Original Article

COVID-19 Seroepidemiology of Health Care Workers and Compliance with Infection Prevention Standard Precautions in a Large Tertiary Referral Center

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Received: 24 May, 2026; Accepted: 9 June, 2026

DOI: 10.22037/nbm.v14i3.52127

Abstract

Background: COVID-19 has placed a massive burden on people worldwide. Health care workers, as the pioneers in the fight against this disease, are the most susceptible to its morbidity and mortality, and their protection is a major priority for every health care organization and the World Health Organization (WHO). In this study, risk factors and infection rate in health care workers (HCWs) with regard to compliance with standard precautions were studied.

Materials and Methods: A total of 200 healthcare workers from a hospital were enrolled in this study. Epidemiologic and professional information (sex, age, job, travel, contact with patients, use of protective facilities) was recorded in a predesigned questionnaire. SARS-CoV-2 antibodies (IgG and IgM) were evaluated using the ELISA sandwich method, indicating infection. Results were analyzed by SPSS 27.

Results: In this study on 200 HCWs, 68% (136) of subjects were female, and 32% (64) were male. 92 (46%) HCWs were seropositive with no sex difference. There was no significant difference in seropositivity by job (medical vs. nonmedical), travel history, or contact with patients at home or in the hospital. Also, contact with patients' aerosols and use of their belongings did not significantly affect HCWs' seropositivity. There was no difference in the use of protective equipment in both seropositive and seronegative groups and in two-sex groups. But the use of gloves, gowns, and glasses by medical workers was significantly higher than by non-medical workers.

Conclusion: The burden of this disease is great for health care workers. Notification and compliance with standard precautions (SPs) are essential health subjects for both HCWs and patients. We need more education and encouragement to increase compliance with standard precautions until the epidemiology and pathology of emerging infectious diseases are better understood.

Keywords: COVID-19, Health care workers, Standard precautions, Seroconversion

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Please cite this article as: Shoaei SD, Hadavand F, Haghighi M, Moradi Shahrbabak H, Molatayefeh T. COVID-19 Seroepidemiology of Health Care Workers and Compliance with Infection Prevention Standard Precautions in A Large Tertiary Referral Center. Novel Biomed. 2026;14(3):141-6.

Introduction

In December 2019, many unknown-origin pneumonia cases were identified in Wuhan, China. The etiology was found as an RNA beta-coronavirus named "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)". The World Health Organization (WHO) announced coronavirus disease 2019 (Covid-19) as a public health emergency of international statement[1].

Over the next three years, the virus underwent mutations, resulting in new variants with varying severity, signs, and symptoms in several waves. It had a 14-day incubation period[2] and a high infection rate of 32.4% in close contacts with any unmasked exposure and 7.7% when both persons were masked[3].

The most frequent symptoms are found in the upper and lower respiratory systems, including a runny nose, sore throat, sneezing, cough, and hoarse voice. Systemic manifestations of malaise, weakness, chills, fever, headache, myalgia, and arthralgia were also prevalent in most patients. Upper and lower gastrointestinal symptoms were also observed with the pathognomonic feature of loss of smell and taste. Morbidity as myocardial, neurological, hepatic, renal, and multisystem injury needing admission could be seen[4-6]. It had a high burden of disease and a 3.4% actual case-fatality ratio[7]. There is a high need for effective prevention for SARS-CoV-2 to mitigate the growing crisis. In this study, health care workers' cooperation in regard to standard precautions and risk factors was studied to plan and educate to prevent rapid spread in hospitals. Also reminding the importance of next pandemic preparedness is considered.

Methods

It is a cross-sectional study on 200 health care workers of Imam Hussein educational medical center in Tehran from June to September 2022. They include medical (nurse, physician, technicians of ambulance, operating room, laboratory, imaging, radiotherapy, and physiotherapy ward workers) and nonmedical (ambulance driver, watchman, technical, administrative, crew, and kitchen workers) personnel with at least 6-month work in hospitals. Demographic data (age, sex, occupation, contact with aerosol, travel in past 6 months, attendance in 2 meters distance with proved COVID-19 patient in travel, at home, and workplace), information on possible exposures, and compliance rate for standard precautions were recorded in a predesigned questionnaire. SARS CO-V2 serum antibodies (IgG and IgM) were evaluated by the Capture ELISA method by Pishtaz Teb Zaman Kits to recognize infection (seroconversion). Results were interpreted by the cut-off index as negative < 0.9, doubtful 0.9-1.1, and positive >1.1 (indicating infection). Doubtful cases were excluded. Results were collected and analyzed by SPSS 27 and the chi-square test.

This study has been registered with ethics code IR.SBMU.RETEC.1399.144.

Results

A total of 200 health care workers were studied. The mean age was 38.55±9.23 years old. 136 cases were women and 64 were men, with no significant difference in frequency of seropositivity in two sex groups (P value > 0.05). Demographic data showed no significant difference in seroconversion based on job (medical and nonmedical), history of travel in past 6

Table 1. Demographic data of COVID-19 serologic study on HCWs.

Variable	Total		Seropositive		Seronegative		P Value
	No.	%	No.	%	No	%	
Total	200	100	92	46	108	54	0.082
Sex							
Female	136	68	61	30.5	75	37.5	0.635
Male	64	32	31	15.5	33	16.5	
Job							
Non-medical	47	23.5	20	10	27	13.5	0.588
Medical	153	76.5	72	36	81	40.5	
Travel in past 6 months							
Yes	49	24.5	18	9	31	15.5	0.134
No	151	75.5	74	37	77	38.5	
Travel with COVID-19 Patient in 2 Meters Distance							
Yes	21	10.5	10	5	11	5.5	0.875
No	179	89.5	82	41	97	48.5	
Contact with COVID-19 Patient							
At Home	6	3	1	0.5	5	2.5	0.531
At Hospital	139	69.5	65	32.5	74	37	
At Both Place	41	20.5	19	9.5	22	11	
No Contact	14	7	7	3.5	7	3.5	

months, travel with COVID-19 patients in 2 meters distance, and contact with COVID-19 patients at home or hospital (Table 1).

Use of protective equipment in two genders showed no significant difference. (P value < 0.05) The use of a mask, apron, and handwashing shows no significant

Table 2. Correlation of contact with respiratory droplets and using patients' belongings with seroconversion to COVID-19.

Variable	Total		Seronegative				P Value
	No.	%	No.	%	No.	%	
Contact with respiratory droplets							
Tracheal Intubation	53	21.5	28	14	25	12.5	0.4
Setting the Nebulizer	47	23	23	13	24	12	0.4
Airway Suction	64	32	33	16.5	31	15.5	0.6
Sputum Collection	30	15	16	8	14	7	0.9
Tracheotomy	30	15	16	8	14	7	0.9
Bronchoscopy	7	3.5	5	2.5	2	1	0.3
Nasopharyngeal Sampling	42	21	20	10	22	11	0.3
CPR	62	31	32	16	30	15	0.6
Using Patients' Belongings							
Bed	15	7.5	6	3	9	4.5	0.1
Sheet	13	7.5	6	3	7	3.5	0.5
Bathroom	9	4.5	4	2	5	2.5	0.5
Medical Devices	27	13.5	14	7	13	6.5	0.8

There is no discernible difference in the frequency of respiratory droplet contact between the seronegative and seropositive groups and also there was no significant difference in using patient possessions, such as beds, covers, bathrooms, and medical equipment like stethoscopes and blood pressure monitors in two group (P-value > 0.05) (Table 2).

145 (72.5%)) employees had a history of COVID-19 clinical disease with a positive finding in a chest CT scan or PCR diagnosis alone or in combination of them. There was a significant difference between the seroconversion in two symptomatic and asymptomatic workers but a similar result of the diagnostic method in the two seronegative and seropositive groups of workers with COVID-19 disease (P value > 0.05) (Table 3 and Figure 1).

Table 3. Incidence of covid-19 disease in HCWs based on serology.

Variable	Total		Seropositive				P Value
	No.	%	No.	%	No.	%	
COVID-19 Disease in Employees							
Yes	145	72.5	60	33	85	42.5	<0.001
No	55	22.5	48	24	7	3.5	

Use of gloves, masks, gowns, glasses, and aprons between two seronegative and seropositive groups has no significant difference (P value > 0.05) (Table 4).

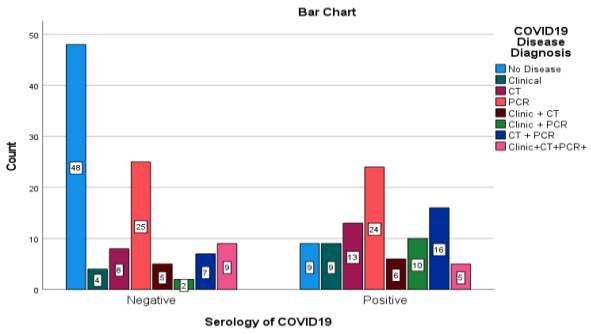

Figure 1. Frequency of positive diagnostic methods in employees with COVID-19 disease.

difference between medical and non-medical workers. (P value > 0.05). But use of gloves, gowns, and glass by medical workers was significantly more than non-medical workers (P value < 0.05) (Table 5).

Discussion

In this study, we investigated the burden of COVID-19 on health care workers. Our aim is to estimate the extent of infection with this virus, some risk factors, and compliance rate for standard precautions.

200 people were studied; 46% were seropositive and 54% seronegative, and 72.5% had COVID-19 clinical disease without hospitalization. One meta-analysis of 28 studies on about 120 thousand medical staff

Table 4. The rate and percentage of using protective equipment based on serology of COVID-19.

Use of protective equipment		Total		Seronegative		Seropositive		P Value
		No.	%	No.	%	No.	%	
Gloves	Always	103	51.5	54	27	49	24.5	0.781
	Often	49	24.5	9	4.5	24	12	
	Sometimes	15	7.5	6	3	6	3	
	Rarely	33	16.5	15	7.5	13	6.5	
Mask	Always	160	80	90	45	70	35	0.457
	Often	33	16.5	16	8	17	8.5	
	Sometimes	4	2	1	0.5	3	1.5	
	Rarely	3	1.5	1	0.5	2	1	
Gowns	Always	42	21	25	12.5	17	8.5	0.846
	Often	35	17.5	19	9.5	16	8	
	Sometimes	33	16.5	17	8.5	156	78	
	Rarely	90	45	47	23.5	43	21.5	
Shield or Glass	Always	28	14	15	7.5	13	6.5	0.901
	Often	30	15	18	9	12	6	
	Sometimes	31	15.5	17	8.5	14	7	
	Rarely	111	55.5	58	29	53	26.5	
Apron	Always	11	5.5	7	3.5	4	2	0.516
	Often	5	2.5	4	2	1	0.5	
	Sometimes	18	9	9	4.5	9	4.5	
	Rarely	166	83	88	44	78	39	
Hand Washing > 3 Times in 8 Hour Shift	Always	190	95	105	52.5	85	42.5	0.265
	Often	7	3.5	3	1.5	4	2	
	Sometimes	1	0.5	0	0	1	0.5	
	Rarely	2	1	0	0	2	1	

reported 51% seropositivity and 15.1% had the history of hospitalization due to this disease[8]. A systematic review showed 11% infection in health care workers of non-emergency departments, and 5% were symptomatic with severe complications and hospitalization. Nurses were the most infected group[9]. Another meta-analysis investigating the spread of COVID-19 disease on health workers on 47 studies showed 11% seropositivity[10]. These differences may be based on the duration of working in medical centers and laboratory kits.

One study showed the highest level of IgG antibody against COVID-19 on the 24th day of contact in hospital staff, persisting after 180 days, particularly in elderly people compared to younger people[11].

There was no sex difference in COVID-19 infection in this study. The Mukherjee study also showed equal susceptibility to COVID-19 infection between two genders[12]. In 212 studies from 11 regions/countries involving 281461 people, 51.8% were male without significant difference in two sexes[13].

In this study, demographic data showed no significant difference in seroconversion based on job (medical and nonmedical), history of travel in the past 6 months, travel with COVID-19 patients within 2 meters, and contact with COVID-19 patients at home, hospital, both places, or without history of contact.

The frequency of contact with respiratory droplets between two seronegative and seropositive groups has no significant difference as using patients' belongings (bed, cover, bathroom, medical equipment: stethoscope, pulse oximeter, blood pressure measuring device).

The COVID-19 pandemic had a destructive effect as a simple reminder of the need for readiness against pathogens with pandemic potential and new emerging viral threats. One important aspect of this readiness is

compliance with Standard Precautions (SPs) by health care workers (HCWs).

Table 5. Rate and percentage of using protective equipment based on sex and profession.

Use of protective equipment		Female		Male		P.V	Medical		Non-medi		P.V
		No.	%	No.	%		No.	%	No.	%	
Gloves	Always	78	39	25	12.5	0.063	85	42.5	18	9	0.004
	Often	31	15.5	18	9		40	20	9	4.5	
	Some T.	7	3.5	8	4		7	3.5	8	4	
	Rarely	20	10	13	6.5		21	10.5	12	6	
Mask	Always	107	53.5	53	26.5	0.121	122	61	38	19	0.966
	Often	25	12.5	8	4		26	13	7	3.5	
	Some T.	1	0.5	3	1.5		3	1.5	1	0.5	
	Rarely	3	1.5	0	0		2	1	1	0.5	
Gowns	Always	33	16.5	9	4.5	0.035	38	19	4	2	0.001
	Often	28	14	7	3.5		33	16.5	2	1	
	Some T.	24	12	9	4.5		29	13	4	2	
	Rarely	51	25.5	39	19.5		53	26.5	37	17.5	
Shield or Glass	Always	20	10	8	4	0.037	22	11	6	3	0.001
	Often	26	13	4	2		29	14.5	1	1	
	Some T.	23	11.5	8	4		29	14.5	2	1	
	Rarely	67	33.5	44	22		73	36.5	38	19	
Apron	Always	8	4	3	1.5	0.341	10	5	1	0.5	0.249
	Often	5	2.5	0	0		5	2.5	0	0	
	Some T.	14	7	4	2		14	7	4	2	
	Rarely	109	54.5	57	28.5		124	62	42	21	
Hand Wash	Always	132	66	58	39	0.033	146	73	44	22	0.223
	Often	2	1	5	2.5		4	2	3	1.5	
	Some T.	0	0	1	0.5		1	0.5	0	0	
	Rarely	2	1	0	0		2	1	0	0	

This study showed use of gloves by 51.5% of HCWs always and 24% often; masks by 80% always and hand washing by 95% always of times. Use of gowns, shields, or glass aprons was lower than 5-20%. Use of protective equipment showed no significant difference in use of gloves, masks, gowns, glasses, aprons, and hand washing based on gender and serology of HCWs. Use of a mask, apron, and handwashing has no significant difference between medical and non-medical workers. But use of gloves, gowns, and glass by medical workers was significantly more than non-medicals.

The Senbato study showed 36.49% compliance with SPs in respondents[14].

The Elseesy study, considering compliance with SPs among HCWs, nurses, and doctors, reported 36.43 ± 15.85% and 33.27 ± 15.76%, respectively[15].

The Omicron variant of SARS-CoV-2 was up to 70% more transmissible than earlier virus variants[16, 17]. Therefore, HCWs should have high compliance with SPs. The burden of infection is high in healthcare workers. They are on the front lines of fighting with new pandemics and involvement with disease and complications. Humans should prepare for future pandemics with the unknown nature of new emerging pathogens.

Conclusion

The burden of this disease is great for health care workers. Notification and compliance with standard precautions (SPs) are essential health subjects for both HCWs and patients. We need more education and

encouragement strategies by health organizations to increase compliance with standard precautions until recognition of the epidemiology and pathology of new emerging infectious diseases.

Acknowledgment

None.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Funding

This research received no specific grant or funding from any public, commercial, or not-for-profit organization.

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