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A cross-sectional study of epidemiological determinants for Covid-19 infection among nurses of a tertiary care hospital

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Abstract:

BACKGROUND: All health care workers including nurses are working in the frontline against coronavirus disease 2019 (Covid-19), which keeps them at high risk of getting infected. This study was conducted to identify risk factors for Covid-19 infection and compliance to Covid appropriate behavior among nurses.

MATERIAL AND METHODS: A cross-sectional study was conducted on 150 nurses in a tertiary care hospital attached to a medical college in Mumbai, from April 2020 to December 2020. Data were collected telephonically using an interviewer-administered pre-validated, semi-structured questionnaire. Data entry and analysis were performed using SPSS version 21.0.

RESULTS: The mean age of the nurses was 38.19 ± 12.14 years. The majority (80.7%) were exposed to Covid-19 while taking active care of Covid patients; a total of 108 (72%) were symptomatic at the time of testing; dietary modifications because of fear of Covid were performed by 121 (80.2%); 92.77% used the appropriate personal protective equipment (PPE) category according to the workplace; 121 (80.77%) followed all steps of donning and doffing at all times, and 19 (12.77%) reported a breach in PPE. A greater proportion of nurses working in Covid duties opted for hospital isolation than home isolation ($p = 0.003$). Risk factors such as sleep, shift duty, shift pattern, food timing, mode of travel, and type of PPE during travel were also found to be significantly associated with work type – Covid versus non-Covid ($p < 0.05$).

CONCLUSIONS: Use of workplace appropriate PPE, proper donning and doffing facilities, duty shifts with a fixed duration, adequate hand hygiene practices, and regular food intake with adequate sleep can prevent Covid-19 infection at the workplace among nurses.

Keywords:

Covid-19, hand hygiene, healthcare worker, nurses

Introduction

All health care workers are exposed to innumerable infectious diseases while working in the hospital setting. Since the beginning of the coronavirus disease 2019 (Covid-19) pandemic, they have been working in the frontline. While delivering their services, many of them have got infected and have turned Covid-positive. They are in direct contact with the Covid-19 patients

and their surroundings. Surfaces such as a hospital bed, bedside tables, railing, curtains, and so on are mutually touched by both patients and health care staff. These surfaces have been reported to be contaminated by influenza and coronaviruses.^[1-3] Being one of the vital resources of the health system, the well-being of nurses in the pandemic is essential as they are maximally exposed to the infection.^[4] Therefore, this study was conducted to identify risk factors for Covid-19 infection and compliance to Covid

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appropriate behavior among nurses. This will help us in identifying and updating infection prevention and control measures and develop guidelines to reduce secondary Covid-19 infections within hospital settings.

Materials and Methods

Study design and setting

This cross-sectional study was conducted in a tertiary care hospital attached to a medical college in Mumbai, Maharashtra.

Study duration

From April 2020 to December 2020.

Study participants and sampling

During this period, 181 nurses got infected. Their details were obtained from contact tracing records. All of them were contacted telephonically after recovery and consent for participation in the study were sought by a Google form link (English/Hindi/Marathi). A waiting period of 2 days was considered; after this, the link was re-sent followed by a waiting period of another 2 days. If consent was not obtained during this period, then they were considered non-consenting and were not contacted again. Out of 181 nurses, 150 (82.87%) consented to participate in the study, of which 149 (99.3%) were female nurses and one was a male nurse.

Data collection tool and technique

Data collection was performed using an interviewer-administered pre-validated, semi-structured questionnaire. The study questionnaire was developed in line with the study objectives and was pilot-tested. It was collected telephonically at a time convenient to them. Each interview lasted for about 30 minutes. Data entry and analysis were performed using SPSS version 21.0.

Ethical consideration

Ethical approval was obtained from the Institutional Ethics Committee (EC/OA-108/2020).

Result

This cross-sectional study conducted on 150 nurses from a tertiary care center yielded the following results:

Baseline characteristics

The mean age of the nurses in our study was 38.19 ± 12.14 (range 19–58) years. Twenty (13.3%) were nursing students, and the rest (86.7%) were staff nurses. The majority of them that is, 120 (80%), were married, 29 (19.3%) were unmarried, and one (0.7%) was a widow. No habits/addictions such as smoking, drinking, or tobacco chewing were reported. None of the study participants were pregnant. At the time of

testing positive, 76 (50.7%) of them were working in Covid wards, 68 (45.3%) were working in non-Covid wards, and the rest (4%) were working in both settings. During Covid duty rotation, 49 (32.66%) nurses were staying in hostels or separate facilities provided by the institute, and the rest 101 (67.33%) were staying at home with the family. Those staying at hostels and separate facilities shared common utility spaces and lavatories with other inmates. Based on self-reported height and weight, the mean body mass index (BMI) was 24.35 ± 3.71 (range 15.81–32.47) kg/m². A total of 383 high-risk contacts [Mean – 2.56 ± 3.08 (range 0–27)] and 65 low-risk contacts [Mean – 0.43 ± 1.53 (range 0–13)] were quarantined against them.

Exposure and clinical outcome

The majority of the nurses, that is, 120 (80.7%), were exposed to Covid-19 while taking active care of covid patients in hospital, 13 (8.7%) were exposed to a Covid-19 positive family member, nine (6%) were exposed while working in the same premises where a Covid-19-positive person was present but with no direct contact, and the remaining seven (4.7%) had no known contact with proven Covid-19 patients. At the time of testing, 108 (72%) were symptomatic with a mean duration of symptom of 1.65 ± 1.56 (range 0–7) days. Seventy (64.81%) of these had taken symptomatic treatment for the same. Other clinical characteristics are given in Table 1. The majority (88%) opted for hospital isolation as facilities for home isolation were not available. All of them joined duty after one negative swab.

Risk factors

About 49 (32.66%) nurses had some comorbidity. The majority of the nurses (72%) worked on shift duty. The duration of shift for all nurses who were in Covid duty was 6–8 hours. The duration of shift in the non-Covid ward was variable, ranging from 8 to 12 hours. Dietary modifications because of fear of Covid-19 were performed by 121 (80.2%) nurses. They included eating balanced meals and the inclusion of citrus fruit in the diet. Other risk factors are given in Table 2.

Covid appropriate behavior

All nurses used some form of personal protective equipment (PPE) at the workplace. However, only 139 (92.77%) used the appropriate PPE category according to the workplace. The PPE supply was described as 'adequate' by all nurses. All nurses received formal training in PPE use including donning and doffing practices. All of them had adequate knowledge regarding donning and doffing. Despite this, only 121 (80.77%) nurses followed all steps of donning and doffing at all times. In the past 6 months, 32 (21.33%) nurses were exposed to a Covid-19-positive patient after doffing. The contact was described as

Table 1: Clinical characteristics of nurses infected with Covid-19

Clinical characteristics	Number (n=150)	Percentage
Type of test		
RT-PCR	113	75.33
Rapid antigen	28	18.66
Both	9	6.0
Reason for testing		
Symptomatic	97	64.66
History of breach in PPE	11	7.33
Positive family member	11	7.33
Post-Covid duty screening	22	14.66
Travel	8	5.33
Pre-operative screening	1	0.66
Symptoms		
Asymptomatic	42	28.0
Fever	73	48.66
Sore throat	27	18.00
Cold	14	9.33
Cough	36	24.00
Malaise/backache	35	23.33
Headache	23	15.33
Loss of taste/smell	8	5.33
Breathlessness	6	4.00
GI Symptoms	2	1.33
Co-morbidity		
Yes	49	32.66
No	101	67.33
Isolation		
Home	18	12.00
Hospital	132	88.00
Mode of treatment		
Oral only	107	71.33
Oral and IV drugs	39	26.00
Oral, IV, and Oxygen	4	2.66

'extremely short', 'forgot something inside the isolation ward', and 'the patient suddenly got serious'. A total of 19 (12.77%) nurses reported a breach in PPE in the past 6 months. All nurses know the steps of hand hygiene, carry a personal hand sanitizer, and follow hand hygiene. All nurses wash hands multiple times a day before and after patient contact. Seventy-two percent of nurses reported being able to maintain physical distance at work at all times. Other behavioral risk factors are given in Table 3.

Difference in risk factors based on work type – Covid versus non-Covid

The mean age of nurses posted in Covid duties (35.27 ± 11.63 vs 41.72 ± 11.87 years) was significantly lesser than those posted in non-Covid duties ($p < 0.001$). It was observed that a greater proportion of nurses working in Covid duties opted for hospital isolation than home isolation (52% vs 36%, $P = 0.003$). Risk factors found significantly associated with work type – Covid versus non-Covid – are given in Table 4.

Table 2: Risk factors for Covid-19 infection

Risk factors	Number (n=150)	Percentage
Co-morbidity (n=49)		
Diabetes mellitus	18	12.00
Hypertension	19	12.66
Thyroid disorder	14	9.33
Asthma	8	5.33
Tuberculosis	3	2.00
Others	7	4.66
Sleep duration		
Adequate (at least 6 h)	92	61.33
Inadequate	26	17.33
Adequate but disturbed	32	21.33
Type of duty		
Shift	108	72.00
Fixed rotation	42	28.00
Meal timing		
Regular	102	68.00
Irregular	48	32.00
Source of meal		
Home-cooked	106	70.66
Outsourced	44	29.33
Water intake		
Adequate	99	66.00
Inadequate	51	34.00
Dietary modification		
Yes	121	80.66
No	29	19.33
Intake of citrus fruits		
Yes	142	94.66
No	8	5.33
Pharmacological prophylaxis for Covid-19		
Nil	29	19.33
HCO	121	80.66
Arsenic album	14	9.33
Multi-vitamins	3	2.00

Discussion

Nurses are one of the vital resources of any health care facility.^[4] The Covid-19 pandemic has put every health care worker at risk of life with no exception to the nurses.^[5] The present study was conducted to find out potential factors associated with Covid-19 infection in nurses working in a tertiary care hospital. Being one of the largest Covid care hospitals in Mumbai, the setup also served as a potential source of infection to the nurses. These findings also suggest that serious nosocomial infections occurred in the beginning phase of the pandemic and contributed to the widespread disease.^[6] This highlights the need to maintain strict preventive measures in health care centers and adhere to Covid Appropriate Behaviour (CAB) to reduce infection.^[7]

Most of the Covid-19 infections are asymptomatic, sub-clinical, or very mild.^[8] Out of 150 Covid-positive

nursing staff, the majority had a fever (48.66%), followed by an asymptomatic presentation (28%). Only four nurses

were given oxygen support, whereas the remaining were managed with oral and injectable treatment. Despite having exposure to critical Covid cases, the majority of Covid-positive nursing staff recovered without any serious morbidity. This can be attributed to a higher number of (88%) hospital-based care and initiation of treatment to the case without any delay. In addition, almost 90% of nurses had taken one or more pharmacological prophylactic measures. However, many other studies failed to show any benefit from hydroxy chloroquine (HCQ) treatment in Covid-19 cases.^[9-11] At the time of study, no nurse had been vaccinated for Covid-19.

Table 3: Behavioral risk factors related to Covid-19 infection

Behavioral Risk factors	Number (n=150)	Percentage
Mode of travel to workplace		
Public vehicle	63	42.00
Private vehicle/walking	87	58.00
PPE during travel		
Face mask	84	56.00
Face covered with a cloth scarf	64	42.66
Gloves	15	10.00
Nil	2	1.33
Physical distancing while travel		
Not applicable	61	40.66
Yes	38	25.33
Not possible to maintain	51	34.00
CAB during visit to markets/outdoors		
Face mask	150	100.00
Social Distancing	147	98.00
Decreased frequency of non-essential visits	113	75.33
Hand washing		
Sanitizer	5	3.33
Soap and water	11	7.33
Both	134	89.33
Eating practice at workplace		
Sharing of food items	3	2.0
Eat in groups with colleagues	22	14.7
Eat separately	125	83.3

All health care workers including nurses were trained for Infection Prevention Control (IPC) practices and the use of PPE. Because of this, all nurses used some or other PPE at their workstations. However, it was found that the category of PPE was not appropriate for the work setting in ~7% of the cases. The extreme shortage of PPE at the beginning of the pandemic was one of the reasons as health care systems of many countries could not cope up with the sudden increase in patient numbers.^[12] All nurses received formal training in donning and doffing of PPE. However, 32 nurses got exposed to Covid-19 patients after doffing, although the contact was described as 'extremely short'. The lack of spacious doffing rooms and over-crowded emergency ward situations were faced by many nurses; hence, 28% could not maintain appropriate

Table 4: Risk factors found to be significantly associated with work type - Covid vs non-Covid

Risk factors significantly associated with work type	Covid (n=82)		Non-Covid (n=68)		P
Living arrangement					
Separate facility	49	59.75	0	0.00	<0.001
Home/hostel	33	40.24	68	100	
Sleep					
Adequate (at least 6 h)	41	50.00	51	75.00	0.006
Inadequate	17	20.73	9	13.23	
Adequate but disturbed	24	29.27	8	11.76	
Shift duty	70	85.37	38	55.88	0.001
Rotatory pattern of shift	64	78.05	37	54.41	0.008
Food timing					
Regular	46	56.09	56	82.35	0.001
Irregular	36	43.90	12	17.65	
Food source					
Home-cooked	38	46.34	68	100	<0.001
Outsourced	44	53.66	0	0.00	
Mode of travel to workplace					
Public vehicle	30	36.59	33	48.53	0.038
Private vehicle/walking	52	63.41	35	51.47	
PPE during travel					
Face mask	38	46.34	46	67.65	0.029
Face covered with cloth scarf	43	52.44	21	30.88	
Gloves	8	9.75	7	10.29	
Nil	1	1.22	1	1.47	
Decreased frequency of market visits	67	81.71	46	67.65	0.058

social distancing at the work. The lack of appropriate doffing facilities can lead to the spread of infections as used PPEs may come in contact with the other nurses while doffing, which is the most vulnerable moment to catch the infection.^[13]

Because of high risk, individuals should carefully watch the doffing individual, alert him/her about possible contamination.^[14] Working with full PPE is exhaustive as many nurses drain out heavily because of excessive sweating and thirst.^[13] Hence, it is observed that there is a tendency to get rid of the PPE kit as soon as a nurse finishes his/her duty. Also, hand hygiene is proven effective in infection control, and all nurses followed adequate hand hygiene using sanitizers and soap.^[15]

Our study shows a significant association between duty pattern and Covid-19 infection. The majority of nurses (72%) had rotating shift duties of 6–8 hours with a change between Covid and non-Covid wards. The rotating shift pattern has a negative effect on mealtime regularity and sleep pattern. Our study shows that inadequate and disturbed sleep increases the susceptibility to infection. Irregular meals and unavailability of home-cooked food also contributed to the ill health of the nurses. A balanced diet and consumption of citrus fruits may help in decreasing the severity of the infection. All the nurses were concerned about their family members' health. Therefore, the majority chose to live in separate accommodation provided during the pandemic. These facilities shared common basic amenities, which increased the infection spread as well as the number of close contacts of positive cases. Those living in their houses either stayed alone or stayed in separate rooms to minimize the contact with family members. Those who were traveling to their homes had to travel by public transport (local train). Use of appropriate PPE such as an N95 mask or a complete face shield while traveling in public transport is recommended to decrease infection spread.

The majority of the nurses reported eating separately while on duty. However, it is observed that the rooms of Covid and non-Covid wards meant for eating are very small with less ventilation. It is not possible to eat in those rooms with social distancing. Cheng *et al.*^[13] 2020 recommend a minimum of 4 hours of shift with PPE. Nurses in our hospital had shifts of 6–8 hours and cannot doff in a duty shift for eating or using washrooms because of the limited number of PPEs.

A total of 49 nurses with comorbidities got infected with Covid-19. Hypertension followed by diabetes and thyroid disorders were the most common. All recovered from the infection and re-joined their duties.

The chance of transmission of infection to other individuals has particular importance in health care settings.^[8,16] Contact tracing was performed for all positive cases. A total of 383 high-risk contacts were identified; most of them were family members and co-workers from the same shift. All these contacts were quarantined and tested for Covid.

Limitation and recommendation

Limitations

It is single-center-based study. No comparison group has been taken.

Recommendations

All nurses should observe Covid-19 appropriate behavior with regular food intake and adequate sleep for their own health.

Conclusion

Use of workplace appropriate PPE, proper donning and doffing facilities, duty shifts with a fixed duration, adequate hand hygiene practices, and regular food intake with adequate sleep can help in preventing Covid-19 infection at the workplace among nurses. Identifying and updating infection prevention and control measures and developing guidelines to reduce secondary Covid-19 infections within hospital settings will go a long way in reducing infections.

Ethical approval

Ethical approval obtained from Institutional Ethics Committee (EC/OA-108/2020).

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Conflicts of interest

There are no conflicts of interest.

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