

# Workload, Work-Related Symptoms, and Rewards of Nurses during the COVID-19 Pandemic

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**Purpose:** This study aimed to compare the workload, work-related symptoms, perceived rewards, and expected rewards of frontline and non-frontline nurses during the coronavirus (COVID-19) pandemic and investigates the organizational strategies required by nurses to cope with its prolongment. **Methods:** A cross-sectional study involving 99 nurses, including frontline (n=67) and non-frontline nurses (n=32) working in a tertiary hospital with a dedicated ward for COVID-19 was conducted. The data were collected from December 2021 to January 2022. Data were analyzed using descriptive statistics, the  $\chi^2$  test, Fisher's exact test, and independent t-tests, and Mann Whitney U test. **Results:** Non-frontline nurses had heavier workloads and more severe work-related symptoms including burnout, stress, and fatigue than frontline nurses. Nurses' perceived rewards for infection management and control were not equally distributed between the two groups. Nurses expected financial rewards including non-financial and reputation-related rewards. **Conclusion:** To prepare for future pandemics, medical stakeholders should develop effective strategies that include workforce management, equity-based rewards systems, and regular education and training in infection management and control for healthcare professionals.

**Key Words:** COVID-19; Nurses; Reward; Workload; Healthcare professionals

## INTRODUCTION

In response to the unprecedented global crisis of the coronavirus disease 2019 (COVID-19) pandemic, the Korea Centers for Disease Control and Prevention (KCDC) has established an infection control policy that includes thorough quarantine measures such as social distancing, hand hygiene, and contact tracing [1]. The Korean government designated most hospital beds in public medical centers as patient beds for less severe COVID-19 cases and 0.5% to 1% of the beds in tertiary hospitals as patient beds for severe cases [2]. In addition, most public medical centers and tertiary hospitals have established COVID-19 screening clinics for the early detection of COVID-19 [2]. The Korean government has made efforts to reduce the transmission and mortality rates of COVID-19 by applying

strong regulations such as requiring polymerase chain reaction (PCR) testing and isolation of persons in close contact with those confirmed to have COVID-19 and providing medical care for all confirmed cases under the National Health Insurance System [3]. However, this prolonged response to COVID-19 has increased the burden on healthcare professionals (HCPs).

Nurses play a critical role in preventing and responding to the COVID-19 outbreak [4]. The COVID-19 outbreak has not only increased nurses' role expectations for managing and monitoring the pandemic but also imposed a heavy social responsibility for patient care [5,6]. COVID-19 designated hospitals have placed patients with confirmed COVID-19 in a separate ward from patients without suspected/probable COVID-19 to minimize the risk of patient-to-patient transmission in hospital facilities [2].

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Frontline nurses working in dedicated COVID-19 patient care areas (e.g., infectious disease wards, isolation rooms in the emergency or intensive care unit [ICU]) provide direct bedside care while wearing personal protective equipment, such as gowns, gloves, face shields or goggles, and filtering facepiece respirators [7]. However, non-frontline nurses caring for patients without confirmed COVID-19 provide usual care with enhanced awareness and recognition of infection monitoring and control to facilitate an immediate response to possible COVID-19 cases in their working areas [2].

Beyond direct patient care, non-frontline nurses are actively involved in COVID-19 prevention strategies, such as screening, evaluating, and monitoring patients and caregivers [8]. The Korean government continues to update the COVID-19 hospital preparedness guidelines in response to rapidly evolving situations [9]. Nurses, particularly non-frontline nurses, are committed to educating patients and their caregivers about the new COVID-19 response guidelines such as checking their caregivers' PCR tests within two days, resolving complaints and counseling, and providing routine surveillance of patients and caregivers. Such additional surveillance tasks, immediate and far-reaching health system changes, and additional administrative tasks are likely to contribute to increased stress, fatigue, and burnout among nurses [10]. Nevertheless, there is a limited understanding of workload and work-related health issues among non-frontline nurses compared with frontline nurses.

According to a recent integrative review, nurses' turnover intention has significantly increased after the COVID-19 pandemic because of workload, burnout, stress, and the fear/threat of COVID-19 [11]. Thus, the government and/or medical hospitals should provide effective strategies to secure stable nursing personnel. Considering that employees compare their input efforts or contributions with commensurate rewards [12], it may be timely to develop and implement a reward plan for nurses who have committed their social and occupational responsibilities during the COVID-19 pandemic. In February 2020, the Ministry of Health and Welfare (MOHW) prepared a plan to provide a daily wage for nurses dispatched to hospitals dedicated to COVID-19 [13], and in January 2021, the MOHW prepared a reward plan to increase night shift allowances for frontline nurses [14]. However, there was no reward plan for non-frontline nurses according to this policy, raising the issue of equity in rewards among nurses. To end the pandemic situation and prevent the spread of infection, the efforts and contributions of frontline nurses as well as non-frontline nurses are significant. Therefore, a

fair reward system should be developed by evaluating the roles and contributions of non-frontline nurses who have greatly contributed to the creation of a safe medical environment by carefully and effectively managing patients and caregivers.

Therefore, the primary purpose of this study was to compare the workload, work-related symptoms, perceived rewards, and expected rewards among nurses caring for patients without suspected COVID-19 and those caring for patients with confirmed COVID-19. The secondary goal of this study was to investigate the organizational strategies required by nurses to cope with the prolonged COVID-19 pandemic.

## METHODS

### 1. Study Design and Participants

This cross-sectional study was conducted at a tertiary hospital in Korea. This hospital is a regional hub hospital designated by the government that is responsible for the intensive care of patients with semi-critical or critical COVID-19. Since the COVID-19 pandemic, this hospital has been managing hospital beds as follows: (1) establishing dedicated hospital wards with negative-pressure isolation rooms for patients with COVID-19 where caregivers and visitors are restricted/disallowed and (2) maintaining general medical beds for patients and their residential caregivers who are negative on PCR tests within 48 hours prior to admission. The patients in general medical beds and their residential caregivers must maintain social distancing, restrict their movements, and undergo PCR tests for COVID-19 every 48 hours. In this study, nurses caring for patients without confirmed COVID-19 were named non-frontline nurses, and those working at COVID-19 dedicated hospital wards were named frontline nurses.

The inclusion criteria for the study were as follows: (1) frontline nurses working in COVID-19-dedicated hospital wards; (2) non-frontline nurses working in general wards caring for patients without confirmed COVID-19; (3) nurses who had worked in their current ward for more than six months; and (4) nurses who voluntarily agreed to participate in the study. The exclusion criteria for the study were nurse administrators who did not provide direct nursing care.

The sample size of this study was calculated using G Power 3.1, and a total of 128 nurses were needed for each group of 64 for a two-sided test with a significance level of 0.05, an effect size of 0.5, and a power 0.80. A total of 142 nurses were distributed considering a 10% non-response

rate; of these, 32 nurses were frontline nurses, and 67 nurses were non-frontline nurses. The response rate for frontline nurses in this study was low at 45%. This is because it was difficult to contact frontline nurses in a situation where COVID-19 quarantine was strict, and the nurses had difficulty changing personal protective equipment for the survey. Therefore, a total of 99 participants were included in the final analysis.

## 2. Data Collection

Data collection was performed from December 2021 to January 2022 for frontline and non-frontline nurses at a tertiary hospital. With the approval of the head of the department, the researcher provided a guide and questionnaire containing the research manual and informed consent, and participants who voluntarily agreed to participate in the study completed the informed consent form and a self-report questionnaire. The survey was conducted in 15 minutes, and participants' responses were directly collected by the researcher using a self-sealed envelope. For the self-report questionnaires, valid and reliable instruments were used to measure work-related symptoms including burnout, stress, and fatigue during the COVID-19 pandemic. General and occupational characteristics and workloads were included in the self-report questionnaires.

## 3. Instruments

A structured questionnaire was used to obtain information on the general and occupational characteristics of the study participants, workloads, work-related symptoms, rewards, and organizational response strategies. All study participants responded on a scale of 0 (much lower) to 10 (much higher) regarding how much their current workload had increased compared with the pre-COVID-19 period. The following information also collected: (1) the most frequent and demanding nursing implementation, (2) the perceived and expected rewards for work related to COVID-19, and (3) organizational strategies required to cope with the prolonged COVID-19 pandemic. The participants selected answers from a list of potential response options.

### 1) Work-related burnout

Work-related burnout was assessed using a 20-item scale developed by Pines, Aronson, and Kafry [15] and modified and supplemented in Korean by Pick [16]. It consists of three domains: physical (six items), emotional

(seven items), and mental burnout (seven items). Each item is scored on a 5-point Likert scale (1=not at all, 2=slightly, 3=moderately, 4=quite a bit, and 5=extremely). The total score ranges from 20 to 100, with higher scores indicating a higher degree of burnout. In a study by Pick [16] that evaluated burnout among clinical nurses in Korea, Cronbach's  $\alpha$  was .86. In this study, Cronbach's  $\alpha$  was .91.

### 2) Work-related stress

Work-related stress was measured using an instrument developed by Her and Kim [17] to evaluate stress among infection control practitioners, a group of specialized nurses fundamental to providing effective health care infection prevention and control. This study was modified based on the practice of COVID-19 infection prevention and control performed by nurses. The instrument consists of 21 items including the following four domains: quantitative work overload (six items), qualitative work overload (seven items), relationship conflict (four items), and organizational factors (four items). Each item is scored on a 5-point Likert scale (1=not at all, 2=slightly, 3=moderately, 4=quite a bit, and 5=extremely). The total score ranges from 21 to 105, with higher scores indicating more severe work-related stress. Cronbach's  $\alpha$  in this study was .97, which was similar to the high reliability of the original instrument (Cronbach's  $\alpha$  =.95) [17].

### 3) Work-related fatigue

Work-related fatigue was measured with an instrument that was initially developed to evaluate fatigue among nurses during the outbreak of Middle East respiratory syndrome (MERS) [18]. It consists of 39 items including the following five domains: (1) complicated procedures and manpower shortage (12 items), (2) conflict in uncertain situations and lack of support (11 items), (3) worsening of patient condition and lack of knowledge (seven items), (4) challenges due to new roles for nurses (five items), and (5) infection risks and social expectations (four items). Each item is scored on a 5-point Likert scale (1=not at all, 2=slightly, 3=moderately, 4=quite a bit, and 5=extremely). The total score ranges from 39 to 195, with higher scores indicating higher fatigue levels. Cronbach's  $\alpha$  for this instrument is .96 and was .92 in this study.

## 4. Statistical Analysis

The data in this study were analyzed using IBM SPSS/WIN 25.0 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp, USA). The level of significance

was set at .05. Continuous variables are expressed as the mean±standard deviation, and categorical variables are expressed as frequencies and percentages. Statistical comparisons were performed using the  $\chi^2$  test, Fisher's exact test, and independent t-tests, and Mann Whitney U test.

### 5. Ethical Consideration

This study was approved by the Institutional Review Board of the Chonnam National University (approval no. 1040198-211125-HR-169-02). All the study participants provided written informed consent.

## RESULTS

### 1. General and Occupational Characteristics

Of the 99 nurses, 67 (67.7%) were non-frontline nurses, and 32 (32.3%) were frontline nurses. The mean age in the non-frontline group and frontline group was 31.28±6.34

and 31.09±7.56 years, respectively ( $p=.896$ ). Regarding the type of department, 55 (82.1%) non-frontline nurses worked in general wards, and 23 (71.9%) frontline nurses worked in the ICU or emergency room, and there was a significant difference between the two groups ( $\chi^2=52.67, p<.001$ ). Frontline nurses had more frequent education related to COVID-19 than non-frontline nurses ( $z=-2.19, p=.028$ ) (Table 1).

### 2. Workloads and Work-related Symptoms

Compared with the pre-COVID-19 period, non-frontline nurses had a higher workload than frontline nurses ( $z=3.71, p<.001$ ). Approximately 75% of frontline nurses reported that wearing personal protective equipment was the most frequent and highly engaged nursing procedure. However, non-frontline nurses reported that handling complaints from patients and caregivers because of hospital policies during the COVID-19 pandemic was the most frequent and highly engaged nursing activity.

**Table 1.** General and Occupational Characteristics of the Study Participants

Variables	Characteristics	Categories	Total (n=99)	Non-frontline (n=67)	Frontline (n=32)	$\chi^2$ or z	p
			n (%) or M±SD	n (%) or M±SD	n (%) or M±SD		
Personal characteristics	Age (year)		31.22±6.72	31.28±6.34	31.09±7.56	0.56	.577 <sup>†</sup>
	Sex	Male	7 (7.1)	4 (6.0)	3 (9.4)	0.38	.678*
		Female	92 (92.9)	63 (94.0)	29 (90.6)		
	Marital status	Single	73 (73.7)	50 (74.6)	23 (71.9)	0.09	.810
		Married	26 (26.3)	17 (25.4)	9 (28.1)		
	Educational level	Undergraduate	85 (85.9)	58 (86.6)	27 (84.4)	0.09	.765*
		Graduate	14 (14.1)	9 (13.4)	5 (15.6)		
	Smoking	Yes	0 (0.0)	0 (0.0)	0 (0.0)	-	-
No		99 (100.0)	67 (100.0)	32 (100.0)			
Alcohol consumption	Yes	46 (46.5)	30 (44.8)	16 (50.0)	0.24	.671	
	No	53 (53.5)	37 (55.2)	16 (50.0)			
Perceived health status	Poor	81 (81.8)	56 (83.6)	25 (78.1)	0.43	.581	
	Good	18 (18.2)	11 (16.4)	7 (21.9)			
Occupational characteristics	Department	General ward	64 (64.6)	55 (82.1)	9 (28.1)	52.67	<.001
		ICU	20 (20.2)	0 (0.0)	20 (62.5)		
		ER	15 (15.2)	12 (17.9)	3 (9.4)		
	Shift work	Rotating 3-shift	89 (89.9)	59 (88.1)	30 (93.8)	0.77	.493
		Non-shift work	10 (10.1)	8 (11.9)	2 (6.3)		
	Length of employment (month)		83.28±85.41	84.49±79.83	80.75±97.37	0.88	.381 <sup>†</sup>
Number of educations related to COVID-19		1.77±2.29	1.45±1.96	2.44±2.78	-2.19	.028 <sup>†</sup>	

\*Fisher's exact test; <sup>†</sup> Mann Whitney U test; Frontline: Nurses working in COVID-19-dedicated hospital wards; Non-frontline: Nurses working in general hospital wards where patients and their caregivers lived together; ER=Emergency room; ICU=Intensive care unit.

During the COVID-19 pandemic, non-frontline nurses had significantly higher work-related burnout ( $t=2.07, p=.042$ ), particularly physical burnout ( $t=2.27, p=.025$ ), than frontline nurses. Overall, work-related stress was significantly higher among non-frontline nurses than among frontline nurses ( $t=2.36, p=.020$ ). Furthermore, non-frontline nurses experienced significantly higher quantitative ( $z=3.37, p=.001$ ) and qualitative work overload than frontline nurses ( $t=2.20, p=.030$ ). There were no significant dif-

ferences in overall work-related fatigue between the two groups. However, non-frontline nurses experienced more fatigue than frontline nurses because of conflict in uncertain situations and lack of support ( $t=2.12, p=.036$ ), worsening of patient condition and lack of knowledge ( $t=2.36, p=.020$ ), challenges because of new roles for nurses ( $t=2.29, p=.024$ ), and infection risks and social expectations ( $t=2.59, p=.011$ ) (Table 2).

**Table 2.** Comparison of Workloads and Work-Related Symptoms between Non-frontline and Frontline Nurses

Variables	Total (n=99)	Non-frontline (n=67)	Frontline (n=32)	t or z	p
	n (%) or M±SD	n (%) or M±SD	n (%) or M±SD		
Workloads compared to the pre-COVID-19 period	7.19±1.92	7.69±1.73	6.16±1.90	3.71	<.001 <sup>†</sup>
Types of workloads*					
Wearing of personal protective equipment	49 (49.5)	25 (37.3)	24 (75.0)		
Explaining to patients and caregivers about conducting regular COVID-19 tests	29 (29.3)	25 (37.3)	4 (12.5)		
Reporting COVID-19 test results of patients and their caregivers	36 (36.4)	25 (37.3)	11 (34.4)		
Handling complaints from patients and their caregivers related to hospital policies during the COVID-19 pandemic	36 (36.4)	29 (43.3)	7 (21.9)		
Coordinating hospital bed transfers due to implementation or release of COVID-19 quarantine	28 (28.3)	20 (29.9)	8 (25.0)		
Work-related symptoms					
Burnout	65.82±10.81	67.34±10.43	62.63±11.04	2.07	.042
Physical burnout	22.37±3.57	22.93±3.50	21.22±3.50	2.27	.025
Emotional burnout	21.70±4.51	22.28±4.37	20.47±4.60	1.90	.060
Mental burnout	21.75±3.70	22.13±3.57	20.94±3.88	1.52	.133
Stress	71.21±10.87	72.96±11.42	67.56±8.68	2.36	.020
Quantitative work overload	22.42±3.71	23.25±3.74	20.69±3.03	3.37	.001 <sup>†</sup>
Qualitative work overload	22.38±3.81	22.96±4.02	21.19±3.05	2.20	.030
Relationship conflict	13.00±2.94	13.27±3.21	12.44±2.20	1.37	.172 <sup>†</sup>
Organizational factors	13.40±2.74	13.48±2.90	13.25±2.42	0.01	>.999 <sup>†</sup>
Fatigue	127.16±23.26	130.04±25.10	121.13±17.71	1.81	.074
Complicated procedures and manpower shortages	9.86±8.3	39.97±9.27	39.63±5.72	0.23	.821
Conflict in uncertain situations and lack of support	36.00±7.84	37.13±7.96	33.63±7.11	2.12	.036
Worsening of patient condition and lack of knowledge	22.49±4.09	23.15±4.25	21.13±3.41	2.36	.020
Challenges because of new roles for nurses	16.68±2.94	17.13±2.99	15.72±2.64	2.29	.024
Infection risks and social expectations	12.13±3.01	12.66±3.17	11.03±2.34	2.59	.011

\*Multiple responses; <sup>†</sup> Mann Whitney U test; Frontline: Nurses working in COVID-19-dedicated hospital wards; Non-frontline: Nurses working in the general hospital wards where patients and their caregivers lived together.

### 3. Nurses' Perceived Rewards and Expected Rewards related to the COVID-19 Pandemic

In terms of perceived rewards, 47.6% of non-frontline nurses responded that they had not received any rewards, and 23.8% of them received a day off. In contrast, 40.6% of frontline nurses answered that they had received no rewards or a danger pay allowance. Frontline nurses received more compliments through hospital newspapers or websites than those non-frontline nurses (Figure 1-A). With regard to expected rewards, nurses in the two groups mostly desired to receive a danger pay allowance, followed by days off, additional pension benefits, regular health checkups, good ratings on work performance reviews, and compliments through hospital newspapers or websites (Figure 1-B).

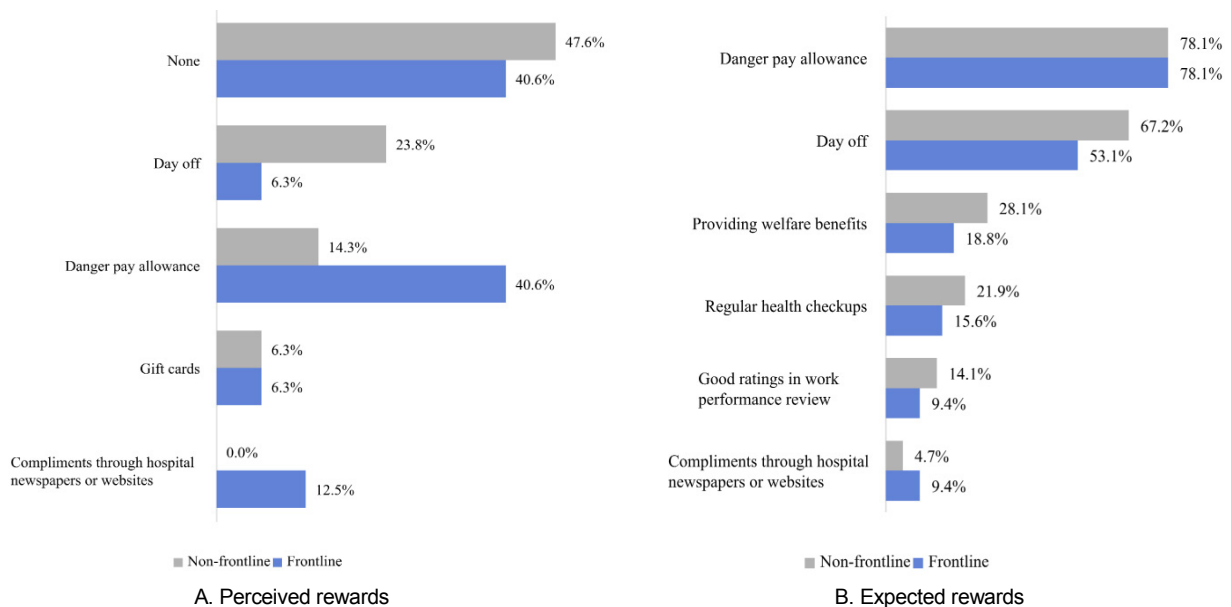
### 4. Organizational Response Strategies to COVID-19

Strategies suggested by nurses that organizations should prepare to cope with the prolonged COVID-19 pandemic are presented in Figure 2. Nurses in the two groups suggested that establishing a dedicated department for COVID-19 management was a top priority. As a second priority, non-frontline nurses proposed expanding the healthcare workforce to treat patients with COVID-19, while frontline nurses suggested establishing a reward system for HCPs.

## DISCUSSION

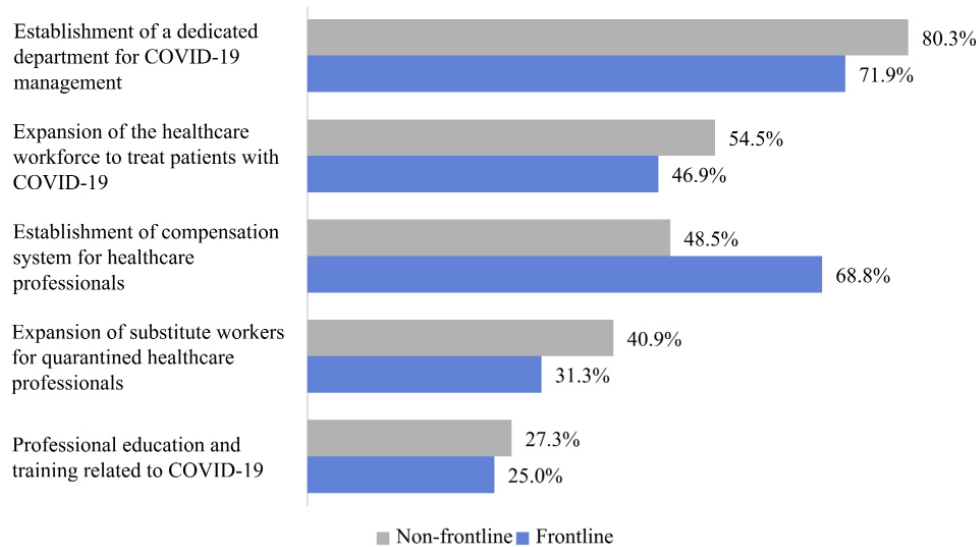
To the best of our knowledge, this is the first study to examine the differences in workloads, perceived rewards, and expected rewards between non-frontline nurses and frontline nurses in Korea. In addition, this study suggests the practical implications of organizational response strategies for the prolonged COVID-19 pandemic from the perspective of nurses who provided care to patients with COVID-19 during this situation.

A recent meta-analysis examining burnout among nurses during the COVID-19 pandemic found that nurses had high levels of burnout, including emotional exhaustion, depersonalization, and lack of personal accomplishment [19]. This study found that non-frontline nurses who did not engage in direct care for patients with confirmed COVID-19 suffered from excessive clinical and administrative tasks and high levels of physical and psychological distress. To date, much attention has been focused on burnout, stress, and health conditions of HCPs dedicated to caring for patients with confirmed COVID-19 [19-21]. Accordingly, in the era of strict infection control caused by the global pandemic, the challenges and problems faced by nurses and other HCPs caring for patients without confirmed COVID-19 are blind spots. Healthcare stakeholders should carefully and rigorously examine these blind spots and establish timely policies and strategies to protect HCPs.



Non-frontline: Nurses working in general hospital wards where patients and their caregivers lived together; Frontline: Nurses working in COVID-19~dedicated hospital wards

**Figure 1.** Perceived and expected rewards related to the COVID-19 pandemic (multiple responses permitted).



Non-frontline: Nurses working in general hospital wards where patients and their caregivers lived together;  
Frontline: Nurses working in COVID-19~dedicated hospital wards.

**Figure 2.** Organizational response strategies needed to cope with the prolonged COVID-19 pandemic (multiple responses permitted).

With regard to the workload of nurses, the non-frontline group focused on managing patients and caregivers and requesting their cooperation in accordance with the updated COVID-19 policies; this increased workload was attributed to frequent changes in COVID-19 policies in response to the rapidly evolving situation [9]. In Korea, the number of patients in each nurse's care in a general ward is 1:12; therefore, in most cases, a caregiver resides with the patient and cares for the patient [22]. Caregivers were included in the surveillance for COVID-19 infection because they were known to be an important source of infection during the MERS outbreak and contributed to the spread of the infection [23]. Therefore, nurses working in general wards where resident caregivers lived together with patients monitored twice as many people as those who were required to officially screen for and evaluate COVID-19 infection. This is in accordance with the findings other studies showing that the burnout of HCPs working in general wards was greater than that of those working on the frontline [24]. The high levels of burnout among non-frontline nurses may be due to the following reasons: First, because hospitals provided additional manpower only to wards dedicated to confirmed COVID-19 cases, non-frontline nurses were not provided with sufficient manpower despite the increase in their workload. As a result, non-frontline nurses were highly likely to experience physical burnout. Second, non-frontline nurses might have experienced psychological burnout because they had fewer positive experiences, such as personal achievement and

social compliments, than those caring for patients with COVID-19. To successfully cope with the pandemic crisis, practical strategies, such as providing sufficient manpower and rewards for additional workloads, should be developed, and the increased work characteristics of non-frontline nurses should be identified.

Although adequate rewards are needed for all nurses devoted to caring for patients during the COVID-19 pandemic [25], there were differences in the perceived rewards provided to nurses depending on their working conditions and departments. The COVID-19 Central Disaster and Safety Countermeasures headquarters prepared a plan to provide a daily wage of KRW 300,000 to nurses dispatched to COVID-19-dedicated hospitals on February 27, 2020 [13] as well as financial rewards for frontline nurses by tripling the night care fee for frontline nurses from January 11, 2021, and paying 50,000 won per day to ICU frontline nurses from February [14]. In February 2022, after this survey, the KCDC announced guidelines related to infection control allowances for HCPs engaged in the hospitalization and treatment patients with COVID-19 [26]. The guidelines stipulate that infection control allowance should be applied differently according to the occupational type of HCPs and consider their working conditions, such as the frequency of contact with patients with COVID-19, work intensity, and exposure risk. Given HCPs' commitment to COVID-19 testing, management, and treatment during the pandemic crisis, all HCPs need to be treated equally in terms of financial and/or non-financial

rewards, regardless of their COVID-19-related working conditions. One study conducted in November 2021 reported that non-frontline nurses showed significantly higher job stress in terms of the adequacy of compensation items than frontline nurses, which suggested that financial rewards provided only to frontline nurses relatively deprived non-frontline nurses [27]. Along with unequal rewards, the issue of providing only financial rewards to HCPs should be addressed. In this study, nurses expected three types of rewards: (1) momentary financial rewards, such as danger pay allowance; (2) non-financial rewards, such as welfare benefits, days off, and regular health check-ups; and (3) reputation-related rewards, such as good ratings on work performance reviews and compliments through hospital newspapers or websites. Based on the results of this study, it is necessary for both healthcare stakeholders and hospitals to develop equity-based, diverse rewards systems.

Despite global infection threats, such as MERS and SARS, well-organized guidelines and policies for pandemic readiness, prevention, detection, and response have not been well established [28]. To prepare for future pandemics, infection monitoring and control strategies should be developed based on practical needs that reflect the real-world experiences of HCPs working during the COVID-19 pandemic era. In this study, nurses suggested the following strategies for healthcare facilities to successfully cope with the prolonged COVID-19 pandemic: (1) establishment of a dedicated infection control department and manpower; (2) establishment of financial and non-financial rewards systems for HCPs; and (3) professional training and education in preparation for the control of pandemic infectious diseases including COVID-19. Based on these findings, nurses working in general wards had few opportunities for COVID-19-related education and had excessive fatigue due to a lack of knowledge about infection control. To prepare for a new viral threat beyond COVID-19, healthcare stakeholders should establish an infection surveillance system that not only fosters dedicated manpower for infection control but also provides regular education and training for all HCPs.

The results of this study contain important characteristics and suggestions about workload, work-related symptoms, and rewards of frontline and non-frontline nurses during the COVID-19 pandemic, but the results should be interpreted carefully because of the following limitations. A relatively small sample size (particularly the small number of frontline nurses) of one tertiary hospital was included in this study. Therefore, further studies should consider including multiple centers and large sample sizes

with equal numbers of frontline and non-frontline nurses. In addition, a questionnaire regarding burnout due to infection control should be developed and applied.

## CONCLUSION

Non-frontline nurses have suffered from excessive workloads due to increased clinical and administrative tasks compared with the pre-COVID-19 period as well as due to infection control measures for patients and caregivers. Furthermore, non-frontline nurses had more severe work-related symptoms, including burnout, stress, and fatigue, than those working in dedicated wards for COVID-19. While all nurses caring for patients during the pandemic should be treated with equity, rewards for infection control measures and management for HCPs have not been sufficiently considered for non-frontline nurses. To prepare for future pandemics, healthcare stakeholders should develop effective and practical strategies including measures to improve nursing manpower management and reward strategies. This study will serve as a foundation for the development of effective strategies for workforce management in preparation for future pandemics.

## CONFLICTS OF INTEREST

The authors declared no conflict of interest.

## AUTHORSHIP

Conceptualization, Methodology, Investigation, & Project administration - YH, KYK and KS; Analysis - YH, KYK and KS; Validation - YH and KYK; Writing original draft, review & editing - YH, KYK, KS, KYJ, KYB, KT, HJ and HY.

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