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Long-term Complications of COVID-19 in Nursing Staff; a Retrospective Longitudinal Study

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Abstract: **Introduction:** Although the lungs are the main target of coronavirus disease (COVID-19), infection is also associated with a high rate of extra-pulmonary complications. This study aimed to evaluate the one-year incidence of long-term COVID-19 complications among the nursing staff. **Methods:** This study is a retrospective longitudinal study. All nursing staff working in public hospitals affiliated with Shahid Beheshti University of Medical Sciences who had been affected with COVID-19 were included in the study via convenience sampling method. The patients were recruited from 20th February 2020 to 20th March 2021. **Results:** 1762 nursing staff with a mean age of 35.08 ± 8.02 (Range: 22-66) years were studied (73.5% female). The results showed that among those who reported at least one type of complication, the duration of complications was significantly longer than 1 week and the median was 8 weeks. The findings demonstrated that complications occurred in 65% of infected females. For men, this rate was 62.3%. Generalized pain, anxiety disorders, and skin complications were among the complications that were significantly more common in women than in men. Additionally, the incidence of anosmia, ageusia, anxiety disorders, and skin complications was significantly higher in younger people than in older people. The comparison of complications revealed that nurses were significantly more likely than other occupations to experience respiratory complications, anosmia and ageusia, generalized pain, and skin complications and that outpatients experienced significantly more complications than hospitalized patients. **Conclusion:** The one-year cumulative incidence of long-term complications in nursing staff with COVID-19 was 64.3%. The most common complications were respiratory complications, generalized pain, anosmia, and ageusia, respectively.

Keywords: COVID-19; Coronavirus; Nursing Staff; Hospitals; Long-Term Care

1. Introduction

Coronavirus disease (COVID-19) is an infectious disease caused by an emerging coronavirus (SARS-CoV-2) (1). It is a critical global disease that continues to infect millions of people worldwide (2,3). The first case of COVID-19 was announced in Wuhan, China in late December 2019, and the disease has since shaken the entire world (2,4). In the second half of April 2022, there were reportedly 506 million cases affected worldwide, and more than 6 million people had perished as a result of this deadly illness (5). Over 147,000 people have died and about 7 million cases have been identified in Iran during this time (6). The initial goal of treatment for patients with COVID-19 is survival (7). Despite the fact that the lungs are the primary target and the symptoms are mostly systemic or respiratory, the infection is also linked to a high rate of extra-pulmonary complications that may cause disability and delayed mortality (3,4,7). There are also neurological complaints such as loss of sense of smell and taste, change in consciousness, headache, seizures, and numbness of the limbs (3). Other problems such as involvement of the

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respiratory system, cardiovascular system, kidneys, liver, endocrine glands, digestive, central nervous system, skin, eyes, and blood coagulation problems, and electrolyte imbalance have been observed (8).

Complications of thromboembolism caused by COVID-19, such as pulmonary embolism, stroke, and other minor strokes, can also cause a wide range of permanent organ damage (7). The virus is thought to aggravate the problems of patients with heart failure. In addition, there have been numerous reports of high rates of acute myocardial infarction, arrhythmia, hypotension, and tachycardia, and other cardiovascular diseases in patients admitted to the intensive care unit due to COVID-19 (4).

New data as well as prior experience with other severe respiratory diseases and intensive care syndrome suggested the possibility of post-COVID-19 syndrome, despite the fact that there is not yet enough information to draw a firm conclusion. These complications include a set of physical, cognitive, and psychological disabilities that can occur in those who survive a serious illness. Patients with severe manifestations of COVID-19 often progress to acute respiratory distress syndrome (ARDS) and require a ventilator. Acute Respiratory Distress Syndrome may cause permanent fibrosis in the lung tissue, resulting in respiratory problems that persist for a long time after recovery (7).

Studies on SARS-CoV-1 and Middle East Respiratory Syndrome (MERS) show that some people do not return to normal health after infection and can experience long-term health problems, including neuropsychiatric complications such as headache, fatigue, dizziness, memory loss, confusion, and difficulty concentrating and slow processing years after acute infection (3). The results of a study on patients with SARS showed that more than a third of them had moderate to severe depression and anxiety up to one year after physical recovery. The mental health effects of COVID-19 may also be exacerbated by loneliness and isolation, job loss and economic consequences, and increased childcare and family responsibilities (7).

One group at risk of COVID-19 are health professionals. It is globally advised to protect health workers through provision of personal protective equipment, training, fatigue relief, and coping with psychosocial consequences (9), due to the high burden of disease.

Considering that comprehensive awareness of these complications helps healthcare providers pay attention to these complications and to diagnose and treat them in a timely manner; the aim of this study was to determine the one-year incidence of long-term complications of COVID-19 among the nursing staff of centers affiliated to Shahid Beheshti University of Medical Sciences in 2021.

2. Methods

2.1. Study design and settings

This study is a retrospective longitudinal study. The nursing staff with COVID-19 who worked in hospitals affiliated to Shahid Beheshti University of Medical Sciences, Tehran, Iran, and had long-term complications (with a duration from 1 week to 54 weeks) were recruited from 20th February 2020 to 20th March 2021.

Participants received an invitation letter with a checklist and consent form to participate in this study. This study received an ethics code (IR.SBMU.PHNS.REC.1400.081) from Shahid Beheshti University of Medical Sciences and researchers adhered to Helsinki Declaration's recommendations.

2.2. Participants

The target population (sampling frame) included all categories of nursing services (nurse, supervisor, assistant nurse, assistant practical nurse, practical nurse, surgical technician, anesthesia technician, and midwife) working in the hospitals affiliated to Shahid Beheshti University of Medical Sciences, who were affected by COVID-19, as diagnosed via polymerase chain reaction (PCR) or Chest computed tomography (CT) or clinical signs of the disease. We did not take into account complications that lasted less than one week (short-term complications) or more than 54 weeks (suspected permanent complications). The sampling method was convenience sampling.

2.3. Data gathering

Data collection was done using a checklist of 22 long-term complications (fatigue, cough, breath shortness, anosmia/ageusia, headache, body/joint pain, diarrhea/nausea, chest pain, stomachache, confusion, sleep disorder, paramnesia, concentration disorder, tachycardia, palpitation, depression, anxiety, skin rash, hair loss, hypotension, flank pain) generated by searching reputable websites such as WHO and CDC. The checklist had 4 sections including demographic variables (4 questions), diagnosis (3 questions), treatment (2 questions), and complications (2 questions). Then checklist was sent to all educational and treatment hospitals (20 hospitals) as an official letter and in each hospital, the required data was provided by the nursing staff completely voluntarily and with their own consent. We received 18 hospital reports out of the 20.

Complications that lasted from one week to 54 weeks were categorized as long-term complications, and their incidence was calculated.

2.4. Statistical analyses

Finally, the data was entered into SPSS 16 and analyzed. Mean and percentage were used for descriptive analysis of

the data. The ratio between the number of patients who reported a specific complication in a given period of time and the total number of patients who developed COVID-19 in the same period was calculated to determine the incidence of the complication. To calculate the significant relationship between variables we used the Chi-squared test.

3. Results

In this study, 1762 nursing staff members (73.5% female) with a mean age of 35.08 ± 8.02 (range: 22-66) years were examined. Table 1 lists the baseline characteristics of the cases that were examined. Between the ages of 20 and 40, 70% were infected. 1162 people (65.94 percent) reported at least one type of complication. The findings showed that the median length of complications among those who reported at least one type was 8 weeks and that the duration of complications was significantly longer than 1 week ($p < 0.0001$). 12 percent of them also experienced complications that lasted longer than six months. It is impossible to make a judgment in this regard, because the complication was still present at the time of the study in 9.23% of the patients. Also, the durability of complications in those aged over 30 years was significantly more than 2 weeks ($p = 0.005$) and in ages under 45 years, it was significantly more than 4 weeks ($p = 0.05$).

The findings revealed that complications affected 65% of the infected women. For men, this rate was 62.3%. Those aged 40 to 50 years were more affected (70.3%), while those aged 50 to 60 years were less affected (53.1%). Also, the incidence of complications was higher in supervisors (75.9%) and lower in practical nurses (41%).

Regarding complications, the incidence of generalized pain, anxiety disorders, and skin complications was significantly higher in women than in men. Also, the incidence of anosmia & ageusia, anxiety disorders, and skin complications were significantly higher at younger ages than at older ages.

The comparison of complications revealed that nurses were significantly more likely than to experience respiratory complications, anosmia and ageusia, generalized pain, and skin complications; additionally, outpatients experienced significantly more complications than hospitalized patients. Table 2 shows more information.

4. Discussion

Healthcare workers have been severely affected by the COVID-19 outbreak, with many becoming infected on the job and a significant number dying. This study looked at the long-term complications of COVID-19. In the current study, 1762 COVID-19 personnel took part, and 1162 of them reported at least one type of complication, with a cumulative annual incidence of the complication of 64.3%. Of the patients, 57.3% were nurses, 74.3% were female, and over 70%

Table 1: Baseline characteristics of studied participants

Variables	Frequency (%)
Gender	
Female	1310 (74.3)
Male	452 (25.7)
Age Groups (year)	
20-30	627 (35.6)
30-40	703 (39.9)
40-50	337 (19.1)
50-60	81 (4.6)
60-70	1 (0.1)
Missing	13 (0.7)
Job Position	
Nurse	1010 (57.3)
Supervisor	79 (4.5)
Assistant Practical Nurse	216 (12.3)
Practical Nurse	40 (2.3)
Surgical Technician	111 (6.3)
Midwife	64 (3.6)
Assistant Nurse	38 (2.2)
Anesthesia Technician	117 (6.6)
Missing	87 (4.9)
Method of diagnosis	
PCR	705 (40.0)
Chest CT scan	164 (9.3)
Clinical findings	199 (11.3)
Combination of two or three methods	689 (39.3)

PCR: polymerase chain reaction; CT: computed tomography.

were between the ages of 20 and 40. Seventy-five percent (773 patients) of those who reported at least one complication had complications for at least 12 weeks. The most common complications among nurses were respiratory (52.1%), general pain (26.0%), anosmia and ageusia (14.6%), anxiety disorders (11.2%), skin complications (8.8%), and gastrointestinal symptoms (6.0%).

Sua´rez-Garcı´a et al. performed a study in Madrid (Spain) and found that a total of 11.1% of health care workers (HCWs) had microbiological confirmation of COVID-19. The median age was 42 years (interquartile range (IQR): 34–52), and 171 (80.3%) cases were women (10). Out of the 16,912 HCWs who were tested for COVID-19 infection in Qatar, 10.6 percent of the results were positive. The median age was 39 years (IQR: 33-48) and nurses and midwives had the highest number of infections (33.2% of all infected HCWs), and in contrast to our study, 65.6% of the cases were male (11). Zheng et al. obtained details on 2457 cases of infection among HCWs in Wuhan, China. Nurses made up more than half of the infected people (52.06 percent), and female HCWs made up 72.28% of the cases (12).

In a systematic review study, infection and mortality of COVID-19 in HCWs were estimated from a global perspective in the early stages of the epidemic. A total of 152,888 infections and 1,413 deaths were reported. Infections were mainly

Table 2: Distribution of long-term COVID-19 complications among the nursing staff based on the demographic variables

Variables	Complications					
	Respiratory	Anosmia	Pain	GI	Anxiety	Skin
Gender						
Female	618 (47.2)	168 (12.8)	345 (26.3)	68 (5.2)	147 (11.2)	125 (9.5)
Male	213 (47.1)	43 (9.5)	94 (20.8)	21 (4.6)	33 (7.3)	10 (2.2)
P-Value	0.98	0.06	0.01	0.64	0.01	<0.001
Age Group (year)						
20-30	291 (27.6)	70 (11.2)	173 (11.2)	38 (6.1)	37 (5.9)	36 (5.7)
30-40	324 (21.8)	76 (10.8)	153 (11.2)	29 (4.1)	72 (10.3)	54 (7.7)
40-50	176 (27.9)	60 (17.8)	94 (17.2)	19 (5.6)	59 (17.5)	39 (11.6)
50-60	37 (19.8)	5 (6.2)	16 (11.2)	3 (3.7)	10 (12.5)	5 (6.2)
60-70	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
P-Value	0.3	0.001	0.05	0.53	0.001	0.02
Job Position						
Nurse	526 (52.1)	147 (14.6)	263 (26.0)	61 (6.0)	113 (11.2)	89 (8.8)
Supervisor	45 (57.0)	16 (20.3)	32 (40.5)	4 (5.1)	14 (17.7)	14 (17.7)
Assistant Practical Nurse	101 (46.8)	18 (8.3)	62 (28.7)	9 (4.2)	16 (7.4)	11 (5.1)
Practical Nurse	13 (32.5)	1 (2.5)	4 (10.0)	1 (2.5)	3 (7.5)	2 (5.0)
Surgical Technician	39 (35.1)	8 (7.2)	21 (18.9)	5 (4.5)	8 (7.2)	3 (2.7)
Midwife	28 (43.8)	8 (12.5)	20 (31.3)	6 (9.4)	9 (14.1)	6 (9.4)
Assistant Nurse	32 (84.2)	3 (7.9)	15 (39.5)	1 (2.6)	4 (10.5)	2 (5.3)
Anesthesia Technician	47 (40.2)	10 (8.5)	22 (18.8)	2 (1.7)	13 (11.1)	8 (6.8)
P-value	0.001	0.001	0.001	0.32	0.22	0.001
Hospitalization history						
Hospitalization	113 (65.7)	20 (11.6)	73 (42.4)	20 (11.6)	42 (24.6)	28 (16.3)
Outpatient	718 (45.2)	191 (12.0)	366 (23)	69 (4.3)	138 (8.7)	107 (6.7)
P-value	0.001	0.87	0.001	0.001	0.001	0.001

Data are presented as frequency (%). GI: gastrointestinal.

in women (71.6%, n = 14058) and nurses (38.6%, n = 10.706). The reported infected HCWs had an average age of 47.3 years, with a range of 18 to 84. Africa reported the fewest COVID-19 infections among HCWs (1472, 1.0%), while Europe reported the most (119628, 78.2%). On 8 May 2020, Spain reported the highest cumulative number of COVID-19 infections in HCWs worldwide with 30,663 (20% of all HCW infections), Italy (23718), and the Netherlands (13884) followed (13). According to the study by Chutiyami et al. the overall infection rate among healthcare workers ranged from 3.9% to 11%. Female healthcare workers (71.6%) had higher rates of infection than male healthcare workers. The number of cases (4812 from 14058) was higher in the age group of 50 to 59 years and nurses were the most affected group among health care professionals. Cough, fever, headache, and malaise were the main clinical symptoms experienced by healthcare workers. The most important symptoms associated with COVID-19 infection were anosmia, fever, myalgia, fatigue, and sore throat (14). The total number of patients among healthcare workers who were examined in 28 studies for a meta-analysis study was 119,883. In HCWs with COVID-19, fever was the most common symptom, followed by cough and fatigue, with a mean age of 38.37 years and a female prevalence of 78.6% (15).

Gómez-Ochoa et al. estimated that the prevalence of SARS-CoV-2 infection in healthcare worker samples, using reverse transcription polymerase chain reaction and the presence of antibodies, was 11% (95% confidence interval (CI): 7.15) and 7% (95% CI: 4.11), respectively. The most affected staff were nursing staff (48%, 95% CI: 41, 56). Fever, anosmia, and myalgia were the main factors associated with SARS-CoV-2 infection (16). Among the symptomatic HCWs for COVID-19, the most commonly reported symptoms were fever (57%) and dry cough (57%) followed by nausea (43%) and myalgia (48%). The study by Magnavita et al. showed that the infected workers were mainly nurses and young people. The most common symptoms observed in infected workers were muscle pain (52.4%) and fatigue (47.6%). Anosmia (42.7%) and ageusia (37.8%) were also very common among infected HCWs (17).

The high rate of infection among nursing staff may be related to the nature of nursing responsibilities, including 24-hour care of infected patients. Additionally, some nurses working in the healthcare sector are primarily concerned with screening patients and are, therefore, exposed to SARS-CoV-2 before their diagnosis is confirmed. In addition to the potential severity of acute COVID-19, persistent symptoms may last for months and can be significantly debilitating. HCWs,

like other people infected with COVID-19, may experience a long-term illness. There are few reports of long-term consequences for HCW survivors of COVID-19 studies.

In a prospective cohort study of admitted patients in Norway, half reported dyspnea, and one quarter had reduced gas transfer on lung function tests 3 months after the initial infection (18). Organ systems other than the respiratory system are also affected by COVID-19, including the cardiovascular and musculoskeletal systems, and these effects can be sustained. More than two months after the initial COVID-19 infection, a sizable portion of patients still had a myocardial infarction, as determined by magnetic resonance imaging (MRI), including numerous patients who were either asymptomatic during the initial illness or only had mild symptoms (19).

A systematic review and meta-analysis showed that 80% of people with confirmed COVID-19 diagnosis still had at least one overall effect beyond 2 weeks after acute infection. Fatigue, anosmia, pulmonary dysfunction, abnormal chest X-ray/CT, and neurological disorders were the most common. The five most common complications were: fatigue (58%), headache (44%), attention disorder (27%), hair loss (25%), and dyspnea (24%) (20). In a study by Townsend et al., of the 128 participants (49.5 ± 15 years; 54% female), more than half reported persistent fatigue (128.67; 52.3%) at an average of 10 weeks after the onset of the symptoms of COVID-19 (21). A qualitative study in the UK examined the perspectives of people who experienced persistent symptoms after COVID-19 infection. Some people who had an allegedly minor COVID-19 infection were still dealing with cyclical symptoms that persisted, including pain, palpitations, shortness of breath, memory loss, and fatigue (22).

In a follow-up study conducted in China, among non-critical cases of hospitalized patients with COVID-19, radiographic changes persisted in approximately two-thirds of patients 3 months after discharge. Following a 3-month follow-up, the following symptoms were present: exertional dyspnea (14.55 percent), cough and sputum (1.81 percent), headache (18.18 percent), fatigue (16.36 percent), and gastrointestinal (GI) symptoms (30.91 percent) (23). Xiong et al. examined the prevalence and clinical symptoms of possible post-traumatic stress disorder (PTSD) in surviving HCWs 6 months after the outbreak of COVID-19 in China. The mean age of the 291 studied surviving HCWs was 37.3 years, 81.1% were female, 58.4% were nurses, and 19.9% of them had possible PTSD 6 months after acute exposure to COVID-19. Factors significantly associated with possible PTSD included life-threatening COVID-19, intensive care unit (ICU) admission, increased respiratory symptoms, exposure to other traumatic events, a residual symptom of dizziness, and residual symptom of shortness of breath (24).

In one study, Liao et al. evaluated the long-term conse-

quences of COVID-19 among HCWs in China. They observed decreased lung diffusion function, abnormal CT patterns, impaired physical function, and psychiatric disorders during the 1-year follow-up. A pulmonary diffusion abnormality was found 1 year after discharge in 40.97% of HCWs who survived mild/moderate COVID-19 and 47.67% of HCWs who survived severe/critical COVID-19, according to the lung function assessment. An abnormal CT pattern was also found in 37.5% of the HCWs. Probable PTSD was reported in 21.9% of the surviving HCWs. The proportion of nurses and females among infected HCWs was high. Recently, anosmia and ageusia emerged among the earliest symptoms of SARS-CoV-2 infection, possibly due to a disruption of the ciliary nasal epithelium mediated by the novel coronavirus (25).

Failure to address infection among HCWs has the potential to increase transmission of COVID-19 in healthcare centers and communities. HCW deficiency may impair the quality of national health care services, both in the acute phase of the epidemic and in the long term. Immediate intervention in the form of effective protective measures, early diagnosis, immediate treatment, and vaccination are essential.

Healthcare workers experienced considerable COVID-19-related physical health issues. This requires targeted interventions and multidisciplinary teams to develop preventive measures, rehabilitation techniques, and clinical management strategies to support and address the long-term care of healthcare workers with COVID-19.

5. Limitations

The fact that participation in the study was voluntary makes it impossible to differentiate if those who opted out did not have COVID-19, experience complications, or simply did not want to participate in the study. Another drawback was that a lot of the complications were based on people's individual perceptions, making it impossible to assume that everyone understood them accurately. We also only got 18 hospital reports out of 20. This might be a confounding factor, so we advise controlling it through systematic sampling in future studies.

6. Conclusions

The one-year cumulative incidence of long-term complications among nursing staff with COVID-19 was 64.3%. The most common complications were respiratory complications, generalized pain, anosmia, and ageusia, respectively.

7. Declarations

7.1. Acknowledgments

We appreciate each and every participant who helped us with the data collection and questionnaire distribution.

7.2. Conflict of interest

The authors have no conflict of interest to declare

7.3. Fundings and supports

7.4. Authors' contribution

All authors participated in data collection, data analysis, manuscript preparation, and final manuscript approval.

7.5. Data availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

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