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Influencing factors of fatigue among public health nurses during the COVID-19 pandemic: A cross-sectional study

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Abstract

Objective: This study investigated the effects of occupational stress, anxiety, depression, and sleep disturbance on the level of fatigue among public health nurses (PHNs).

Design: The study had a cross-sectional, correlational survey design.

Measures: A total of 198 PHNs were enrolled from 30 public healthcare centers/offices. Data were collected between May and July 2021 using a structured questionnaire to investigate the general characteristics, occupational stress, anxiety, depression, sleep disturbance, and fatigue of the participants. Descriptive statistics and multiple regressions were used to determine fatigue and its influencing factors among PHNs.

Results: The participants showed high fatigue and occupational stress levels due to a lack of rewards. The percentage of participants with mild-to-severe anxiety and mild-to-severe depression, and those who identified themselves as poor sleepers were 44.9%, 50.5%, and 70.2%, respectively. High levels of sleep disturbance ($\beta = .23$, $p < .001$), occupational stress ($\beta = .21$, $p < .001$), anxiety ($\beta = .20$, $p = .016$), depression ($\beta = .17$, $p = .043$), being younger ($\beta = -.15$, $p = .004$), and being a regular worker ($\beta = .13$, $p = .017$) were influencing factors of fatigue.

Conclusions: Individual efforts and organizational interventions to enhance sleep quality are needed to relieve fatigue among PHNs. Further, organizational support can be considerate of young nurses and regular workers, and alleviate their occupational stress. Moreover, anxiety and depression should be managed efficiently to reduce fatigue.

KEYWORDS
anxiety, depression, fatigue, nurses, occupational stress, public health, sleep disturbance

1 | INTRODUCTION

The global COVID-19 pandemic has been ongoing for over two years under unpredictable circumstances and causing many changes to the healthcare field, economy, and society (World Health Organization, 2021). Public health centers are prime examples of public institutions established to promote the health of community residents. They have been playing the role of central hubs for infectious disease control at the local level since the early stages of the COVID-19 pandemic (Melvin et al., 2020). Studies reported that healthcare workers were separated from their families and suffered an upheaval in their daily lives during the worst phases of the COVID-19 crisis, and there was fatigue accumulation due to the excessive workload (Hou et al., 2020; Jang et al., 2021; National Center for Mental Health, 2021). Public

health nurses (PHNs) account for approximately 40% (9986/25,000) of all workers in Korean public healthcare centers and represent the highest percentage for a single occupation (Ministry of Health and Welfare, 2020). During the pandemic, Korean PHNs have been performing various tasks, including the collection of samples within screening clinics inside public healthcare centers, receipt of confirmed case reports, transfer and transport of confirmed patients, management of notifications for confirmed and quarantined patients, epidemiological investigation, consultation for symptomatic patients, and disinfection management (Ministry of Health and Welfare, 2022). As the pandemic lingers, PHNs experience psychological distress, overwhelming fatigue, lack of energy, and exhaustion due to frequent changes in disease control guidelines, emergency duties, changes in duties, constant use of personal protective equipment (Adams & Walls, 2020), and responses to complaints from residents (Duarte et al., 2020). The severity and pattern of fatigue perceived by nurses differ and can negatively influence their physiological, psychological, and cognitive functions (Zhan et al., 2020).

Researchers reported that approximately 35% (935) of 2667 first-line nurses in China experienced fatigue (Zhan et al., 2020). Further, the influencing factors of fatigue among healthcare workers as reported in previous studies were occupational factors such as overtime work (Sagherian et al., 2020), and psychological factors, such as perceived stress (Sasangohar et al., 2020), anxiety (Wells & Miklencicova, 2021), depression (Jang et al., 2021), and sleep disturbance (Zou et al., 2021). The severity of psychological symptoms during the COVID-19 pandemic seems to be higher than that experienced during MERS or SARS in the past (Al Maqbali et al., 2021). A previous study also reported that healthcare providers who came in contact with COVID-19 patients manifested a poorer quality of work and higher risk of damage to their psychological well-being that could increase fatigue, compared to others (Dehkordi et al., 2020).

While various studies have highlighted fatigue or exhaustion among healthcare workers or hospital nurses during the COVID-19 pandemic, those on fatigue and its influencing factors among PHNs—who are at the front line of public health and local response to infectious diseases—have been lacking. PHNs, who are both civil servants and healthcare workers, may experience fatigue due to various factors. Severe fatigue can affect their health and negatively impact the well-being of community residents as well as their performance of public health duties. Therefore, it should be treated as an important issue.

1.1 | Objective

This study primarily aimed to establish evidence for the development of interventions by investigating fatigue and its influencing factors among PHNs. The specific objectives were to identify 1) the levels of occupational stress, anxiety, depression, sleep disturbance, and fatigue perceived by PHNs; and 2) the influencing factors of fatigue among PHNs.

2 | METHODS

2.1 | Study design

This study used a cross-sectional, correlational survey design to identify levels of fatigue and its influencing factors among PHNs.

2.2 | Participants and data collection

Convenience sampling was used to recruit nurses with at least 6 months of work experience from 30 public healthcare centers/offices in Jeju-do, Korea. Among the 200 participants who consented to participate in the study, two were excluded due to insincere responses. Ultimately, data from 198 participants were used in the final analysis. The sample size needed for regression analysis was calculated using G*Power software (ver. 3.1.9.7; Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). The parameters used included an effect size of 0.15, a medium effect size (Farag et al., 2022), significance level of .05, and statistical power of 95%. The calculation result indicated that the minimum sample size needed was 129; the number of participants enrolled in the study satisfied this requirement.

Data were collected between May and July, 2021. The questionnaire was distributed to participants with the cooperation and approval of the head of each public healthcare center. Then, a researcher informed participants of the objectives and procedures of the study. Participants who provided their written informed consent were instructed to complete the questionnaire in a self-reporting format, and completed questionnaires were retrieved immediately by the researcher. The questionnaire took approximately 15 min to complete.

2.3 | Measures

2.3.1 | General characteristics

The participants provided information regarding their age, sex, marital status, place of employment (public healthcare center/public healthcare office), employment type (regular/irregular worker), clinical practice experience, public healthcare center/office work experience, and monthly salary.

2.3.2 | Occupational stress

Occupational stress was measured using the Korean Occupational Stress Scale-Short Form (KOSS-SF) (Chang et al., 2005). The KOSS-SF comprises 24 items from seven subscales: job demand, insufficient job control, interpersonal conflict, job insecurity, organizational system, lack of reward, and occupational climate. Each item is rated on a

four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Using the score conversion method suggested by Chang et al. (2005), the score for each subscale was converted into a 100-point scale and summed to compute the total value, which was then divided by eight to arrive at the final score. The score ranged between 0 and 100 points, with higher scores indicating a higher level of occupational stress. Cronbach's alpha was .79 in the study by Chang et al. and .85 in this study.

2.3.3 | Anxiety

Anxiety was measured using the Korean translation of the Generalized Anxiety Disorder-7 (GAD-7) (Spitzer et al., 2006). The GAD-7 comprises seven items, and the participants were asked to rate how often they experienced the described symptoms over the last 2 weeks. Each item is rated on a four-point Likert scale ranging from 0 (not at all) to 3 (every day). Total scores range from 0 to 21, with higher scores reflecting higher severity levels of generalized anxiety disorder symptomology. Scores of 5, 10, and 15 may represent cutoff points for mild, moderate, and severe anxiety symptoms, respectively. Cronbach's alpha was .92 in the study by Spitzer et al. and .94 in this study.

2.3.4 | Depression

Depression was measured using the Korean translation of the Patient Health Questionnaire-9 (PHQ-9) (Kroenke et al., 2001). The PHQ-9 comprises eight items, and the participants were asked to rate how often they experienced certain issues during the last two weeks. Each item is rated on a four-point Likert scale (0–3). Total scores range from 0 to 27, with higher scores indicating higher depression levels. Scores of 5, 10, 15, and 20 may represent cutoff points for mild, moderate, moderately severe, and severe depressive symptoms, respectively. Cronbach's alpha was .94 in the study by Kroenke et al. and .90 in this study.

2.3.5 | Sleep disturbance

Sleep disturbance was measured using the Korean translation of the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989). The PSQI comprises 19 items divided into seven subscales: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. Total scores are calculated by summing the mean scores of these seven subscales ranging from 0 to 21. The higher the score, the poorer the quality of sleep. Scores > 5 indicate poor sleep. Cronbach's alpha was .83 in the study by Buysse et al. and .82 in this study.

2.3.6 | Fatigue

Fatigue was measured using the Korean translation of the Multidimensional Assessment of Fatigue (MAF) (Tack, 1991). The MAF is a self-administered questionnaire consisting of 16 items that measure fatigue with four subscales: degree and severity of fatigue, fatigue-induced distress, the effect of fatigue on daily activities (e.g., housework, cooking, bathing, working, social activity, sexual activity, leisure time, shopping, walking, and other types of exercise), and timing of fatigue. The responses delineate a model of fatigue in the past week. A global index of fatigue is calculated, and its score ranges from 1 to 50 (1 = no fatigue; 50 = severe fatigue). Cronbach's alpha was .93 in the study by Tack and .96 in this study.

2.4 | Data analysis

A statistical analysis of the collected data was performed using SPSS version 27.0 for Windows (IBM, Armonk, New York, USA). The general characteristics, occupational stress, anxiety, depression, sleep disturbance, and fatigue of participants were identified through descriptive statistics. Differences in fatigue according to the general characteristics were tested using independent *t*-tests and ANOVA, with Scheffé test for post-hoc analysis. The correlations between fatigue and related factors were examined using Pearson's correlation coefficients, and correlations between fatigue and its influencing factors were examined using multiple regression analysis. In the test regarding autocorrelation of errors, the Durbin–Watson statistic was 1.77, and the tolerance was 0.366–0.883(>0.1), indicating no autocorrelation. Meanwhile, the variance inflation factor was 1.132–2.733 (<10), thus indicating no multicollinearity problem.

2.5 | Ethical approval, informed consent, and registration

The study procedures were approved by the Institutional Review Board of Kongju National University (No. KNU_IRB_2021-24). Written informed consent was obtained from all the participants. All survey data were stored in accordance with the national legislation and institutional policies. The patients were given a USD 20 gift card for their participation.

3 | RESULTS

3.1 | General characteristics of the participants

The mean age of the participants was 38.3 (range: 23–59) years; 190 participants (96.0%) were women; 109 (55.1%) were married; 172 (86.9%) worked in a public healthcare center; 106 (53.5%) were

TABLE 1 Differences in fatigue according to the general characteristics of participants ($N = 198$)

Characteristics	Categories	*n* (%) or M ± SD	Fatigue	
			M ± SD	*t* or *F* (*p*)
Age		38.3 ± 10.9 (23–59)		
	<30 (a)	60 (30.3)	30.84 ± 8.37	8.46 (<.001)
	30–39 (b)	58 (29.3)	30.65 ± 9.78	a,b,c > d
	40–49 (c)	39 (19.7)	28.22 ± 9.68	
	≥50 (d)	41 (20.7)	22.34 ± 9.12	
Sex	Woman	190 (96.0)	28.71 ± 9.48	1.65 (.101)
	Man	8 (4.0)	22.99 ± 12.57	
Marital status	Married	109 (55.1)	27.65 ± 11.00	−1.42 (.157)
	Unmarried	89 (44.9)	29.56 ± 7.82	
Place of employment	Public healthcare center	172 (86.9)	28.55 ± 9.72	.17 (.867)
	Public healthcare office	26 (13.1)	28.21 ± 9.93	
Employment type	Regular worker	92 (46.5)	31.50 ± 8.67	4.20 (<.001)
	Irregular worker	106 (53.5)	25.91 ± 9.88	
Clinical practice	<2	45 (22.7)	29.25 ± 10.06	−.62 (.603)
experience (year)	2–5	51 (25.8)	29.61 ± 8.24	
	5–10	28 (14.1)	27.10 ± 10.06	
	>10	74 (37.4)	27.82 ± 10.38	
Public healthcare center/office work experience (year)	<2	62 (31.3)	28.93 ± 8.92	2.10 (.102)
	2–5	46 (23.2)	31.14 ± 8.96	
	5–10	26 (13.2)	26.23 ± 11.86	
	>10	64 (32.3)	27.14 ± 9.81	
Monthly salary (1000 KRW)	≤250	136 (68.7)	28.97 ± 10.04	.99 (.324)
	>250	62 (31.3)	27.50 ± 8.98	

a,b,c,d = Scheffé test. KRW, Korean won.

irregular workers; 74 (37.4%) and 64 (32.3%) had > 10 years of clinical practice experience and public healthcare center/office work experience, respectively; and 136 (68.7%) had a monthly salary of ≤ 2,500,000 KRW (Table 1).

3.2 | Occupational stress, anxiety, depression, sleep disturbance, and fatigue

The mean occupational stress score measured using KOSS-SF was 56.30 points. Regarding the sub-domains, "lack of reward" had the highest level, followed by "job demand," "organizational system," and "insufficient job control." The mean anxiety score measured using GAD-7 was 4.56 points. The number of participants with symptoms of anxiety (score of ≥ 5 points) was 89 (44.9%), including 32.8% with "mild anxiety" (5–9), 9.1% with "moderate anxiety" (10–14), and 3.0% with "severe anxiety" (15–21). The mean depression score measured using PHQ-9 was 5.63 points. The number of participants with symptoms of depression (score of ≥ 5 points) was 100 (50.5%), including 30.8%, 14.1%, 5.1%, and 0.5% with "mild" (5–9), "moderate" (10–14), "moderately severe" (15–19), and "severe" (20–27) depression, respectively. The mean sleep disturbance score measured using PQSI was 7.35 points, with 139 participants (70.2%) identifying themselves as "poor sleepers" (≥ 5). The mean fatigue score measured using MAF was 28.51 points (Table 2).

3.3 | Correlations between fatigue and general characteristics and research variables

The participants showed differences in their level of fatigue according to age ($F = 8.46$, $p < .001$) and employment type ($t = 4.20$, $p < .001$). Participants aged < 50 had higher levels of fatigue than those aged ≥ 50, and regular workers had higher levels of fatigue than irregular workers (Table 1). Fatigue was positively correlated with occupational stress ($r = 0.47$, $p < .001$), anxiety ($r = 0.61$, $p < .001$), depression ($r = 0.61$, $p < .001$), and sleep disturbance ($r = 0.47$, $p < .001$) (Table 3).

TABLE 2 Occupational stress, anxiety, depression, sleep disturbance, and fatigue ($N = 198$)

Variables	*n* (%) or M ± SD
Occupational stress (KOSS-SF)	56.30 ± 8.67
Job demand	61.52 ± 15.91
Insufficient job control	60.80 ± 14.05
Job insecurity	49.62 ± 13.60
Interpersonal conflict	48.23 ± 16.18
Organizational system	61.27 ± 15.38
Lack of reward	62.94 ± 15.96
Occupational climate	59.88 ± 14.50
Anxiety (GAD-7)	4.56 ± 4.47
No/minimal (0–4)	109 (55.1)
Mild (5–9)	65 (32.8)
Moderate (10–14)	18 (9.1)
Severe (15–21)	6 (3.0)
Depression (PHQ-9)	5.63 ± 5.05
No/minimal (0–4)	98 (49.5)
Mild (5–9)	61 (30.8)
Moderate (10–14)	28 (14.1)
Moderately severe (15–19)	10 (5.1)
Severe (20–27)	1 (0.5)
Sleep disturbance (PQSI)	7.35 ± 3.10
Good sleeper (<5)	59 (29.8)
Poor sleeper (≥5)	139 (70.2)
Fatigue (MAF)	28.51 ± 9.72

M, mean; SD, standard deviation.
Abbreviations: KOSS-SF, Korean occupational stress scale short form; GAD, generalized anxiety disorder; MAF, multidimensional assessment of fatigue; PHQ, patient health questionnaire; PQSI, Pittsburgh sleep quality index.

3.4 | Influencing factors of fatigue

Multiple regression analysis was performed using fatigue as the dependent variable and factors found to be associated with fatigue in univariate analyses (age, employment type, occupational stress, anxiety, depression, and sleep disturbance) as independent variables. The regression model was statistically significant ($F = 34.03$, $p < .001$). Sleep disturbance ($\beta = .23$, $p < .001$), occupational stress ($\beta = .21$, $p < .001$), anxiety ($\beta = .20$, $p = .016$), depression ($\beta = .17$, $p = .043$), age ($\beta = -.15$, $p = .004$), and employment type ($\beta = .13$, $p = .017$) were identified as significant influencing factors of fatigue (Table 4).

4 | DISCUSSION

In recent years, mass outbreaks of novel infectious diseases occurring without warning have become a major concern for public health. This study investigated fatigue as perceived by PHNs and its influencing factors that may be detrimental to community infection control and the well-being of residents during the current COVID-19 pandemic.

In this study, the mean fatigue score among PHNs measured using MAF was 28.51 points, higher than the clinically significant cutoff value of 21 points (Connolly et al., 2019). The score found in this study was also higher than that of fatigue levels found in previous studies conducted prior to COVID-19 on pregnant women (23.53–26.46 points) (Effati-Daryani et al., 2021) and patients with hip osteoarthritis (18.6 points) (Fu et al., 2019). However, the score was lower than that for Iranian hospital nurses (32.46 points) reported in a study conducted in 2020 (Hosseini et al., 2021). Such differences in scores may be due to variations in national policies, the pattern of the pandemic at divergent time points, work environment conditions (nurses' right to participate in institutional management, managerial leadership, organizational support, relationships with colleagues or staff, etc.), roles of PHNs and hospital nurses, and characteristics of patients (Shah et al., 2021). To deal with current and future health crises, close attention should be paid to potential fatigue-causing factors among PHNs. It is also necessary to implement strategies for eliminating and reducing factors that can cause fatigue to prevent its exacerbation or progression into post-traumatic stress disorder (Hou et al., 2020) and burnout (Sikaras et al., 2022).

Among the influencing factors of fatigue identified in this study, sleep disturbance had the largest relative influence on the exacerbation of fatigue. Likewise, research has also established that changes in sleeping patterns (Labrague, 2021; Zou et al., 2021) and irregular sleeping habits (Sayilan et al., 2021) were fatigue-causing factors among healthcare workers responding to the COVID-19 pandemic, and they experienced high levels of fatigue when they had lower sleep efficiency (Shin & Kim, 2020). These results support the finding that sleep disturbance negatively influences fatigue. Among the PHNs in this study, 70% identified themselves as "poor sleepers," which was higher than the 23.6% among hospital medical staff (Huang & Zhao, 2020) and 60% among hospital nurses (Tu et al., 2020), thereby suggesting that PHNs have been experiencing sleep disturbance at a very severe level. Previous studies reported that the level of sleep disturbance among healthcare workers during a pandemic was associated with being a female, encountering confirmed or suspected patients (Krupa et al., 2021), and an increase in workload (Stewart et al., 2021). Nurses had the lowest quality of sleep (Krupa et al., 2021; Kwon et al., 2020) among all healthcare workers. These findings suggest that PHNs are likely to be in a high-risk group for sleep disturbance as they are mostly women, who encounter confirmed and suspected COVID-19 positive patients during the screening process. They also have an excessive workload in the midst of the pandemic, including up to two hours of overtime on a daily (Kim et al., 2022). Therefore, efforts should be made to improve sleep hygiene, such as adjusting the work schedule to allow enough sleep before work, shielding noise and light from sleeping areas, and reducing caffeine intake before bedtime (Querstret et al., 2020). Additionally, improvement in the work environment and administrative/institutional considerations promote adequate rest and sleep by minimizing overtime work and guaranteeing resting hours (Sagherian et al., 2020; Scott et al., 2010).

TABLE 3 Correlation between fatigue and research variables ($N = 198$)

Variables	Occupational stress r (*p*)	Anxiety r (*p*)	Depression r (*p*)	Sleep disturbance r (*p*)	Fatigue r (*p*)
Occupational stress	1				
Anxiety	.46 (<.001)	1			
Depression	.51 (<.001)	.76 (<.001)	1		
Sleep disturbance	.22 (.002)	.43 (<.001)	.47 (<.001)	1	
Fatigue	.47 (< .001)	.61 (<.001)	.61 (<.001)	.47 (<.001)	1

TABLE 4 Factors influencing fatigue among public health nurses ($N = 198$)

Predictors	*B*	Standard error	Standardized *β*	*t*	*p*
Constant	10.55	4.25		2.48	.014
Age (year)	−0.14	0.05	−.15	−2.93	.004
Employment type: Regular worker	2.53	1.05	.13	2.41	.017
Occupational stress	0.23	0.06	.21	3.50	<.001
Anxiety	0.43	0.18	.20	2.43	.016
Depression	0.33	0.16	.17	2.04	.043
Sleep disturbance	0.72	0.18	.23	3.96	<.001
$R^2 = 0.52$, Adjusted $R^2 = 0.50$, F = 34.03 $p < .001$					

Dummy variable: employment type (reference = irregular worker).

Another influencing factor of fatigue among PHNs was occupational stress. This finding is similar to that of a previous study suggesting that healthcare workers, including nurses, perceived occupational stress during the COVID-19 pandemic as a predisposing factor to fatigue (Peng et al., 2021). Other studies reported that nurses experienced occupational stress due to unpaid bonuses related to COVID-19 duties (Manzanares et al., 2021), staffing shortage and supply delays (Shanafelt et al., 2020), difficulties associated with new roles and demands (Albott et al., 2020), complicated procedures at work, frequent changes in the work system (Walton et al., 2020), conflicts associated with uncertainties of the situation, and a lack of support (Hong et al., 2021). During the current pandemic, emergency and extended duties, rapid increases in civil work, expectations from the community and organizations (Duarte et al., 2020), professionalism, and ethical responsibilities as a civil servant (Kooli, 2021) increased occupational stress among PHNs, thus contributing to the exacerbation of fatigue. The occupational stress score among PHNs (56.30 points) in this study was higher than that of Korean hospital health workers (49.09 points) (Jihn et al., 2021), local civil servants (39.68 points) (Kang et al., 2021), and psychiatrists (43.99 points) (Sim et al., 2022).

Additionally, this study showed that the job stress for "lack of reward" was the highest. The data in this study were collected using a cross-sectional survey. Consequently, such data cannot serve as evidence to prove the causal relationship between the effects of the pandemic and occupational stress. However, based on the findings of a previous study that PHNs perceived organizational support to be low despite a high level of emotional labor during the pandemic (Kim et al., 2022), it can be assumed that occupational stress due to inadequate rewards negatively affected fatigue. Accordingly, managers of public healthcare centers should recognize that occupational stress factors different from those before the pandemic could influence PHNs. Thus, they should provide reasonable rewards considering the changed work intensity, workload, and role changes.

Other influencing factors associated with increased fatigue among PHNs were anxiety and depression. A national survey with 14,839 Korean hospital nurses (Jang et al., 2021) reported that high levels of depression and stress were associated with fatigue. Another study also demonstrated that high levels of anxiety and depression were associated with high levels of fatigue among healthcare workers, including physicians and nurses, during the pandemic (Zhan et al., 2020; Zou et al., 2021). These findings are consistent with the results of this study. We found that the percentage of PHNs with mild-to-severe anxiety and depression was 44.9% and 50.5%, respectively, higher than the percentages of 33.4% (215/643) with mild-to-severe anxiety (Shen et al., 2021) and 43.61% (481/1,103) with mild-to-severe depression (An et al., 2020) reported in previous studies on hospital nurses. A report on the investigation of mental health and burnout of medical personnel

responding to COVID-19 (National Center for Mental Health, 2021) also indicated that the levels of anxiety and depression were higher among healthcare workers in public healthcare centers than among those working in hospitals. Lasalvia et al. (2021) established that healthcare workers' anxiety, depression, and exhaustion remained at high levels despite changes in the epidemiological patterns of the pandemic, improvements in medical systems, and vaccination drives. Our study showed that approximately half of the PHNs experienced anxiety and depression, confirming that such psychological symptoms must be considered to reduce fatigue. Meanwhile, cognitive-behavioral approaches (Hong et al., 2021), social support at the hospital and organizational levels (Peng et al., 2021), counseling support services, online workshops, and educational material (World Health Organization, 2020) are recommended for enhancing the mental health of healthcare workers. The health authorities in Korea have also prepared non-contact resources to provide psychological support to healthcare workers, including depression prevention programs, telephone psychological counseling services, and mobile applications. However, only 18.2% of healthcare workers were aware of such services (National Center for Mental Health, 2021), which indicates the need for active promotion at the governmental and organizational levels.

This study's findings also revealed that the level of fatigue perceived by PHNs was higher among regular workers than irregular workers. Owing to the community transmission of COVID-19, PHNs were temporarily relieved of their regular duties and arbitrarily assigned to prioritize COVID-19-related work. The need to learn ever-changing public health policies and regulations, the excessive burden of infection control duties, the lack of systematic education and guidelines, and absence of replacement workers (Kim et al., 2022) could have caused an even higher level of fatigue among regular PHNs. Public health problems (maternal and infant mortality, intimate personal violence, child/elder abuse and neglect, and substance use disorders) that were urgent concerns earlier are likely to worsen as the pandemic progresses (Edmonds et al., 2020; Honda et al., 2020). Accordingly, various support measures, including developing infectious disease crisis response protocols and additional staffing, must be established to ensure that regular PHNs do not neglect their core duties due to accumulated fatigue even post-COVID-19. These core duties comprise public health administration, health promotion, maternal and child healthcare, mental healthcare, and management of patients with chronic diseases.

This study also showed that fatigue was more severe among younger PHNs. These findings were similar to those of a previous study on hospital nurses (Jang et al., 2021; Sikaras et al., 2022) and Stone et al. (2021), who reported that 73.9% of public health professionals aged <30 experienced exhaustion. Relatively young nurses may perceive a high level of fatigue when they are involved in work that requires close contact with confirmed patients at COVID-19 screening centers (Jun et al., 2021), due to lack of expertise in infection prevention and control work (Galanis et al., 2021; Kox et al., 2020). Moreover, another study reported that younger nurses had poorer sleep quality (Sayilan et al., 2021) and were likely to have high levels of anxiety and depression (Huang & Zhao, 2020), contributing to increased fatigue or exhaustion (Dall'Ora et al., 2020). Therefore, special measures are needed to help address fatigue among young PHNs.

4.1 | Limitations

The limitations of this study are as follows. First, because the study population was limited to PHNs working in public healthcare centers located in a specific region of Korea, caution should be taken when generalizing the findings. Second, on account of the low proportion of men among PHNs, an adequate sample size could not be obtained when compared to women. Third, due to the cross-sectional survey design, there are constraints in explaining the causal relationships between fatigue and its influencing factors. Fourth, the study identified sleep disturbance, anxiety, depression, and fatigue experienced in the 2 weeks prior to our study as perceived by the participants; hence, the possibility of recall bias cannot be dismissed. Fifth, the study did not investigate other occupational characteristics such as overtime work hours, work proficiency and intensity, and workload (Alahmadi & Alharbi, 2018). Further, personal characteristics such as sleep pattern before the COVID-19 pandemic, duration of sleep (Min et al., 2021), circadian rhythms (Chang & Li, 2022), and parenting or family care (Alsayed et al., 2022), which may also influence fatigue, were not incorporated. Sixth, the study failed to control for cases of individuals accompanied by symptoms of anxiety and depression, and those with high levels of psychological symptoms and sleep disturbance. Thus, we recommend investigating the association between sleep and occupational characteristics of PHNs as well as their fatigue levels for future studies. We also endorse longitudinal studies regarding the effects of fatigue on the quality of life, turnover rate, and job performance of healthcare professionals. Finally, we suggest studies on developing and validating interventions for reducing fatigue.

4.2 | Strengths

Nevertheless, this study identified the levels of fatigue, sleep disturbance, anxiety, and depression among PHNs working at 30 public healthcare centers and offices. It also identified sleep disturbance, occupational stress, anxiety, depression, employment type, and age as influencing factors of fatigue in order to establish basic data to develop interventions for relieving fatigue. This was also the first study on fatigue among Korean PHNs during the COVID-19 pandemic. The findings in this study can serve as important reference material in reducing turnover among PHNs and maintaining public health and infection control at the community level.

5 | CONCLUSIONS

This study indicates the urgency for interventions that reduce fatigue among PHNs during the COVID-19 pandemic. We observed that fatigue, anxiety, depression, and poor sleep quality were at high levels

among PHNs. The study also identified that high levels of sleep disturbance, occupational stress, depression, anxiety, employment type (regular worker), and age (younger age) were associated with higher fatigue levels. Further, organizational support can be considerate of young nurses and regular workers, and alleviate their occupational stress. Moreover, anxiety and depression should be managed efficiently to reduce fatigue.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHOR CONTRIBUTIONS

Ok-Hee Cho: Conceptualization, Methodology, Investigation, Writing – Original Draft, Writing – Review & Editing, Supervision, Project administration. Jeongeun Yoon: Conceptualization, Methodology, Data Analysis, Writing – Original Draft, Writing – Review & Editing. Mina Kim: Data Collection, Writing – Review & Editing.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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