

# The Side Effects of Protective Equipment Usage and Nurse Fatigue During the COVID-19 Pandemic

Reza Hosseinabadi<sup>1</sup>, Shoorangiz Beiranvand<sup>1</sup> , Shima Ghasemiasl<sup>2</sup>,  
Khatereh Anbari<sup>3</sup>

<sup>1</sup> Social Determinants of Health Research Center, School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran

<sup>2</sup> School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran.

<sup>3</sup> Social Determinants of Health Research Center, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran

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## ABSTRACT

*The COVID-19 pandemic has significantly increased the workload of nurses worldwide. Therefore, this study aimed to examine the prevalence of adverse effects related to using personal protective equipment and its correlation with nurse fatigue. In this cross-sectional study, 313 nurses employed in educational hospitals in Khorramabad, Iran were selected using convenience sampling. Data were collected from September 2021 to March 2022 through a fatigue questionnaire and a researcher-made questionnaire. The results showed that dry mouth (65.8%) and facial wrinkles (51.6%) were the most commonly reported side effects. The comparison of fatigue scores indicated a significant association between physical fatigue and the use of coverall suits ( $p < 0.05$ ). Moreover, women reported significantly higher physical fatigue scores ( $p = 0.04$ ). Regarding age, there was a significant difference in mental fatigue ( $p = 0.01$ ), physical fatigue ( $p = 0.004$ ), and overall fatigue scores ( $p = 0.004$ ), with younger nurses showing significantly higher scores. The results of this study showed that fatigue and side effects related to the use of personal protective equipment are common among nurses. Managing shifts and human resources, as well as improving the quality of protective equipment, are essential to reducing fatigue and related side effects in similar future crises.*

**Keywords:** COVID-19; Nurse; Fatigue; PPE

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## Introduction

In November 2019, the COVID-19 was reported for the first time, and it rapidly spread across China and other parts of the world, becoming a pandemic [1]. Since no specific drug or vaccine was available for COVID-19 at the time, public health measures such as isolating suspected COVID-19 patients, social distancing, disinfecting public spaces, and using personal protective equipment (PPE) were declared essential to prevent the spread of the disease [2]. From the onset of the pandemic, healthcare workers have been identified as the most affected group. On February 11, the China Centers for Disease Control and Prevention reported an infection rate of 3.8% among healthcare workers [3]. Staff in all major hospitals were required to use PPE, including surgical masks, N95

respirators, face shields or safety goggles, surgical gloves, and powered air-purifying respirators [4].

The reality is that the use of PPE by healthcare workers is often cumbersome and uncomfortable, especially when prolonged use of this equipment is necessary during emerging infectious disease outbreaks [5]. Evidence shows that new headaches have been observed in healthcare workers after four hours of N95 mask use [6]. It has also been noted that PPE use is not without harm, as it can cause reduced vision, altered hearing, increased heat sensation, decreased mobility, and difficulty breathing [7]. The use of N95 masks can also have other physiological consequences such as dizziness, nausea, vomiting, and hypoglycemia [8]. In addition to these symptoms, the use of

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\* Corresponding author: Shourangiz Beiranvand, School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran .

E-mail: [shorangizbiranvand@yahoo.com](mailto:shorangizbiranvand@yahoo.com)

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PPE leads to skin injuries and complications such as facial dermatitis, which is particularly significant for female nurses.

Evidence suggests that this issue has received little attention, and few studies have been conducted on it [9]. Field evidence also indicates that some PPE, such as N95 masks and coverall suits, are intolerable for many individuals, including some staff, and lead to severe physical and mental fatigue [9].

Nurse fatigue is defined as a subjective and multidimensional feeling of exhaustion that is pervasive both physically and mentally, interfering with the nurse's physical and cognitive abilities, and may persist even after periods of rest [10]. Experiencing high levels of fatigue can affect patient care outcomes and impose significant costs on the healthcare system [11]. Nurse fatigue creates a significant impairment in the nurse's performance [12, 13] and seriously impacts their ability to effectively care for their patients [14]. Evidence indicates that workplace conditions, particularly high ambient temperatures, combined with the use of PPE, especially coverall suits, exacerbate the working conditions for nurses and increase their fatigue. A review of the literature on PPE use and fatigue reveals that there is limited evidence in this area [15]. One of the few studies, which involved ten nurses, showed that as the level of protection increased from masks to the use of protective clothing (coveralls), both physical and mental fatigue among nurses increased [16, 17]. No studies were found that examined the relationship between the use of protective equipment and fatigue among a larger population of nurses. Therefore, this study was conducted to investigate the adverse effects of using PPE and its association with nurse fatigue during the COVID-19 pandemic.

## **Materials and Methods**

This study is cross-sectional descriptive-analytical research conducted between September 2021 and March 2022.

The study population consisted of all nurses working in educational hospitals affiliated with Lorestan University of Medical Sciences in Khorramabad, Iran. The sample size was calculated using the Cochran formula, resulting in 305 participants. To account for the possibility of incomplete questionnaires, an additional 30 participants were added, leading to a total sample size of 335 nurses.

Participants were selected using convenience sampling from three educational hospitals covering various COVID-19 (ICU and emergency COVID-19 departments) and non-COVID-19 departments.

Inclusion criteria for the study included nurses working during the COVID-19 pandemic in educational hospitals, and at least four months of work experience, and both genders. Exclusion criteria involved incomplete questionnaires and withdrawal of consent during questionnaire completion.

After the proposal was approved and ethical committee permission was obtained (Code: IR.LUMS.REC.1400.142), the researcher visited all departments to introduce themselves, obtain informed consent, and distribute the questionnaires.

### **Data Collection**

The data collection instruments included a demographic and occupational characteristics form, a researcher-made questionnaire to assess problems related to PPE use, and a fatigue questionnaire.

The demographic and occupational characteristics form included items such as age, gender, education, job responsibilities, service department, work experience, respiratory illness history, and smoking history.

The researcher-made questionnaire included information on the type of personal protective equipment and physical and psychological side effects resulting from its use. The content validity of the questionnaire was reviewed by ten faculty members.

The Chalder Fatigue Questionnaire, a brief 14-item tool, measures both mental and

physical fatigue symptoms. This scale was translated into Persian by Nasri in 2010. The reliability coefficients were reported as 0.85 (test-retest) and 0.91 (internal consistency), with a cutoff score of 22 [18].

To assess the frequency, descriptive statistics including mean, standard deviation, and percentage frequencies were used. The relationship between variables was analyzed using Chi-square tests, independent t-tests, and one-way ANOVA. Data analysis was performed using SPSS version 22.

## Results

A total of 332 nurses participated in this study, and ultimately 313 completed questionnaires were analyzed. The mean age of the nurses was  $30.13 \pm 7.39$  years, with the youngest being 22 years old and the oldest 54 years old. The highest frequency was observed in the age group of 20-29 years (61.7%). Of the participants, 78% were female. The majority of participants (92%) held a bachelor's degree.

The highest frequency of service location was in non-COVID-19 departments (46.6%). The most frequently used protective equipment by the nurses was masks (43.8%), with most of them using N95 masks (77.6%). Most nurses reported using only one mask. Additionally, 62% of nurses described the quality of the masks as undesirable (Table 1).

The results of the frequency analysis of adverse effects related to the use of PPE showed that among the PPE, masks were used continuously throughout the entire shift.

The most frequently reported side effect by nurses was dry mouth (65.8%), while the least frequent was panic attack (7.7%). A total of 89.8% of the participants experienced at least one skin-related issue. Chi-square test results indicated that nurses who frequently or always wore masks had significantly higher rates of nose itch, facial and nasal pain, dry mouth, stress, and panic compared to those who only occasionally used PPE (Table 2).

Table 1. Distribution of frequency of demographic and occupational characteristics of the Nurses Studied

Variable	N(%)	Variable	N(%)		
Age	22-29	193(61.7)	Job	Head-nurse	24(7.7)
	30-39	80(25.6)		Staff	16(5.0)
	>40	40(12.8)		Nurse	273(87.2)
Marriage	Married	123(39.3)	Shift	fixed	50(16.0)
	Single	190(60.7)		Rotation	26(8.4)
Respiratory Disease	Yes	9(2.9)	Ward	General COVID-19	52(16.6)
	No	304(97.1)		ICU COVID-19	36(11.5)
Smoking history	Yes	13(4.2)		Emergency COVID-19	79(25.2)
	No	300(95.8)		Non- COVID-19	146(46.6)
History of Allergy	Yes	71(22.7)	Education	Bachelor	291(93)
	No	242(77.3)		Master	22(7.0)

Table 2. Distribution of frequency of use of types of personal protective equipment and their usage during shifts

Variable	N(%)	Variable	N(%)		
PPE type	Mask	137(43.8)	Mask type	Surgical	70(22.4)
	Surgical Gloves	133(42.5)		N95	243(77.6)
	Protective goggles	123(39.3)	Number of masks	On	201(64.2)
	Coverall suit	87(27.8)		Two	112(35.8)
PPE Frequency use	Always	117(37.4)			
	More often	127(40.6)			
	Some time	57(18.2)			
	Never	12(3.8)			

The results of the independent t-test for comparing the fatigue scores by gender showed no significant difference in mental fatigue and overall fatigue scores between the two genders; however, women reported significantly higher physical fatigue scores ( $p = 0.04$ ). Regarding age, there were significant differences in mental fatigue ( $p=0.01$ ), physical fatigue ( $p = 0.004$ ), and overall fatigue scores ( $p = 0.004$ ), with younger nurses obtaining significantly higher scores. The results of the ANOVA for comparing fatigue scores based on job responsibilities and department also showed no significant differences (Table 3).

The results of the analysis examining the relationship between the type of protective equipment used and fatigue scores showed no significant association between the use of masks, face shields, and gloves with mental fatigue, physical fatigue, or overall fatigue scores. However, there was a significant association between the use of coveralls and physical fatigue as well as total fatigue scores ( $p < 0.05$ ). The analysis of the relationship between age and nurse fatigue demonstrated a significant association between physical fatigue and age, with nurses under 30 years old

experiencing significantly higher fatigue scores compared to those over 30. Furthermore, the relationship between gender and fatigue revealed that physical fatigue and total fatigue scores were significantly higher in female nurses compared to male nurses (Table 4).

### Discussion

This study aimed to examine the prevalence of adverse effects from personal protective equipment (PPE) usage and its relationship with nurses' fatigue. The findings revealed that around 80% of nurses always or frequently used PPE, with masks and shields being the most commonly used items. Similar to our study, Sarfaraz et al. in Rawalpindi, India, reported that 79% of nurses regularly used masks [19]. In our study, 77% of nurses used N95 masks, whereas Sarfaraz's study showed 54% usage. This difference may be attributed to the availability of N95 masks and the sample composition, as during COVID-19, some countries faced shortages of PPE. Additionally, 35% of nurses in our study reported using two masks, compared to 22% in Sarfaraz's study [19]. This difference might be due to variations in the sample composition, as Sarfaraz's study

Table 3: Frequency of adverse effects experienced due to personal protective equipment and their association with frequency of equipment use

Side effect	N(%)	Side effect	N(%)	Side effect	N(%)
Dyspnea	54(17.3)	Enlarged Skin Pores	102(32.6)	Sore Throat	132(42.2)
Nasal Dryness	145(46.3)	Facial Wrinkles	160(51.6)	Sensation of Heat	134(42.8)
Sneeze	131(41.9)	Urticaria	47(15)	Panic	**24(7.7)
Rhinorrhea	91(29.1)	Nasal and Facial Pain	110(35.1) **	Stress	**118(37.7)
Nasal and Perinasal Itching	181(57.8) *	Mask Imprint on Cheeks	147(47)	Headache	65(20.7)
Perinasal Sweating	125(39.9)	Nasal Deformity	136(43.5)		
Dermatitis	118(37.7)	Xerostomia	206(65.8) ***		

\* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$

Table 4: Comparison of mean and standard deviation of fatigue scores among nurses based on age, gender, service department, and responsibilities

Variable		Mental Fatigue Mean (SD)	Physical Fatigue Mean (SD)	Total Fatigue score Mean (SD)
Gender	Male	8.66(3.51)	12.26(5.27)	20.18(8.58)
	Female	8.86(3.6)	13.83(5.53) *	22.67(8.58)
Age	30<	9.15(3.54) **	14.1(5.50) ***	23.24(8.23) ***
	>30	8.07(3.62)	12.15(5.31)	20.19(8.53)
Ward	General Covid	8.88(3.77)	14.11(7.75)	23(10.36)
	ICU Covid	9.63(3.93)	14.24(5.23)	23.84(9.02)
	Emergency Covid	8.4(3.04)	12.8(4.44)	21.33(6.96)
Nurse role	Non-Covid	8.81(3.73)	13.43(5.21)	22.2(8.38)
	Head-nurse	10.29(5.99)	14.91(7.89)	25.2(13.68)
	Staff	10.18(2.97)	12.78(3.84)	23.01(5.90)
	Nurse	8.6(3.31)	13.39(5.32)	21.97(7.98)

included all hospital staff, including security and IT personnel, who likely had less direct patient contact. In this study, 15% of nurses reported hives, and 57% reported nasal itching as a common skin issue due to mask usage. Since 62% of nurses rated the mask quality as subpar, the high prevalence of side effects could be attributed to poor-quality masks. Similar results have been reported in other studies. For example, Westerman reported a 61% prevalence of skin issues due to PPE, with at least 94% of participants reporting at least one skin issue [20]. This study was conducted during the peak of the COVID-19 pandemic, and most nurses used N95 masks, so many of the skin issues could be linked to these masks. Westerman has shown an association between prolonged use of filtered masks (over 4 hours per day) and skin problems [19]. International studies have also confirmed the connection between filtered mask usage and skin issues [21, 22]. In this study, the most commonly reported PPE-related issues were dry mouth, nasal and facial itching, wrinkles, facial redness, indentations on the skin from equipment, nasal sweating, and dermatitis. Aloweni et al. found similar results, with the most common adverse effects being pressure injuries from masks, mask-induced acne, and facial pain. These findings align with our study. Similarly, McKenna et al. reported a 71% prevalence of pressure-induced facial injuries, slightly higher than our findings. McKenna's study also reported a 57% prevalence of skin problems and 20% prevalence of respiratory issues, which are consistent with our results [24]. Similar to our study, Kumar et al. identified sweating and thirst as common side effects of PPE usage [25]. The results of our study did not show a significant relationship between the use of masks, shields, and gloves and mental fatigue, physical fatigue, or overall fatigue scores. However, there was a significant difference in physical and overall fatigue between genders, with female nurses experiencing significantly more fatigue than male nurses. This finding aligns with Candido et al., who found that prolonged PPE use was associated with higher physical fatigue in female healthcare workers. These results

suggest that women may have lower physical resilience compared to men, leading to greater fatigue [26]. There was no significant difference in fatigue levels between nurses working in COVID and non-COVID wards. This result contrasts with Candido's study, which found that staff working in non-COVID units reported lower physical fatigue [26]. The discrepancy could be due to differences in the sample composition, as Candido's study included various healthcare workers, including nurses, doctors, social workers, researchers, and students. In contrast, this study focused solely on nurses, who bore the brunt of patient care during the COVID-19 pandemic. The high patient load, combined with the prolonged use of PPE, likely contributed to overall fatigue, regardless of the unit they worked in. Additionally, due to the heightened risk of infection and concern for their own and their families' health, nurses may have opted for safer protective equipment, such as N95 masks, even in non-COVID units, resulting in longer periods of use. It should also be noted that during the pandemic, N95 masks were made available to all nurses in teaching hospitals. Dry mouth was one of the most frequently reported issues in this study, which aligns with Candido's findings. This similarity may be due to the frequent use of N95 masks in both studies [26]. One of the limitations of this study was the potential for inaccurate responses from nurses due to the high workload and busy conditions in the wards during the COVID-19 period. Therefore, they were asked to complete the questionnaire at their convenience at home and submit it later.

## **Conclusion**

The results of this study showed that fatigue and side effects related to the use of personal protective equipment were common among nurses. Physical fatigue was reported more in women and younger people. Managing shifts and human resources, as well as improving the quality of protective equipment, are essential to reducing fatigue and related side effects in similar future crises.

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## Conflict of Interests

Authors declare that they do not have any conflict interests.

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