant information, and secured storage was prepared for both paper questionnaires and electronic datasets.

## **2.2 Study Setting**

The study was conducted across the community, district health centers, and provincial hospitals in Vietnam's seven key provinces/cities, including Hanoi, Bac Ninh, Bac Giang, Nghe An, Dak Lak, Binh Duong, and Kien Giang.

## **2.3 Participants and Procedures**

### **2.3.1 Study Sample**

The study sample included all HCWs directly engaged in clinical activities of diagnosing, treating, or providing care to suspected/confirmed COVID-19 patients within the study setting in 2021. The frontline HCWs were selected based on the following criteria: (1) directly participated in epidemic prevention and control for patients infected with COVID-19 in selected medical facilities; (2) agreed to participate in the study and provided informed consent.

### **2.3.2 Sample Size**

With a 95% confidence interval, a prevalence of possible PTSD symptoms among HCWs was estimated at 22.6% [25], with a precision of 5% and a design effect of 2.0. Based on these parameters, a sample size of 538 was calculated to address the study objectives sufficiently. Adjusting for 15% non-response, the final sample size was 632. Data was successfully collected from 763 respondents.

### **2.3.3 Study Procedures**

The project used the multi-stage sampling method to select the study setting. There were three steps. In the first step, the project chosen purposefully seven key provinces/cities (Binh Duong, Kien Giang, Dak Lak, Bac Giang, Bac Ninh, Hanoi, Nghe An) that were severely affected during the COVID-19 pandemic. Regarding step 2, two districts were randomly selected in each province, followed by the selection of provincial/general hospitals and Centers for Disease Control (CDCs). In addition, three communes were randomly chosen within each district, and the district health centers were purposefully selected for the research objective. In the final step, participants were recruited through lists of HCWs who participated in COVID-19 prevention and control activities between 2021 and 2022. These lists were provided by the Department of Personnel/General Planning of each medical facility.

## **2.4 Study Questionnaires**

Data were collected using a structured interview questionnaire. The research assistants administered the survey. There were three parts to the study. The first part was the participants' socio-demographic characteristics, PPE factors (personal protective equipment), and COVID-19 concerns. Socio-demographic characteristics included age (by years); sex; marital status (single/divorced/widowed, married/lived cohabitant); educational level (college and below, university and above); profession (doctor, nurse, assistant doctor, and others); work experience ( $\leq 10$  years and  $>10$  years).

PPE factors include asking the HCWs whether or not they have adequate personal protective equipment (PPE) training, adequate PPE availability, and reused PPE.

With regards to COVID-19 concerns, the HCWs were asked whether or not they were worried about being infected with COVID-19, worried about lacking PPE, concerned about an uncontrollable pandemic, felt lonely with being isolated from family, suspected or confirmed with COVID-19 during the pandemic, and had a family member(s) being treated in ICU or dead due to COVID-19.

The second and third parts were PTSD symptoms and resilience traits. We used the Impact of Event Scale-Revised (IES-R) to measure PTSD and the Brief Resilience Scale (BRS) to measure the resilience trait of HCWs.

### **2.4.1 The Impact of Event Scale-Revised (IES-R)**

The 22-item Impact of Event Scale-Revised (IES-R) was used to assess symptoms of PTSD, which is a revised version of the older 15-item IES 1. Items are rated on a 5-point scale ranging from 0 ("not at all") to 4 ("extremely"). The IES-R yields a total score (0-88), and subscale scores can also be calculated as Intrusion, Avoidance, and Hyperarousal. The IES-R has been previously verified for use among Vietnamese and has shown to have high reliability/internal consistency (Cronbach's alpha = 0.96) [26]. A cut-off score of 24 and above was considered "possible PTSD symptoms" [25, 27]. The study divided the participants into two groups:

- Have no possible PTSD symptoms: Participants scored less than 24 out of 88 points on the IES-R scale. This group is considered to have no significant concerns regarding mental health.
- Have possible PTSD symptoms: Participants scoring 24 or more out of 88 points on the IES-R scale. This group is considered to have mental health concerns that warrant attention, though they have not received an official diagnosis of stress disorder.

### **2.4.2 The Brief Resilience Scale (BRS)**

The Brief Resilience Scale (BRS) was created to assess the ability to bounce back or recover from stress. The BRS assesses and measures resilience regarding how quickly one adapts to stress, recovers from it, resists disease, and thrives in adversity. There are six items on the scale. The score range on the BRS is from 1 (strongly disagree) to 5 (strongly agree) 5, with a total score ranging from 0-60. The Brief Resilience Scale (BRS) was developed and tested with Vietnamese HCWs, and the BRS-VN has acceptable reliability (Cronbach's alpha = 0.87) [28].

## 2.5 Data Analysis

Categorical variables for socio-demographic, PPE factors, and COVID-19 concerns variables were summarized as percentages and compared between the study outcome group (have possible PTSD symptoms and have no possible PTSD symptoms) using the Chi-square or Fisher's exact test. Continuous variables were summarized as medians and interquartile ranges and compared using the Mann-Whitney-Wilcoxon tests. Variables with a p-value < 0.2 in the bivariate analysis were included in the multivariate logistic regression models with outcome (having symptoms of possible PTSD). The model demonstrated reasonably practical predictive performance with an area under the curve of approximately 0.72, and the Hosmer-Lemeshow goodness-of-fit statistic produced a p-value greater than 0.05, indicating a good fit of the model to the data. Data was performed using the STATA 14.2 statistical software package.

## 3. Results

### 3.1 Socio-Demographic Characteristics, PPE Factors, and COVID-19 Concerns of the Participants

763 HCWs completed the questionnaires and were included in this study. The demographic characteristics of HCWs included 15.9% of participants having possible PTSD symptoms; two-thirds were female, with a median age of 34 (IQR: 30-40). Regarding marital status, the prevalence of possible PTSD symptoms was 80.2% for HCWs who are married/live cohabitant and 19.8% for HCWs who are single/divorced/widowed. Regarding educational status, 57.9% of participants with a university degree and above and 42.1% of those with a college degree and below reported having possible PTSD symptoms. Among those surveyed, the prevalence of possible PTSD symptoms was seen in 40.5% of HCWs who worked at the provincial level of health systems, followed by 29.8% and 29.7% of participants who worked at the district and commune level of healthcare establishment, were shown to have possible PTSD symptoms. Regarding the participants' professional status, a substantial number of HCWs were nurses (45.5%), followed by 28.1% of doctors, and 11.6% of assistant doctors reported having possible PTSD symptoms. In addition, the prevalence of possible PTSD symptoms was 50.4% when HCWs had worked experience for more than ten years and nearly half when HCWs had worked for less than ten years (Table 1).

**Table 1** Socio-demographic characteristics, work-related factors, and COVID-19 concerns of the participants (N = 763)\*.

	Total n (%)	Possible PTSD symptoms		p-value
		No (n = 642)	Yes (n = 121)	
<b>Socio-demographic characteristics</b>				
Age (years), Median (IQR)	34 (30-40)	34 (30-40)	34 (30-39)	0.31 <sup>a</sup>
Sex				
Male	279 (36.6)	242 (37.7)	37 (30.6)	0.24
Female	481 (66.0)	397 (61.8)	84 (69.4)	

<b>Marital status</b>				
Single/divorced/widowed	154 (20.2)	130 (20.2)	24 (19.8)	0.83
Married/lived cohabitant	609 (79.8)	512 (79.8)	97 (80.2)	
<b>Educational level</b>				
College and below	338 (44.3)	287 (44.7)	51 (42.1)	0.68
University and above	424 (55.6)	354 (55.1)	70 (57.9)	
<b>Health system levels</b>				
Commune	203 (26.6)	169 (26.0)	36 (29.7)	0.69
District	240 (31.5)	204 (31.8)	36 (29.8)	
Provincial	320 (41.9)	271 (42.2)	49 (40.5)	
<b>Profession</b>				
Doctor	235 (30.8)	201 (31.3)	34 (28.1)	0.63
Nurse	349 (45.7)	294 (45.8)	55 (45.5)	
Assistant Doctor	91 (11.9)	77 (12.0)	14 (11.6)	
Others	88 (11.5)	70 (10.9)	18 (14.9)	
<b>Work experience</b>				
≤10 years	364 (47.7)	309 (47.6)	60 (49.6)	0.74
>10 years	398 (52.2)	337 (52.4)	61 (50.4)	
<b>PPE factors</b>				
<b>Adequate PPE training</b>				
No	29 (3.8)	24 (3.7)	5 (4.1)	0.80
Yes	734 (96.2)	618 (96.3)	116(95.9)	
<b>Adequate PPE availability</b>				
No	63 (8.3)	50 (7.8)	13 (10.7)	0.41
Yes	695 (91.1)	587(91.4)	108(89.3)	
<b>Reused PPE</b>				
No	540 (70.8)	464 (72.3)	76 (62.8)	0.09
Yes	220 (28.8)	175 (27.3)	45 (37.2)	
<b>COVID-19 concerns</b>				
<b>Worried about being infected with COVID-19</b>				
No	172 (22.5)	154 (24.0)	18 (14.9)	<b>0.047</b>
Yes	587 (76.9)	485 (75.6)	102(84.3)	
<b>Worried about lacking PPE</b>				
No	388 (50.9)	341 (53.1)	47 (38.8)	<b>0.004</b>
Yes	375 (49.1)	301 (46.9)	74 (61.2)	
<b>Worried about an uncontrollable pandemic</b>				
No	147 (19.3)	132 (20.6)	15 (12.4)	<b>0.037</b>
Yes	616 (80.7)	510 (79.4)	106(87.6)	
<b>Felt lonely about being isolated from family</b>				
No	305 (40.0)	269 (41.9)	36 (29.8)	<b>0.012</b>
Yes	458 (60.0)	373 (58.1)	85 (70.2)	

**Suspected or confirmed of COVID-19 during the pandemic**

No	176 (23.1)	150 (23.4)	26 (21.5)	0.65
Yes	587 (76.9)	492 (76.6)	95 (78.5)	

**Family member(s) being treated in ICU or dead due to COVID-19.**

No	724 (94.9)	611 (95.2)	113(93.4)	0.41
Yes	39 (5.1)	31 (4.8)	8 (6.6)	

**Resilience (Total BRS score)**

22	22	19
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**Median, IQR**

(19-24)	(20-24)	(17-22)
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**<0.001<sup>a</sup>**

(\*) The total per row is sometimes slightly less than 763 due to missing values. However, less than 5-10% of the participants had some missing values for these variables;

PPE: Personal protective equipment; IQR: Interquartile range; BRS: Brief Resilience Scale;

Numbers printed in bold are statistically significant, p-value < 0.05;

Chi-square test or Fisher's exact test;

a: Mann-Whitney-Wilcoxon test.

In terms of PPE factors, the results showed possible PTSD symptoms prevalence in a large amount of the HCWs who received adequate PPE (95.9%) and adequate PPE availability (89.3%), and in more than a third of HCWs reported reusing PPE during the pandemic. Regarding COVID-19 concerns, the prevalence of possible PTSD symptoms was seen in most HCWs who were worried about being infected with the COVID-19 virus, worried about an uncontrollable pandemic, and feeling lonely about being isolated from their family (84.3%, 87.6%, and 70.2%, respectively). At the same time, approximately two-thirds of the participants worried about lacking PPE and showed possible PTSD symptoms. During the pandemic, the prevalence of possible PTSD symptoms was found in a significant proportion of HCWs who were suspected or confirmed of COVID-19. In contrast, the minors, accounting for 6.6%, corresponded to those with a family member(s) being treated in the ICU or dead due to COVID-19 and showed possible symptoms of PTSD (Table 1).

Because the cut-off score for IES-R was 24 and above, 15.9% of HCWs reported having possible PTSD symptoms. Based on the total BRS score, the median resilience score of the HCWs was 22, with IQR 19-24, which indicates a moderate level of resilience (Table 1).

**3.2 Association Between Related Factors, Resilience, and Possible PTSD Symptoms**

It can be seen that low levels of resilience were significantly associated with possible PTSD symptoms. In contrast, HCWs meeting the criteria for possible PTSD symptoms on the IES-R were more likely to be worried about being infected with COVID-19, worried about lacking PPE, concerned about an uncontrollable pandemic, and felt lonely with being isolated from their family members (Table 1).

HCWs who reused PPE (OR = 1.58, 95% CI: 1.03-2.44), those who worried about lacking PPE (OR = 1.59, 95% CI: 1.02-2.47), and those who had high resilience score were less likely to have possible symptoms of PTSD than respective comparison groups (Table 2).



**Table 2** Logistic Regression Model for Posttraumatic Stress Disorder.

Variables	Row N	% reported having possible PTSD symptoms	OR (95% CI)	p-value
<b>Reused PPE</b>				
No	540	14.1	Ref	
Yes	220	20.5	1.58 (1.03-2.44)	<b>0.036</b>
<b>Worried about being infected with COVID-19</b>				
No	172	10.5	Ref	
Yes	587	17.4	1.18 (0.65-2.13)	0.59
<b>Worried about lacking PPE</b>				
No	388	12.1	Ref	
Yes	375	19.7	1.59 (1.02-2.47)	<b>0.040</b>
<b>Worried about an uncontrollable pandemic</b>				
No	147	10.2	Ref	
Yes	616	17.2	1.11 (0.59-2.11)	0.75
<b>Feeling lonely with being isolated from family</b>				
No	305	11.8	Ref	
Yes	458	18.6	1.25 (0.79-1.96)	0.34
<b>Resilience (Total BRS score)</b>	763	15.9	0.81 (0.76-0.86)	<b>&lt;0.001</b>

Numbers printed in bold are statistically significant, p-value < 0.05

A higher resilience score was associated with a decreased risk of developing possible PTSD symptoms (OR: 0.81); 95%CI: 0.76-0.86 (Table 2).

#### 4. Discussion

The study aimed to investigate the relationship between resilience and possible PTSD symptoms of frontline HCWs during COVID-19 in Vietnam. Furthermore, this study aimed to identify associated factors of possible PTSD symptoms. These findings revealed that the presence of possible PTSD symptoms was significantly associated with heightened worries about COVID-19 infection, concerns regarding inadequate PPE, anxiety about the uncontrollable nature of the pandemic, and feelings of loneliness due to isolation from family members among HCWs. It is also shown that lower resilience levels were linked to higher possible symptoms of PTSD.

##### 4.1 Prevalence of Possible PTSD Symptoms Among HCWs

In our study, possible PTSD symptoms were found in 15.9% of HCWs who worked on the frontline during the pandemic. This figure was considerably lower than previously reported PTSD prevalence (21.2-71.5) [25, 27, 29]. In a cross-sectional study conducted at COVID-19 field hospitals in Ho Chi

Minh City, Vietnam, the observed prevalence of PTSD was 21.2% [27]. Although our research and the one conducted by Tran et al. [27] shared similar traits in terms of the study population (frontline HCWs) and methods for diagnosing PTSD symptoms (IES-R), critical differences in sample size and location could account for the variation in the results. The study by Tran et al. focused on 543 HCWs in COVID-19 field hospitals in Ho Chi Minh City, Vietnam, while our study covered a larger sample from various locations across the country. In other words, the difference in sample size and geographic representation might have influenced the overall prevalence rates of PTSD in the respective studies. Besides, the significant difference in possible PTSD prevalence between our research and other studies [25, 29] could be explained by the study's timeframe. In our study, we conducted the research during the fourth wave of the COVID-19 pandemic in Vietnam, nearly two years after the initial outbreak. This timeframe allowed us to examine the long-term adaptive reactions of the Vietnamese health system, especially frontline HCWs, in their fight against COVID-19. Throughout these two years, the healthcare workforce gained substantial experience, as some had been involved in the battle against the virus since the first wave. This accumulated experience may have influenced the prevalence of possible PTSD symptoms among HCWs during the fourth wave. Therefore, it is essential to acknowledge these contextual factors because the varying experiences and levels of preparedness might have contributed to the observed differences in PTSD prevalence among frontline HCWs during different stages of the COVID-19 pandemic.

#### ***4.2 Association Between Associated Factors and Possible PTSD Symptoms***

It is revealed that HCWs conveyed several concerns regarding the COVID-19 situation. They were worried about being infected with COVID-19, lacking PPE, and an uncontrollable pandemic and felt lonely with being isolated from family. Based on the results, these concerns were reported to be significantly associated with developing possible PTSD symptoms. These findings were similar to a cross-sectional study of the medical workforce in a Chinese hospital during COVID-19 [30]. Several factors, including working in the isolation ward, fear of infection, lack of protective equipment, the epidemic would never be controlled, and loneliness from being separated from loved ones, all contributed to the expansion of psychological pressure [30]. Similarly, a separate cross-sectional study conducted among 354 HCWs in Taiwan found that variables such as worry about an uncontrollable pandemic and social isolation that can lead to feelings of loneliness were significantly associated with psychological distress among HCWs [31]. These consistent findings across different studies indicate the need to address the psychological well-being of HCWs during the pandemic. Providing adequate mental health support, ensuring access to sufficient protective equipment, and fostering social connections and support systems might play essential roles in mitigating the psychological impact of COVID-19 on frontline HCWs. Furthermore, understanding and recognizing these significant concerns can aid in developing targeted interventions and support strategies tailored to the specific needs of HCWs, ultimately promoting their mental resilience and well-being as they battle against the pandemic or future challenging situations.

Despite not showing a significant association in the bivariate analysis, reused personal protective equipment (PPE) was found to be positively associated with the development of possible PTSD symptoms after adjusting other variables in the multiple logistic regression. In agreement with this finding, data from the study in the UK indicated that pressure to reuse PPE and failure of the workplace to limit risk via preparedness are two examples of preventable workplace issues that

increase the likelihood of having high PTSD symptoms [32]. Besides, HCWs who were worried about lacking PPE have been reported to have higher risks of developing PTSD symptoms. Similar findings have been reported in other studies, where concern over a shortage of personal protective equipment (like masks and face shields) during the pandemic is associated with a higher likelihood of experiencing PTSD symptoms [33, 34]. These findings underline once more how crucial it is to prepare for and prioritize the mental health of HCWs properly. As HCWs continue to fight valiantly against the pandemic and any potential future challenging situations, providing thorough mental health support, ensuring access to adequate protective equipment, and fostering a supportive work environment can significantly contribute to promoting mental resilience and general well-being.

#### **4.3 Association Between Resilience and Possible PTSD Symptoms**

In the current study, resilience scores were continuously analyzed. The median BRS score was 22, higher than in previous studies (3.3-19) [35-37]. An observational study conducted at an Indonesian general hospital found that among the 61 participants, 59% experienced moderate to severe anxiety, while 83.62% exhibited normal to high levels of resilience. Accordingly, the median score of BRS was 3.67 [37]. Based on the observational study carried out at a Medical Center in Turkey, it was revealed that among the 676 nurses who participated in the study, the median BRS score was 19 [35]. The observed variations in resilience scores between our study and previous results can be attributed to several critical factors.

Regarding the difference between the time frame of data collection, our study was conducted in 2021, and the Indonesian research was carried out in 2020. The evolving nature of the pandemic and the changing healthcare landscape during this period may have influenced healthcare workers' resilience levels. Furthermore, cultural influences could contribute to the observed differences in resilience scores. Divergent cultural norms, coping strategies, and social support systems between regions might impact how HCWs in Turkey respond to the stress and challenges presented by the pandemic.

The results of the logistic regression suggested that there was a negative relationship between resilience and possible PTSD symptoms. In other words, HCWs with higher levels of stability had a greater capacity to deal with stressors and tended to be less susceptible to developing possible symptoms of PTSD. The study by Zhang et al. aimed to investigate the relationship between aiding Wuhan experience and adverse mental health outcomes among nurses one year after the COVID-19 outbreak in China [38]. While a considerable proportion of participants in both groups reported symptoms of depression, anxiety, and PTSD, aiding Wuhan nurses were more likely to suffer from insomnia. However, the multivariable logistic regression analysis revealed no significant association between helping Wuhan's experience and depression, anxiety, insomnia, PTSD, or resilience, although resilience was found to have a negative correlation with depression, anxiety, insomnia, and PTSD [38].

Similarly, two other research have demonstrated that nurses with higher levels of resilience exhibit reduced susceptibility to stress-related disorders and are more likely to maintain their overall well-being [39, 40]. Our study's findings align with existing literature, emphasizing the significance of psychological empowerment for HCWs, particularly regarding resilience. Resilience, a fundamental trait of an individual's character, holds significant importance in effectively coping with challenging situations, resulting in positive outcomes [41]. By carefully assessing and

strengthening nurses' resilience through customized and appropriate training and interventions, it becomes feasible to alleviate the psychological impact of workplace stressors and even possible symptoms of PTSD, thereby empowering nurses and enhancing their self-efficacy.

#### **4.4 Limitations**

Our study has some limitations. Firstly, it is a cross-sectional study, so we cannot establish causal relationships. Secondly, our study focused on the COVID-19 pandemic in Vietnam in 2021, but the data was collected in 2022. The reliance on data obtained a year after the events of interest could result in recall bias as individuals' memories of details of the pandemic may have been impacted or become distorted with time.

#### **5. Conclusions**

In conclusion, this study offers a valuable understanding of the relationship between possible PTSD symptoms and resilience among frontline HCWs during the COVID-19 pandemic. Therefore, these findings have important implications for developing interventions to enhance HCWs' mental health and strength after the pandemic. It is recommended that healthcare facilities should give their HCWs' mental health and well-being a top priority by offering training, emotional support, and activities that improve coping and motivational skills.

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#### **Author Contributions**

Conceptualization, Linh Nguyen, Giang Le and Van Thi Hai Hoang; Data curation, Dang Huong; Formal analysis, Linh Nguyen and Dang Huong; Investigation, Khoa Le and Dang Huong; Methodology, Linh Nguyen, Giang Le and Van Thi Hai Hoang; Project administration, Khanh Do and Hao Tran; Supervision, Van Thi Hai Hoang; Validation, Linh Nguyen and Giang Le; Visualization, Linh Nguyen and Dang Huong; Writing – original draft, Linh Nguyen and Khoa Le; Writing – review & editing, Linh Nguyen, Khoa Le and Giang Le.

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#### **Competing Interests**

The authors have declared that no competing interests exist.

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