

Original Articles

SARS-CoV-2 Infection and Risk Stratification among Healthcare Workers in the Largest COVID-19 Dedicated Tertiary Care Hospital in Dhaka, Bangladesh

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Abstract

Background: The health care workers (HCWs) are working 24/7 in managing devastating pandemic Corona virus disease 19 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as front liner which leads them to be at highest risk for contacting infection. In Bangladesh, being a lower middle-income country and densely populated, the burden is much more on HCWs.

Methods: We did a cross-sectional study with an aim to identify the prevalence, risk factors, and outcomes of SARS-CoV-2 infection among the HCWs in a COVID-19 dedicated tertiary care hospital. Statistical analysis was done in SPSS version-26. Multivariate regression analysis was done to evaluate risk factors responsible for COVID-19 infection and the severity of the COVID-19 disease. We expressed odds ratio with 95% CI, and considered the p-value of <0.05 as significant in the two-tailed test.

Results: A total of 864 HCWs had participated with mean age of 34.16 ± 6.77 and 426 (49.31%) males. Among them 143 (16.55%) were tested RT-PCR positive for SARS-CoV-2. Bronchial asthma/COPD and Hypertension were the most common co-morbidities with 23 (16.08%) for each. About 102 (71.33%) of the RT-PCR positive HCWs became symptomatic. Fever, cough and myalgia were the most common symptoms 84(82.35%), 67(65.69%) and 52(50.98%) respectively.

Multivariate regression analysis revealed hypertension, gout, and working in the COVID-19 confirmed ward had a significant odds ratio for getting infected with SARS-CoV-2 [95% CI, p-value 1.91 (1.08 - 3.41), 0.027; 5.85 (1.33 - 25.74), 0.020; and 1.83 (1.10 - 3.03), 0.019].

Bronchial asthma/COPD and gout found to be risk factors for moderate to severe COVID-19 disease [95% CI, p-value 3.04 (1.01 - 9.21), 0.049 and 23.38 (3.42 - 159.72), 0.001]. Hospitalization rate was 12(85.7%), and 3(100%) and median hospital stays were 11 (5.5 - 15), and 20 (7 - 30) days for moderate and severe diseases respectively. Outcome was uneventful without any ICU admission and death.

Conclusion: HCWs working in the COVID-19 confirmed ward are at increased risk of infection with SARS-CoV-2. Some co-morbidities like hypertension and gout are important risk factors for contacting SARS-CoV-2 infection. Bronchial asthma/COPD and gout favors disease severity.

Key words: Health care worker, SARS-CoV-2 infection, COVID-19.



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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in December 2019 in Wuhan City, Hubei Province, China.¹ On March 11, 2020, World Health Organization (WHO) declared the coronavirus disease a pandemic.² Since its emergence, transmission is ongoing and has become a global health threat.³ As of July 11, 2021, global confirmed 186,418,493 cases with 4,024,103 deaths.⁴ In Bangladesh, after detecting the first case on 8 March 2020, the total confirmed cases reached 1010315, and the death toll reached 16189 by July 11, 2021.⁵

Health Care workers (HCWs) are the front-line fighters in combating COVID-19. Due to close personal exposure to patients of COVID-19, they are at high risk of infection and a source of further spread.⁶ Earlier reports revealed that healthcare workers could account for 10–20% of all diagnoses, that people from Black, Asian, and minority ethnic backgrounds are at higher risk of infection.^{7,8,9} Till 9 April 2020, in the United States, 19% HCWs were identified RT-PCR positive for SARS-CoV-2.¹⁰ In Italy, during the earlier period of COVID-19 pandemic, a survey was conducted to see seroprevalence of and risk factors associated with SARS-CoV-2 infection in HCWs, which revealed 10115 HCWs (12.2%; 95%CI, 12.0%-12.4%) had positive results (median [IQR; range] age, 50 [39-55; 20-80] years; 7298 [72.2%] women).¹¹

In Bangladesh, till 9 August 2020, 2531 doctors, 1754 nurses, and 3011 health workers have been affected with SARS-CoV-2 infection, and 73 specialist doctors died of this COVID-19 disease.¹²

Bangladesh government declared four tertiary care hospitals, as COVID-19 dedicated, in the capital city, where a maximum of patients has been getting treatment. A tertiary care hospital in Dhaka did a small-scale study among 343 HCWs. A total of 37(10.79%) cases were detected COVID-19 positive with 21(56.76%) symptomatic cases. Among the symptomatic patients, 15(40.54%) had mild and 6(16.22%) had moderate symptoms with complete recovery of all.¹³ A small study a non-covid dedicated tertiary care hospital found Male physicians (65.3%) and 31-40 age group physicians were predominantly affected with SARS-CoV-2.¹⁴ According to the Bangladesh Medical Association, 148 doctors died of COVID-19 disease up to April 2021.¹⁵ Dhaka Medical College Hospital is the largest COVID-19 dedicated hospital in Bangladesh. So, it was an important task to observe HCWs' situation in our hospital. It will help us to know the extent of

the problem and plan for the measures to decrease the infection rate among the health care workers. We aimed to identify the prevalence, risk factors, and outcomes of SARS-CoV-2 infection among the HCWs. Our secondary objective was to identify correlation between risk factors and severity of illness. We also sought to evaluate the standard of infection control measures of the institution.

Methods

Study design and participants

COVID-19 dedicated unit of Dhaka Medical College Hospital is separated into two parts- COVID confirmed ward and suspected ward. The authority uses to admit the Patients with RT-PCR positive for SARS-CoV-2 infection into the COVID confirmed wards and suspected COVID-19 patients with unavailable or inconclusive RT-PCR for SARS-CoV-2 into the COVID-19 suspected wards. The patients' beds usually place 6 feet apart. There is a doffing area at each exit, equipped with sanitizer and a biohazard bag for disposal of used PPE. Doctors' and nurses' duty stations are located in an isolated place outside the wards. HCWs follow a roster duty consisting of 7 days of hospital duty followed by a quarantine period of 21 days. During the whole duty hour and quarantine period, the HCWs needs to stay in an assigned hotel. Hotel authority provides user-restricted vehicles for transportation. The hospital authority provides PPE, N 95 masks, gloves, hand sanitizers during the duty period to the HCWs. The hospital authority arranges an RT-PCR test for the HCWs on day-10 and onwards after the last day of duty.

It was a retrospective cohort study. The Medicine department of Dhaka Medical College Hospital conducted the study from 5 May 2020 to 31 October 2020. The ethical review committee of Dhaka Medical College provided the ethical clearance. The participants gave Informed verbal consent to be testified by two independent observers. We approached all the health care workers irrespective of their position of working in the COVID-19 unit of Dhaka Medical College Hospital.

Procedures

We prepared a telecon interview guide (attached in supplement-1) and took the interview by telecon. We explained the purpose of the study to the participants and assured them about anonymity. The components of the questions included the demography, date of the commencement of hospital duty, placement of work,

comorbidities, measure of Infection prevention and control (IPC), COVID-19 symptoms if affected, results of RT-PCR test for SARS-COV-2, name of the drugs received either at home or hospital and outcome of COVID-19 among infected. Disease severity were assessed according to national guidelines on clinical management of COVID-19 disease version 7 [16]. We assessed their COVID-19 status up to 31 July 2020. The information was recorded in a preformed case record form by the investigators.

Analysis

We did the statistical analysis in SPSS version 26. Normally distributed continuous variables were presented as mean (SD), skewed variables were expressed as median (IQR), and categorical variables were presented as percentages n (%). The differences between the demography and the comorbidity were evaluated with a chi-square test, and the relative risk was expressed with a 95% confidence interval (95% CI). We did the Univariate regression analysis and multivariate regression analysis to evaluate risk factors responsible for COVID-19 infection and the severity of the COVID-19 disease. We expressed the odds ratio with 95% CI, and we considered the p-value of <0.05 significant in the two-tailed test.

Results

Total 1876 health care workers were approached, 1236 responded to phone and among them 864 gave consent.

A total of 864 HCWs participated in the study, among them 506 (58.56%) were physicians, 358 (41.44%) were nurses. The mean age was 34.16 ± 6.77[mean±SD] with 426 (49.31%) males. Among the included HCWs, 143 (16.55%) were tested positive RT-PCR for SARS-COV-2. Of them, 119(83.22%) worked in the COVID-19 confirmed ward and 24(16.78%) worked in the COVID-19 suspected ward. Among them, 61(42.66%) had at least one comorbidity. Bronchial asthma/COPD and Hypertension were the most common co-morbidities 23 (16.08%) for each followed by smoking 16 (11.19%), obesity 16 (11.19%), diabetes mellitus 14 (9.79%), dyslipidemia 6 (4.20%) and gout 4 (2.80%). [Table 1]

Among the RT-PCR positive HCWs, 102(71.33%) were symptomatic with mild disease 85(83.33%), moderate 14(13.73%), and severe disease 3(2.94%) respectively. Fever was the most common symptom 84(82.35%), followed by cough 67(65.69%) and myalgia 52(50.98%). The other symptoms were sore throat 40(39.22%), runny nose 27(26.47%), diarrhea 26(25.49%), anosmia/parosmia 20(19.61%), and arthralgia 18(17.65%). Only 4(3.92%) presented with the rash. [Table 2].

Multivariate regression analysis was done to evaluate risk factors for RT-PCR positivity. It revealed hypertension, gout, and working in the COVID-19 confirmed ward had a significant odds ratio for getting infected with SARS-CoV-2 [95% CI, p-value 1.91 (1.08 - 3.41), 0.027; 5.85 (1.33 - 25.74), 0.020; and 1.83 (1.10 - 3.03), 0.019]. [Table 3]

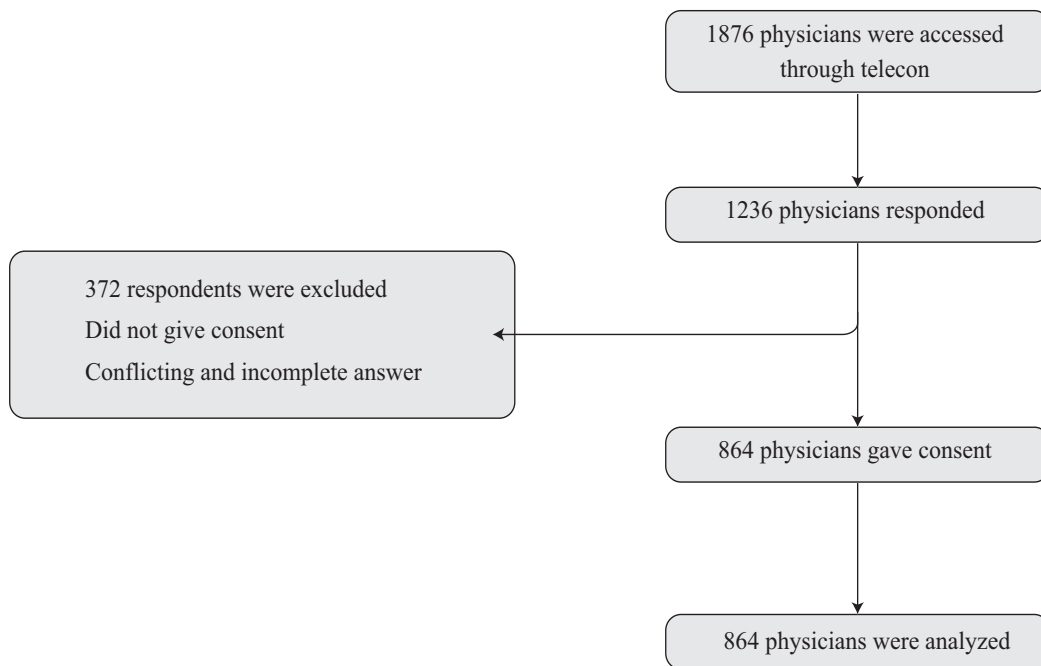


Figure 1: Patient selection for this cross-sectional study

Table-1 : Socio-demographic data of the study population

Characteristics	HCWs (n = 864)	RT-PCR Positive n, (%) 143 (16.55)	RT-PCR Negative n, (%) 721(83.45)	RR (95%CI)	p value
Age (years) Mean \pm SD	34.16 \pm 6.77	34.93 \pm 7.62	34.00 \pm 6.58		
20 to 29	222 (25.69)	31(21.69)	191 (26.49)	0.80 (0.55 - 1.16)	0.229
30 to 39	500 (57.87)	85 (59.44)	415 (57.56)	1.07 (0.79 - 1.45)	0.677
40 to 49	96 (11.11)	15 (10.49)	81 (11.23)	0.94 (0.57 - 1.53)	0.796
e"50	46 (5.32)	12 (8.39)	34 (4.72)	1.63 (0.98 - 2.72)	0.074
Sex					
Male	42 (49.31%)	74 (51.75%)	352 (48.82%)	1.10 (0.82 - 1.49)	0.522
Female	438 (50.69%)	69 (48.25%)	369 (51.18%)		
Job category					
Physician	506 (58.56%)	85 (59.44%)	421 (58.39%)	1.04 (0.76 - 1.41)	0.816
Nurse	358 (41.44%)	58 (40.56%)	300 (41.61%)		
Working station					
Confirmed ward		119 (83.22%)	541 (75.03%)	1.65 (1.03 - 2.64)	0.037
Suspected ward		24 (16.78%)	180 (24.97%)	Reference	
Co-morbidities					
Present		61 (42.66%)	296 (41.05%)	1.07 (0.74-1.54)	0.722
Absent		82 (57.34%)	425 (58.95%)	Reference	
Diabetes mellitus		14 (9.79%)	45 (6.24%)	1.63 (0.87 - 3.06)	0.128
Hypertension		23 (16.08%)	63 (8.74%)	2.00 (1.20 - 3.35)	0.008
Bronchial Asthma/COPD		23 (16.08%)	94 (13.04%)	1.28 (0.78 - 2.10)	0.332
Smoking		16 (11.19%)	102 (14.15%)	0.76 (0.44 - 1.34)	0.348
Obesity		16 (11.19%)	83 (11.51%)	0.97 (0.55 - 1.71)	0.912
Dyslipidemia		6 (4.20%)	13 (1.8%)	2.39 (0.89 - 6.38)	0.084
Gout		4 (2.80%)	4 (0.55%)	5.15 (1.27 - 20.87)	0.021
Steps followed during Donning		143 (100.0%)	718 (99.58%)	—	—
Steps followed during Doffing		141 (98.60%)	713 (98.89%)	0.79 (0.17 - 3.76)	0.768

Table-2 : Clinical characteristics of RT-PCR positive HCWs

Characteristics	RT-PCR positive HCWs (n = 143)
Clinical Status	Asymptomatic 41 (28.67%)
	Symptomatic 102 (71.33%)
Severity of disease	Mild 85 (83.33%)
	Moderate 14 (13.73%)
	Severe 3 (2.94%)
Clinical features	Fever 84 (82.35%)
	Cough 67 (65.69%)
	Sore Throat 40 (39.22%)
	Runny Nose 27 (26.47%)
	Arthralgia 18 (17.65%)
	Myalgia 52 (50.98%)
	Diarrhoea 26 (25.49%)
	Anosmia / Parosmia 20 (19.61%)
	Rash 4 (3.92%)

Table 3 : *Multivariate analysis of risk factors for RT-PCR positivity for SARS-CoV-2*

Characteristics	RT-PCR positive	RT-PCR negative HCWs	OR (Confidence interval)	P value
	HCWs (n= 143)	(n=721)	OR, CI	
Age in years				
e"50	12 (8.39)	34 (4.72)	1.43 (0.59 - 3.42)	0.429
40-49	15 (10.49)	81 (11.23)	0.93 (0.46 - 1.86)	0.829
30-39	85 (59.44)	415 (57.56)	1.08 (0.68 - 1.72)	0.746
20-29	31 (21.69)	191 (26.49)	Reference	
Work Place				
Confirmed ward	119 (83.22%)	541 (75.03%)	1.83 (1.10 - 3.03)	0.019
Suspected ward	24 (16.78%)	180 (24.97%)	Reference	
Hypertension				
Yes	23 (16.08%)	63 (8.74%)	1.91 (1.08 - 3.41)	0.027
No	120 (83.92%)	658 (91.26%)	Reference	
Gout				
Yes	4 (2.80%)	4 (0.55%)	5.85 (1.33 - 25.74)	0.020
No	139 (97.20%)	717 (99.45%)	Reference	

We performed multivariate regression analysis to correlate any association between risk factors and disease severity. It/ it revealed HCWs suffering from Bronchial asthma/COPD and gout had moderate to severe COVID-19 disease [95% CI, p-value 3.04 (1.01 - 9.21), 0.049 and 23.38 (3.42 - 159.72), 0.001]. [Table 4]

Among the infected HCWs, the hospitalization rate was 34(40.00%), 12(85.7%), and 3(100%) for mild, moderate, and severe diseases respectively. Median hospital stays [Median, IQR] were 7 (7 - 9), 11 (5.5 - 15), and 20 (7 - 30) days respectively for mild, moderate, and severe disease. Irrespective of disease severity outcome was uneventful without any ICU admission and death. [Table 5]

Table 4 : *Multivariate analysis to evaluate risk factors for disease severity*

Comorbidities	RT-PCR positive HCWs	Moderate to severe cases (n=18)	p value
	n (%)	OR (95% CI)	
Diabetes mellitus	2 (11.11)	1.02 (0.17 - 5.98)	0.985
Hypertension	3 (16.67)	1.75 (0.46 - 6.67)	0.415
Bronchial Asthma/COPD	5 (27.78)	3.04 (1.01 - 9.21)	0.049
Smoking	2 (11.11)	1.05 (0.23 - 4.78)	0.952
Obesity	1 (5.56)	0.34 (0.04 - 2.84)	0.319
Dyslipidemia	1 (5.56)	0.99 (0.06 - 15.71)	0.993
Gout	2 (11.11)	23.38 (3.42 - 159.72)	0.001

Table 5 : *Outcome of RT-PCR positive cases*

Disease severity (n=143)	Hospitalization	Hospital stays (Days)	ICU admission	Cured	Death
	n (%)	Median (IQR)	n (%)	n (%)	n (%)
Asymptomatic (41)	0 (0.0)	—	0 (0.0)	41 (100.0)	0 (0.0)
Mild (85)	34 (40.00)	7 (7 - 9)	0 (0.0)	85 (100.0)	0 (0.0)
Moderate (14)	12 (85.7)	11 (5.5 - 15)	0 (0.0)	14 (100.0)	0 (0.0)
Severe (3)	3 (100.0)	20 (7 - 30)	0 (0.0)	3 (100.0)	0 (0.0)

Discussion

In this study, about 16% of the healthcare workers had been infected with SARS-CoV-2 and 17% of them suffered from moderate to severe disease. Hypertension, working in the COVID-19 dedicated ward, and gout were the risk factors for SARS-CoV-2 infection. Bronchial asthma/COPD and Gout were the risk factors for the severity of the disease was identified.

So, the infection burden is significant among the health care workers working amid this deadly pandemic. As health care workers are the frontline fighter, they are at the highest risk of infection by SARS CoV-2. According to our findings, the infection rate was much higher than previously reported studies from the different regions and earlier studies in our country.^{13,17,18} The infection rate was comparable with the overall infection rate of the general population of Bangladesh during that period.¹⁹

Again, SARS-CoV-2 infection was much higher (83.22%) among the HCWs who worked in the confirmed (RT-PCR +ve) COVID-19 ward than those (16.78%) who worked in the suspected COVID-19 (RT-PCR –ve) ward. It may attribute to repeated exposure to the high virulence SARS CoV-2 in RT-PCR +ve patients.

The participants of this study were relatively young similar to other studies in China and United States.^{20,21,22,23} The young doctors mainly attended to the patients and remained in close contact with the patients for an extended period than the senior physician, who played a supervising role.

Another reason was that DMCH is an academic hospital, so most of the HCWs who were engaged in treating COVID-19 patients were trainees and residents of different faculties of Medicine.

Male and female HCWs were almost similarly (51.75% vs. 48.25%) affected in our study. But studies in China showed that female HCWs are affected more than males.^{20,21} We included only physicians and nurses in this study, and it showed that physicians outnumbered the nurses (59.5% vs. 40.5%). The Chinese study also observed similar findings in a Chinese study.²⁰ But other studies from China, the USA, and earlier studies from Bangladesh showed that nurses are affected more than doctors.^{13,20,24}

The study found that the most affected HCWs (57.34%) did not have a pre-existing co-morbid disease but a significant number of (42.66%) HCWs had at least one co-morbid risk factor. Bronchial asthma (16.08%) and HTN (16.08%) were the most prevalent co-morbid diseases, similar to the findings of other studies.^{13,25}

Although the majority of the affected HCWs were symptomatic (71.33%), a significant number (28.67%) of them were asymptomatic. Among the symptomatic cases, most (83.33%) had mild disease, 13.73% had moderate disease, and only 2.94% had severe disease.

It attributes to their younger age and fewer pre-existing co-morbid diseases similar to earlier studies.^{13,25}

Fever (82.35%), cough (65.69%), myalgia (50.98%), sore throat (39.22%), runny nose (26.47%), and diarrhea (25.49%) were the most prevalent symptoms among the HCWs in our study. It was similar to the large cohort in Wuhan, China.²⁶ This study also found 1 (0.9%) death among the affected HCWs. On the contrary, all the affected HCWs in our study had an uneventful complete recovery with no ICU admission or death. It was likely due to the early detection, younger age, few co-morbid diseases, and less severe disease.

Almost all studies on risk factors were retrospective and susceptible to recall bias about PPE use and other factors. Some risk factor studies did not control for confounders. Few studies that analyzed risk factors in multivariate models addressed collinearity, complicating interpretation for potentially correlated risk factors. However, available evidence on risk factors for coronavirus infections in HCWs indicating an association between PPE use versus nonuse, masks, gloves, gowns, and eye protection, as well as hand washing. Evidence indicated an association with different infection exposures, such as involving during intubations, direct contact with infected patients, or bodily secretions.²⁵

In our study, we found that the infection rate was much higher among the HCWs despite using proper PPE (98.6%), N95 masks (92.3%), appropriate donning steps (100%), and doffing (98.6%) steps. The lack of the ideal doffing area, disinfection of duty station, mask fit test, none was associated with increased risk of infection might be attributed to this. The infection rate was also significantly higher among the HCWs having HTN and gout and those working in the confirmed COVID-19 ward. Some recent studies proved that in the production of the pro-inflammatory cytokine interleukin (IL)-1beta and IL -6 were higher in patients with gout.^{27,28,29,30} Another report revealed the risk of pneumonia was increased (adj. HR 1.27, 95% CI 1.18 to 1.36) in gout.³¹ These reports supported our observations of increased risk of SARS-CoV-2 infection in HCWs suffering from gout. An earlier study from Bangladesh found that HCWs involved in aerosol-generating procedures, not using appropriate PPE, inadequate training on PPE use, and reusing PPEs were the possible risk factors for infection.¹³

A Chinese study found that Working in the high-risk department, suboptimal hand washing before or after patient contact, longer working hours, and improper use of PPE were the risk factors for getting an infection. They found that the aerosol-generating procedures did not increase the risk of COVID.²²

We did the study mainly on relatively young health care workers. So, we cannot generalize the findings for all age groups. Moreover, the study population had fewer comorbidity.

It was a single centered retrospective study. We could not recruit all the HCWs. It would be better if we could increase the total number of participants. In this study, few participants were from the ICU. Thus, we were not able to make any conclusion about the potential role of a high aerosol-generating area for having COVID-19 infection.

Conclusion

This small study revealed that a substantial number of HCWs working as front-liners are getting infected with SARS-COV-2 with variable disease severity without fatal outcomes. Those working in the COVID-19 confirmed ward are at increased risk of infection. Some other co-morbidity like hypertension and gout are important risk factors for getting infected with SARS-COV-2.

Conflict of interest

None of the author received any financial aid from any person or institution.

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