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Original Article

Post-Traumatic Stress Disorder Among Critical Care Nurses Caring for COVID-19 Patients

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1. ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) pandemic has significantly impacted global health, with a substantial number of severe cases requiring admission to isolated intensive care units (ICUs). This unprecedented situation exposed critical care nurses (CCNs) to a highly stressful traumatic environment, placing them at increased risk for developing post-traumatic stress disorder (PTSD). Early identification and intervention for PTSD are crucial to mitigate the negative consequences for nurses' well-being, job performance, and overall quality of life. **Aim:** This study aimed to assess post-traumatic stress disorder among CCNs caring for COVID-19 patients. **Method:** A descriptive cross-sectional design with a convenience sample of 109 CCNs work in 13 isolated ICUs from three hospitals in Egypt which are designated to take care of Corona patients. A post-traumatic stress disorder assessment questionnaire was used to collect data for this study. **Results:** The results showed that 23.9% of participant nurses exhibited provisional PTSD with significantly higher scores ($P < 0.05$) across all PTSD symptom domains including re-experience, avoidance, negative alterations in cognition and mood, and the hyperarousal domain. The findings also revealed that extra overtime hours within the ICU, shortage of personal protective equipment, history, and number of exposure times to COVID-19 ($p = 0.021, 0.015, 0.017, < 0.001$ respectively) were the most significant work-related risk factors of PTSD. **Conclusion:** CCNs suffered from provisional PTSD to some extent. All work-related factors should be controlled. **Recommendations:** Implementation of a comprehensive health education program could be a valuable strategy to equip nurses with the knowledge and skills necessary to manage PTSD and cope with potentially traumatic experiences.

Keywords: *Post-Traumatic Stress Disorder, Critical Care Nurses, COVID-19 Patients*

2. Introduction

Coronavirus disease 2019 (COVID-19) is a viral pneumonia caused by severe acute respiratory syndrome coronavirus 2 that was detected in Wuhan, China by the end of December 2019. This virus is extremely infectious and has invaded the world **(Dousari, Moghadam, & Satarzadeh, 2020)**. The rapidly increasing cases of this disease forced the World Health Organization (WHO) to announce that COVID-19 is a global pandemic **(World Health Organization, 2020b)**. By December 2023, there have been over 772 million confirmed cases of COVID-19, including seven million deaths worldwide **(WHO, 2023b)**.

The novel coronavirus was a strange virus with varying symptoms, effects, and complications. Some affected persons presented with mild symptoms, while others suffered from serious complications such as hypoxemia, pneumonia, acute respiratory distress syndrome, respiratory failure, and even death **(Li & Ma, 2020)**. The overwhelming number of COVID-19 cases that required intensive care units (ICUs) admission has caused a significant burden on hospitals and healthcare workers (HCWs). There is insufficient equipment, crisis preparedness, high incidence of infection, stress, and work burnout **(Kumar & Al Khodor, 2020; Shang et al., 2020)**.

Due to the nature of the critical care nurses' (CCNs) work, they usually spend significant time alongside the COVID-19 patients in ICUs and provide direct care to them. Therefore, they are frequently trying to fulfill high demands, workloads, and complex tasks to provide specialized care to these patients **(Ageel & Shbeer, 2022; Grealy, Johansson, & Coyer, 2019)**. Also,

they are the first responders who can effectively translate the comprehensive, person-centered approach into services and relationships across critical care settings **(Rosa, Ferrell, & Wiencek, 2020)**.\

There are many challenges facing CCNs during the COVID-19 pandemic including daily contact with the infected patients, prolonged exposure to infections among staff, and poor prognosis of patients' health **(Kader et al., 2021)**. They also have great responsibilities toward their patients, even with limited supplies and equipment **(Kennedy, 2021)**. According to the recommendation of the International Council of Nurses during the COVID-19 pandemic, it emphasized expanding the capacity of ICUs which increased working hours and rotating shifts of HCWs, especially CCNs **(Buchan & Catton, 2020)**.

Intensive Care Units are a high-risk environment for infection, especially during disease outbreaks due to more special care such as mechanical ventilation. Moreover, CCNs conduct many invasive procedures and aerosol-generating procedures which increase the risk of transmission of COVID-19 **(Pandian et al., 2020)**. Additionally, CCNs are facing many difficult ethical decisions regarding patient care priorities while operating under severe time constraints, especially during COVID-19. Owing to the limited number of ICU beds and inadequate resources in many countries, ICU admission priority is based on disease severity **(Robert et al., 2020)**. Also, the restricted visitation policy, safety and quality of care, and additional tasks create more burdens on them **(Morley, Copley, Field, Zelinsky, & Albert, 2022)**.

Critical care nurses are exposed to many stressors in ICUs during the COVID-19 pandemic. It may be due to the infection's spread and its transmission to their families, feelings of being isolated, absence of family, inadequate leadership support, and lack of evidence-based treatment **(Guttormson et al., 2022a)**. Moreover, the COVID-19 pandemic is a catastrophic stressor that involves serious injury or threatened death so it is a traumatic event **(Deltour, Poujol, & Laurent, 2023; Kaubisch, Reck, Tettenborn, & Woll, 2022)**. All these stressors put the CCNs under high levels of stress and pressure which predispose them to post-traumatic stress disorder (PTSD) **(Li, Tokac, Werner, Fish, & Lou, 2022)**.

Post-traumatic stress disorder is defined as a maladaptive condition that may be developed as a response to traumatic, catastrophic, horrifying, and life-threatening events **(Ressler et al., 2022; Simon et al., 2021)**. It is characterized by the persistence of intense reactions toward a traumatic event, altered mood, a sense of threat, disturbed sleep, and hypervigilance **(Shalev, Liberzon, & Marmar, 2017)**. A previous study of 21 countries in one year, estimated that 3.6% of the world population has suffered from PTSD **(WHO, 2013)**. About 5 out of every 100 adults in the U.S. have PTSD at some point in their lives. In 2020, about 13 million Americans had PTSD **(National Center for PTSD, 2023a)**.

There are many negative effects of PTSD on CCNs such as absenteeism, reduced performance, job dissatisfaction, decreased quality of care, and burnout **(Levi, Patrician, Vance, Montgomery, & Moss, 2021)**. Additionally, educational impairment across the lifespan can be present **(Vilaplana-Pérez et al., 2020)**. It can also lead to more destructive consequences such as anxiety and persistent physical diseases which endanger humans' lives **(Huang et al., 2022)**. Relationship problems that may lead to suicide attempts can be seen too **(National Center for PTSD, 2023b)**.

2.1 Significance of the Study

In Egypt, there are scarce studies that assessed PTSD symptoms among CCNs who deal with COVID-19 patients. One study that assessed the prevalence of psychological distress and PTSD among nurses during the COVID-19 epidemic in Egypt reported that 68.9% of the participants suffered from PTSD **(Taha & Abd ELhay, 2020)**. Another study conducted by **Abd Elnaeem, Abdelhafez,** and **Tolba (2021)** that assessed the PTSD levels among CCNs during COVID-19, reported that 47.5% had a moderate level of PTSD symptoms and 39% had a severe level.

The previous two studies conducted during the peak of the pandemic among CCNs and the authors revealed that PTSD incidence was high. Additionally, each one was conducted in only one hospital. Therefore, the current study conducted at the end of the pandemic outbreak included the three largest isolation hospitals (in terms of the number of CCNs) in Mansoura city. PTSD may continue throughout life if it isn't screened and managed effectively so it should be assessed more than once, especially during crisis.

2.2 Aim of the Study

The aim of this study is to assess post-traumatic stress disorder among critical care nurses caring for COVID-19 patients.

2.3 Research Questions

To fulfill the aim of this study, the following research questions are formulated:

- **Q1:** What is the prevalence of post-traumatic stress disorder among CCNs caring for COVID-19 patients?
- **Q2:** What are the common symptoms of post-traumatic stress disorder among CCNs caring for COVID-19 patients?
- **Q3:** What are the factors associated with post-traumatic stress disorder among CCNs caring for COVID-19 patients?

3. Method

3.1 Design

This study used a descriptive cross-sectional design used in the current study.

3.2 Setting

This study was conducted in 13 isolated ICUs that were located in various hospitals throughout Mansoura city. These hospitals are Critical Care and Convalescence Hospital which includes nine ICUs with 45 beds, Chest Disease Hospital which includes two ICUs with 33 beds, and New Mansoura General Hospital which includes two ICUs with 4 beds. These units are designated to provide care to COVID-19 patients. Also, the units are well equipped with advanced technology such as mechanical ventilators, cardiac monitors, and suction machines, as well as adequate manpower and nursing staff, which are all essential for the management of COVID-19 patients. The nurse-patient ratio in the selected units is nearly 1:2 in all shifts.

3.3 Subjects

A convenience sample of 109 nurses working in the above-mentioned isolated ICUs (38 from the Critical Care and Convalescence hospital, 44 from Chest Disease Hospital, and 27 from New Mansoura General Hospital) had at least 6 months of working experience in the study setting. They must be involved in providing direct care for COVID-19 patients for at least a month and accepted to participate in this study. Nurses who had sleep disorders or psychiatric disorders before the COVID-19 pandemic were excluded.

3.4 Data Collection Tools

Data in the current study were collected using one tool.

Tool I. Post-Traumatic Stress Disorder Assessment Questionnaire

This tool assessed PTSD among critical care nurses caring for COVID-19 patients. It is comprised of two parts:

Part I. "Nurses' Demographic Characteristics and Work-Related Data"

This part was developed by the primary investigator (PI) after reviewing recent relevant literature **(Engelbrecht, Heunis, & Kigozi, 2021; Issa et al., 2021; Kabunga & Okalo, 2021; Kader et al., 2021; Kerai et al., 2017; Leng et al., 2021)**. It aimed to collect the participant's demographic characteristics such as gender, age, current marital status, educational level, and family history of psychological problems. Additionally, it aimed to cover the participant's work-related data such as hospital name, residence, years of working experience in ICU, chronic disease, transferring to ICU during COVID-19, shift duration, extra overtime, and shortage of personal protective equipment during the COVID-19 pandemic. Also, this part includes information about the participants' satisfactory income, attendance of any workshops, training programs, or conferences about COVID-19, history of exposure to COVID-19, number of exposure times to COVID-19, and death of relatives or colleagues from COVID-19.

Part II. "Post-Traumatic Stress Disorder Questionnaire"

This part was adopted from **Weathers et al. (2013)**. It was designed according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders, so it is called Post-Traumatic Stress Disorder Checklist- 5 (PCL-5). This part aimed to assess the presence of PTSD symptoms among the participants in the last month from the traumatic event occurrence. It consisted of 20 symptoms that were categorized into 4 main domains: the re-experiencing domain (5 symptoms), the avoidance domain (2 symptoms), the cognition or the mood alterations domain (7 symptoms), and the hyperarousal domain (6 symptoms).

Scoring system

Each item has been ranked using a five-point Likert scale ranging from 0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit and 4 = extremely. The sum of the 20 items ranges from 0 to 80. Those who got a score less than 33 were considered not to have PTSD while a score equal to or more than 33 is indicated for having PTSD **(Bassi, Negri, Fave, & Accardi, 2021; Liu et al., 2020; Pan et al., 2021)**.

3.5 Validity and Reliability of the Tool

The tool was tested for its content validity by a group of seven experts in the field of critical care nursing from the faculty of nursing at Mansoura University. Recommended modifications were made accordingly. The reliability of the tool was measured using Cronbach's alpha test and its value was 0.894 which indicates the high reliability of the tool. Part II of the data collection tool was translated into the Arabic language and the back-translation technique was used to ensure the validity of the translation. The reliability of the tool was measured using Cronbach's alpha test and its value was 0.894 which indicates the high reliability of the tool. According to **Blevins, Weathers, Davis, Witte,** and **Domino (2015)**, PCL-5 demonstrated strong internal consistency (α = .94) and test-retest reliability (r = .82) which indicated that it is a psychometrically sound measure of PTSD symptoms.

3.6 Pilot Study

A pilot study was conducted on 10% of the total sample (11 participant nurses) before starting the data collection to assess the objectivity, feasibility, clarity, and applicability of the tool. This group was excluded from the study.

3.7 Ethical Considerations

An ethical approval was obtained from the Research Ethics Committee of the Faculty of Nursing - Mansoura University and the certificate ethical number was P.0269. Written informed consent was obtained from the participants after providing them with details about the study's aim, nature, and benefits. Additionally, they were informed that their participation in the study was voluntary, and they had the right to accept or refuse to participate. They were also assured that their personal data would be kept confidential, their response would not be included in their annual evaluation, and they had the right to withdraw from the study at any stage without any responsibility.

3.8 Data Collection Process

Data were collected by the PI within 2 months in 2022. The PI introduced herself to the participant nurses. An initial assessment was carried out for all nurses to confirm that they met the inclusion criteria and were free from the exclusion criteria. The PI asked the participants to sign on the written consent forms with "I agree" without asking them to write their names on the data collection tools. The tools were distributed to all nurses who agreed to take part in the study. The PI allowed all participants to ask any questions and instructed them to answer all questions to avoid missing data. Data collection tools were collected from the participant nurses after 15-20 minutes. The PI revised all questionnaires for any forgotten data. The score of critical care nurses' PTSD was calculated through the predetermined scoring system.

3.9 Data Analysis

Data were coded and analyzed using the Statistical Package for Social Sciences program version 20.0. Categorical data were expressed as numbers and percentages. Furthermore, Continuous data were normally distributed and expressed as mean ± standard deviation (SD). The Chi-square test (X^2) was used for the comparison of variables with categorical data. The P-value for statistically significant was set at ≤ 0.050. The Cronbach's alpha value (internal consistency) of the tool was 0.894, which indicates the high reliability of the tool.

4. Results

Table 1 presents the demographic characteristics of the participant nurses. It showed that more than half of the participant nurses were females and their age ranged between 20 – < 30 years. Additionally, 61.47% of them were married. Regarding the educational level, nearly half of them had a bachelor's degree in nursing. The result also illustrated that the majority of the participant nurses did not have a family history of psychological problems.

Table 2 illustrates the work-related data of the participant nurses. It revealed that 40.37% of the participant nurses work in Chest Disease Hospital and 71.6% live in rural areas. As regard years of experience, it was found that 51.4% had worked in the ICU for a period between one and five years. No chronic disease was reported by 95.4% of participants. Regarding COVID-19 specific experiences, 67% of nurses indicated they were not transferred to isolated ICU during the pandemic. Shift duration showed that 65.1% worked 12-hour shifts, with a majority taking extra overtime hours throughout the pandemic.

Regarding resource availability, about half of the nurses did not experience a shortage of personal protective equipment (PPE) during the pandemic. The finding also revealed that 89.9% reported that their income was not satisfactory and 78% of nurses reported not attending any COVID-19-related workshops, training programs, or conferences. Moreover, 79.8% of the participant nurses were exposed to COVID-19 However, of those exposed, only 58.6% experienced a single

COVID-19 infection. About 68.8% did not experience loss of a colleague or relative due to COVID-19.

Figure 1 displays the participant nurses' score regarding the PTSD prevalence. The finding illustrated that 23.9.1% of the participant nurses had PTSD.

Table 3 depicts the scores of PTSD symptom domains among the participant nurses. The table revealed that nurses with provisional PTSD exhibited significantly higher scores in all symptom domains: re-experiencing, avoidance, negative alterations in cognition and mood, and hyperarousal compared to those without PTSD ($p < 0.001$). However, the greatest score differences were observed in the negative alterations in cognition and mood (12.50 [6.25]) and hyperarousal domains (11.00 [2.25]). These findings revealed that these specific symptom domains were the most pronounced among CCNs with provisional PTSD. Overall, the results demonstrated statistically significant differences across all PTSD domains between the participant nurses with provisional PTSD and those without.

Table 4 articulates the association between the work-related factors of the participant nurses and PTSD. It revealed that nurses who reported working extra overtime hours within the ICU showed a significantly higher risk of PTSD (92.3% vs. 30.1%, p=0.021) compared to those without extra overtime hours. Similarly, experiencing a shortage of PPE during caring for COVID-19 patients was significantly associated with PTSD (69.2% vs. 57.8%, p=0.015).

Additionally, Exposure to COVID-19 patients also appeared to be a contributing factor. Nurses with a history of exposure had a higher prevalence of PTSD (96.2% vs. 25.3%, p=0.017) compared to those without. This became even stronger when analyzing the frequency of exposure. Nurses exposed more frequently had a significantly higher prevalence of PTSD (p<0.001). Finally, there was no statistically significant association between the other work-related factors of the participant nurses and exposure to PTSD (P<0.05).

Table 1. Demographic Characteristics of the Participant Nurses

Variables	Participant Nurses n= 109	
	n	**%**
Gender		
• Male	46	42.2
• Female	63	**57.8**
Age (Years)		
• 20 – < 30 years	61	**56.0**
• 30 – < 40 years	48	44.0
Mean ±SD (28.5 ±5.5)		
Marital status		
• Single	38	34.86
• Married	67	**61.47**
• Divorced	4	3.67
Educational level		
• Diploma	11	10.1
• Technical nursing institute	43	39.4
• Bachelor	50	**45.9**
• Postgraduate studies	5	4.6
Family history of psychological problems		
• No	103	**94.5**
• Yes	6	5.5

N: Number ***%*:** percentages ***SD*:** Standard Deviation

Table 2. Work-Related Data of the Participant Nurses

Variables	Participant Nurses n= 109	
	n	**%**
Hospital name		
• Critical Care and Convalescence Hospital	38	34.86
• Chest Disease Hospital	44	**40.37**
• New Mansoura General Hospital	27	24.77
Residence		
• Rural	78	**71.6**
• Urban	31	28.4
Working experience in ICU (Years)		
• < 1	18	16.5
• 1 – < 5	56	**51.4**
• 5 – < 10	24	22.0
• ≥ 10	11	10.1
Chronic disease		
• No	104	**95.4**
• Yes	5	4.6
Transfered to ICU during COVID-19		
• No	73	**67.0**
• Yes	36	33.0
Shift duration (Hours)		
• 8	38	34.9
• 12	71	**65.1**
Extra overtime in ICU during COVID-19		
• No	27	24.8
• Yes	82	**75.2**
Shortage of the PPE during COVID-19		
• No	56	**51.4**
• Yes	53	48.6
Satisfactory income		
• No	98	**89.9**
• Yes	11	10.1
Participating in previous COVID-19 workshops, training programs, or conferences		
• No	85	**78.0**
• Yes	24	22.0
History of exposure to COVID-19		
• No	22	20.2
• Yes	87	**79.8**
If the answer is yes, how many times of exposure? (n=87)		
• Once	51	**58.6**
• Twice	27	31.0
• Three times	9	10.4
Colleagues or relatives died from COVID-19		
• No	75	**68.8**
• Yes	34	31.2

N: Number ***%:*** percentages ***ICU***: Intensive Care Unit ***PPE***: personal protective equipment ***COVID-19***: Coronavirus Disease- 2019.

Figure 1. Percentage Distribution of the Participant Nurses' PTSD Prevalence.

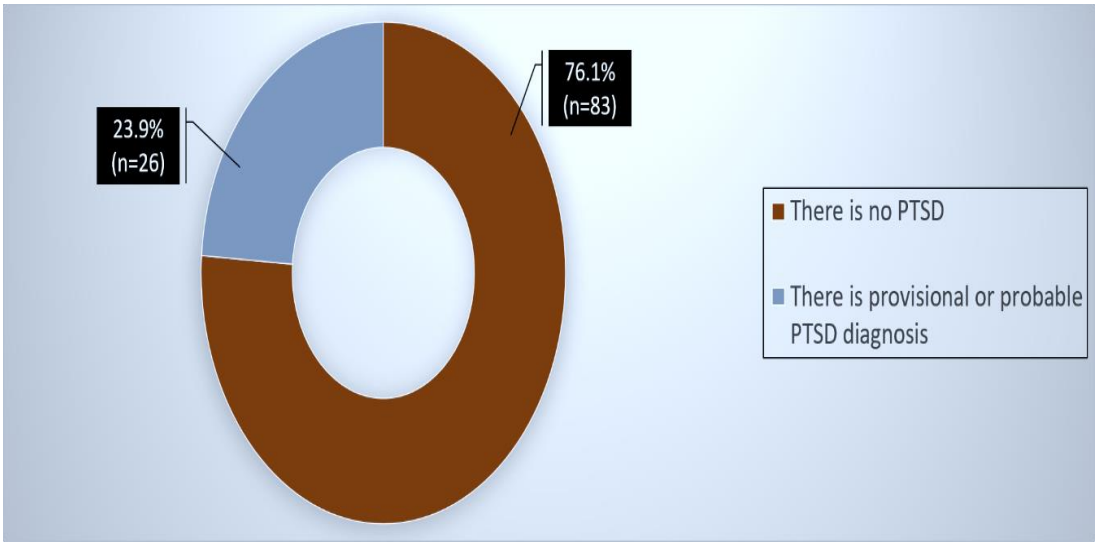

Table 3. The Scores of PTSD Symptom Domains Among the Participant Nurses.

	No PTSD	**Provisional PTSD diagnosis**	**Significance Test**
	Median [IQR]	**Median [IQR]**	**P**
Domains			
Re-experience	4.00 [6.00]	10.00 [4.50]	**<0.001****
Avoidance	2.00 [2.00]	5.00 [3.25]	**<0.001****
Negative alterations in cognition or mood	4.00 [5.00]	**12.50 [6.25]**	**<0.001****
Hyperarousal	4.00 [4.00]	**11.00 [2.25]**	**<0.001****
PLC-5 total score	16.00 [13.00]	36.00 [5.25]	**<0.001****

PTSD: post-traumatic stress disorder **IQR:** interquartile range **PCL-5:** post-traumatic stress disorder checklist - fifth edition ***P*-value** is statistically significant at $p < 0.05$.

Table 4. Association Between the Work- Related Factors of the Participant Nurses and Post-Traumatic Stress Disorder

	No PTSD (n=83)		**PTSD (n=26)**		**Significance Test**	
	n	**%**	**n**	**%**	**X^2**	***P***
Residence						
• Rural	58	69.9	20	76.9	0.483	0.487
• Urban	25	30.1	6	23.1		
Working experience in ICU (Years)						
• < 1	13	15.7	5	19.23	1.858	0.602
• 1 – < 5	43	51.8	13	50.0		
• 5 – < 10	17	20.5	7	26.92		
• > 10	10	12.0	1	3.85		
Chronic disease						
• No	81	97.6	23	88.5	3.770	0.052
• Yes	2	2.4	3	11.5		

transferred to ICU during COVID-19						
• No	58	69.9	15	57.7	1.329	0.249
• Yes	25	30.1	11	42.3		
Shift duration (Hours)						
• 8	30	36.1	8	30.8	0.252	0.616
• 12	53	63.9	18	69.2		
Extra overtime hours in ICU during COVID-19						
• No	25	30.1	2	7.7	5.344	**0.021***
• Yes	58	69.9	24	**92.3**		
Shortage of PPE during facing COVID-19						
• No	48	57.8	8	30.8	5.804	**0.015***
• Yes	35	42.2	18	**69.2**		
Satisfactory income						
• No	72	86.7	26	100.0	3.833	0.051
• Yes	11	13.3	0	0.0		
Previous COVID-19 workshops, training programs, or conferences						
• No	63	75.9	22	84.6	0.875	0.350
• Yes	20	24.1	4	15.4		
History of exposure to COVID-19						
• No	21	25.3	1	3.8	5.657	**0.017***
• Yes	62	74.7	25	**96.2**		
If the answer is yes, how many times of exposure? (n=87)						
• Once	45	71.4	6	25.0	20.079	**<0.001****
• Twice	16	25.4	11	45.8		
• Three times	2	3.2	7	29.2		
Colleagues or relatives died from COVID-19						
• No	61	73.5	14	53.8	3.561	0.059
• Yes	22	26.5	12	46.2		

N: numbers ***%***: percentage ***PTSD:*** post-traumatic stress disorder ***ICUs***: Intensive Care Units ***COVID-19:*** Coronavirus- 2019 ***PPE:*** personal protective equipment ***X^2:*** Chi-Square test ***P*-value** is statistically significant at $p < 0.05$

5. Discussion

The coronavirus disease 2019 is a pandemic disaster, it affects the whole world resulting in the appearance of thousands of infected cases that necessitate ICU admission **(Gupta et al., 2020)**. Critical care nurses are one of the HCWs who were in the front lines for facing the pandemic **(Riedel, Horen, Reynolds, & Jahromi, 2021)**. The COVID-19 burden make CCNs more vulnerable to posttraumatic stress disorder which is one of the most common psychological problems **(Levi, Patrician, Vance, Montgomery, & Moss, 2021)**.

In light of the present study, our results illustrated that more than half of the participant nurses were female, their age ranged between 20 – < 30 years, and married while nearly half of the participant nurses have a bachelor's degree. Regarding years of work experience in ICUs, more than half of the participant nurses had between 1 to less than 5 years. This might be because nurses with a bachelor's degree in nursing start working in ICUs then they take over administrative responsibilities within a few years after their employment. These results mirror the findings of an Egyptian study conducted by **Komsan (2021)**.

The findings affirmed that more than two-thirds of the nurses didn't shift to ICU during COVID-19. This finding is in the same line with a Sweden study titled "Registered nurses' experiences of working in the ICU during the COVID-19 pandemic" **(Bergmann, Falk, Wolf, & Larsson, 2021)**. According to shift duration in isolated ICU, nearly two-thirds of the participant nurses worked for 12 hours per shift. This finding is congruent with an Egyptian study during the first wave of the pandemic in 2019 **(El-Sokkary et al., 2021)**. On the contrary, a study conducted by **Yang et al. (2022)** reported that more than half of the HCWs worked for up to 8 hours/day.

Concerning the overtime in the ICU during COVID-19, the majority of the participant nurses took overtime during COVID-19. This was related to the nature of work of CCNs who provide direct care for COVID-19 patients which make them at higher risk for COVID-19 infection leading to staff

shortage **(Komsan, 2021)**. This study is agreed with **Marcomini et al., (2021)**. However, a study in England reported that more than half of newly qualified nursing associates didn't have to work more overtime than normal **(King et al., 2021)**. It might be due to enough staff numbers being included in that study.

More than half of the participant nurses didn't suffer from the shortage of PPE during COVID-19. It was expected as after the first COVID-19 wave in March 2020, it affected more people, and more equipment and supplies were used, so PPE is one of the most important requirements for fighting the pandemic which forced the Egyptian government to save appropriate quantities of PPE. This corresponds with the findings of a study by **Baraka, Ramadan,** and **Hassan (2021)**. However, a study conducted in Daegu reported that resources adequacy was below the median **(Bae et al., 2022)**. This would be because the data was collected at the peak of the spreading of COVID-19 pandemic at the first year of its appearance.

Regarding the satisfactory income, most of the participant nurses didn't get a satisfactory income. This study is similar to an Egyptian study that found that most medical professionals in the governmental sector were dissatisfied with their salary unlike the private sector **(El-Mazahy, Mekky, & Elshaer, 2023)**. On the other side, a cross-sectional study in Jordan found that majority of their participants reported that the financial return is acceptable **(Al Hadid, Al Barmawi, Alnjadat, & Al Farajat, 2022)**. It might be due to most of the participants had baccalaureate degrees which is one of the highest academic degrees in nursing there.

The majority of the participant nurses didn't attend any workshops, training programs, or conferences related to COVID-19. This finding agrees with the fact that nurses during the COVID-19 crisis were busy and overloaded with patients care and other responsibilities **(Said & El-Shafei, 2021)**. This result is in the same line with a study in Muscat, Oman (**Labrague & Santos, 2020**). However, a study reported that the majority of their nursing staff had previous training about COVID-19 **(Cho et al., 2021)**. This could be from the participants' hospital safety climate with a mean 57.70 ± 9.22 which allowed for training of the majority of the participants on wearing PPE.

Considering history of exposure to COVID-19, The present study illustrated that majority of the participant nurses had a history of exposure to COVID-19. This study concords with a study conducted by **Taha** and **Abd ELhay (2020)**. In contrast to a study in Turky which reported that more than three-quarters of front-line nurses tested negative results for COVID-19 **(Murat, Kose, & Savaser, 2021)**. This discrepancy may be due to the adequacy of PPE and isolation precautions during working at the COVID-19 units.

The current study showed that the prevalence of PTSD among the participant nurses was nearly one quarter. This result might be due to the implementation time of the study that was set at the end of the last COVID-19 wave, the availability of different COVID-19 vaccinations for all medical staff and the public. Several studies supported our result **(Bae, Yoon, Y. Kim, & Kim, 2022**; **Bahadirli & Sagaltici, 2021**; **Lu et al., 2021; Pan et al., 2021; Riaz et al., 2023)**.

In contrast to our result, **Ayalew et al. (2022)** conducted an Ethiopian study that addressed post-traumatic stress disorder symptoms and its predictors among HCWs following COVID-19 pandemic and revealed that PTSD score was higher. This difference could be due to the large sample size that was computed 422 participants. Also, **Moon, Han, Park, and Ryu, 2021 and Qutishat, Abu Sharour, Al-Dameery, Al-Harthy** and **Al-Sabei (2021)** investigated the prevalence of post-traumatic stress and related factors among nurses during the COVID-19 outbreak and showed that more than one third of the nurses were in the high risk of PTSD. This disparity could be due to decreased mental preparedness and poor nursing staff.

Additionally, our results are also mismatched with other two studies **(Engelbrecht, Heunis, & Kigozi, 2021; Kabunga & Okalo, 2021)** who screened the PTSD among nurses during COVID-19 and found it high. This would be assigned to the difference in data collection time that occurred during the second wave of the pandemic where there were unprecedent percentage of patient deaths. Furthermore, a descriptive cross-sectional study in a COVID hospital assessed post-traumatic stress disorder among nurses and confirmed the presence of significant psychological distress **(Marcomini et al., 2021)**. This could be from the sample of the study that contained nurses who had worked in psychiatric units before the COVID. Hence, a lack of experience in infection management and in caring for such patients increased their likelihood of developing PTSD.

Our findings demonstrated that the most affected domains among nurses who have developed PTSD are negative alterations in cognition and hyperarousal domains compared to non-PTSD participant nurses. This result is congruent with a study evaluated PTSD symptoms among medical staff after the peak of the COVID-19 pandemic at a tertiary care hospital and illustrated that hyperarousal was the most common PTSD domain **(Zhang, et al., 2020)**. Also, **Pan et al. (2021)** conducted a Chinese cross-sectional survey about prevalence and factors associated with post-traumatic stress disorder in HCWs exposed to COVID-19 and reported that the negative alterations in cognition was the most affected domain.

On the other hand, some descriptive cross-sectional studies assessed prevalence of post-traumatic stress disorder in COVID hospitals and showed that the most affected PTSD domains is reexperience domain **(Marcomini et al., 2020; Tang, Pan, Yuan, & Zha, 2017)**. This discrepancy might be due to the disturbing and annoying thoughts that predominated among the participants. Another cross-sectional study investigated 202 Chinese nurses exposed to the corona virus disease in 2019 and the factors related to their post-traumatic stress disorder and reported that the highest score in all domains was the avoidance **(Wang et al., 2020)**. This mismatch could be due to different PTSD screening time and using different tool for PTSD assessment.

In the current study, there was statistically significant difference between both groups (non-PTSD and PTSD) regarding overtime in ICU during COVID-19. There was a significant association between overtime in ICU during COVID-19 and PTSD occurrence. This finding is supported by **Marcomini et al. (2021)** who addressed the statistically significant association between a working shift change and increased the risk of receiving a provisional PTSD diagnosis (p = 0.01). Additionally, **Kabunga** and **Okalo (2021)** who assessed PTSD in frontline nurses and associated predicting factors during the second wave of COVID-19 and indicated that nurses who had increased workload were more likely to experience PTSD compared to their colleagues who had less workload.

Contrary to our recent results, a study screened 230 ICU nurses for the prevalence of post-traumatic stress disorder and found that there were fewer ICU Nurses who worked overtime in the PTSD group than in the non-PTSD group which proved no correlation between work overtime and the prevalence of PTSD (p= o.66). **(Mealer, Shelton, Berg, Rothbaum, & Moss, 2007)**. This contradiction may be due to the large sample size which contained nurses working in different hospitals and a variety of ICUs including combined medical/surgical, medical, cardiac, surgical, and other ICUs.

Concerning PPE, statistically significant difference was found between both groups (P < 0.015). Hence, there was a significant association between the shortage of PPE during COVID-19 and PTSD occurrence. This result is in line with a cross-sectional study investigated PTSD symptoms and impairment in functioning among nurses caring for patients with COVID-19. This study illustrated that nurses who reported not having access to adequate PPE had significantly higher levels of PTSD symptoms compared to those who reported having access to adequate PPE **(Ayotte, Scherr, & Kellogg, 2022)**. Similarly, many other studies correspond with our result **(Arnetz et al., 2020; Guttormson et al., 2022b; Issa et al., 2021; Mehta et al., 2021)**.

On the other side, a cross-sectional study evaluated factors associated with post-traumatic stress disorder in nurses after directly caring for corona virus diseased patients and found that there is no association between inappropriate of availability of PPE and PTSD (P = 0.352). **(Yoon, Bae, & Baek, 2023)**. This disagreement might be attributed to the fact that shortage of PPE is not a serious issue in Korea as since the Middle East respiratory syndrome outbreak, the major themes emerged among HCWs were concerns for PPE safety and discomfort of wearing PPE rather than its shortage **(Kang, Son, Chae, & Corte, 2018)**.

The current findings revealed that the PTSD group had more exposure times to COVID-19 compared with the non-PTSD group. A statistically significant difference was found between both groups (P < 0.015). Hence, there was a statistically significant association between the numbers of exposure times to COVID-19 and PTSD occurrence. This agrees with the fact that COVID-19 infection is a factor for depression, anxiety, and stress occurrence. Hence, the more exposure times to COVID-19, the more stress incidence which may increase to reach high levels leading to PTSD occurrence

(Khademian, Delavari, Koohjani, & Khademian , 2021).

our findings are supported by the results of **Zhang et al. (2020)** who clarified that negative COVID-19 tests among the HCWs were found to be negatively correlated with having probable PTSD ($p < 0.00$). Incoherent to this result **Taha** and **Abd ELhay (2020)** proved that there was no relation between the number of COVID 19 infections and PTSD frequency score. Finally, no differences in the other work-related factors of the participant nurses and PTSD were found between the two groups (all $p > 0.05$).

6. Limitations

The sample in this study was limited to three hospitals only, which may not determine the PTSD of all CCNs in Egypt.

7. Conclusion and Recommendation

According to the study finding, CCNs suffered from provisional PTSD to some extent. All work-related factors should be controlled. Implementation of a comprehensive health education program could be a valuable strategy to equip nurses with the knowledge and skills necessary to manage PTSD and cope with potentially traumatic experiences.

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9. Declaration of Conflicting Interests

The authors have no conflicts of interest to declare.

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