Original Article

SARS-CoV-2 Seroprevalence among Health-Care Workers in Isfahan, Iran

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Abstract

Background: Health-care workers (HCWs) are in the frontline for fighting the coronavirus disease 2019 (COVID-19) pandemic and are at higher risk of acquiring the infection. Therefore, the defining immunity status among HCWs helps mitigate the exposure risk. In this study, we investigated the anti-SARS-CoV-2 immunoglobulin G (IgG) and immunoglobulin M (IgM) and also the associated risk factors in the HCWs working in Isfahan University of Medical Sciences COVID-19 referral hospitals.

Materials and Methods: In a cross-sectional study, demographics, COVID-19 symptoms during the past 2 weeks, and health-care details were collected from 200 consenting health workers of COVID-center-hospitals of Isfahan University of Medical Sciences from 23 October to 21 December 2020. The recombinant SARS-CoV2 nucleocapsid protein enzyme-linked immunosorbent assay-based IgM, and IgG antibody tests were evaluated. Data were analyzed using Chi-square and independent-*t*-student tests, and $P < 0.05$ was considered significant.

Results: One hundred and forty-one women and 59 men with a mean age of 36.4 ± 7.77 years participated in the study. IgG Ab and IgM Ab were positive in 77 (38.5%) and 12 (6%) of samples, respectively, and both antibodies were detected in 9 (4.5%). Higher ages, direct contact with the patients with COVID-19, muscle pain, loss of taste and smell, fever, and cough were the factors associated with antibody seropositivity against SARS-CoV2.

Conclusion: This study demonstrated that the prevalence of HCWs with antibodies against SARS-CoV-2 is relatively high in Isfahan University referral hospitals. The development of safety protocols and screening and vaccination strategies in the frontline HCWs must be implemented to reduce the burden of infection.

Keywords: COVID-19, health-care workers, risk factors, seroepidemiologic studies

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Introduction

In December 2019, unknown pneumonia among workers in a seafood market emerged in Wuhan, China. The disease had been caused by a novel coronavirus called SARS-CoV-2.[1] The coronavirus disease 2019 (COVID-19) has been rapidly spread from China to other countries, creating major global health problems.[2] The number of patients and deaths due to COVID-19 are increases daily.[3] People are advised to stay at their homes to stop the spread of coronavirus, but health-care workers (HCWs) have to go to hospitals and clinics to care for patients.[4]

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There are documents of infection with SARS-CoV-2 in HCWs in some countries.[5] Close contact with patients puts HCWs at risk of the disease. If HCWs are infected by the virus, they will easily infect patients and their coworkers.[6] HCWs with positive diagnosis COVID-19 should be isolated from patients and other health workers.[5] It makes the number of medical staff insufficient to patients' care. To cope with this challenge, different strategies such as periodic screening are suggested by health systems in the countries.[7] Nonetheless, the prevalence of infection with SARS-CoV-2 among health personals is not assessed in most countries.

Isolation of the virus from the clinical samples and molecular and serology tests are appropriate for the diagnosing disease.[8] Seroprevalence tests, as a test that provides valuable information about past and present infections, may have important effects on the decrease of burden disease among HCW and can be considered an indicator of the spread of COVID-19.[5,9] On the other hand, the determining risk factors of COVID-19 among HCWs are crucial to detecting high-risk wards and guides policymakers to apply appropriate policies for the control of infection in hospitals.[10] In this study, the seroprevalence and risk factors of the SARS-CoV-2 among HCWs in two referral hospitals in Isfahan, Iran, have been assessed.

Materials and Methods

In a cross-sectional study, from October 23 to December 21 2020, two hundred HCWs of Khorshid and Amin hospitals of Isfahan University of Medical Sciences were invited to participate in the study. These two hospitals are the main centers for COVID-19 in Isfahan province which reverse transcription polymerase chain reaction (PCR)-confirmed COVID-19 patients were admitted or referred for management.

Inclusion criteria were being employees or learners in the mentioned hospitals. People who had temporarily worked in these hospitals were not included in the study. Sampling was performed by cluster random sampling method according to different jobs in the hospitals.

After obtaining informed consent, a checklist containing demographic and clinical information including age, gender, hospital ward, job, direct/indirect contact with the COVID-19 patient, work experience, clinical symptoms during the last 2 weeks, participation in self-protection education programs, and infected with COVID-19 in the past was completed for each participant through face-to-face interview. Five milliliter of the venous blood sample was taken from each participant. According to the standard conditions of sample transfer, they were transferred to the Research Center for Infectious Diseases and Tropical Medicine laboratory within 4 h.

All samples were tested for immunoglobulin G (IgG) and immunoglobulin M (IgM) antibodies by enzyme-linked immunosorbent assay method (pishtaz teb company, Iran). The sensitivity and specificity of this kit to determine the presence of IgM antibodies have been 79.4% and 97.3%, and for IgG antibodies have been 94.1% and 98.3%, respectively.[11] According to the kit instruction, the antibody titers were defined as positive/negative; >1.1 was considered positive and <1.1 as negative for both IgG and IgM titers. In cases with IgM seropositivity, nasal and nasopharyngeal swab samples were taken, and real-time PCR was performed using standard-specific primers (rotor-GENE Q max qiagen hilden, Germany).

The study protocol has been assessed and approved by the research ethics committee of Isfahan University of Medical Sciences (approval number: IR.MUI.MED.REC.1399.428). The purpose of the study was explained to all participants before obtaining written informed consent, and the volunteers will be enrolled in the study. The personal information of enrolled participants was collected and maintained confidentiality.

Data were analyzed using SPSS (version 21.0, SPSS Chicago, IL, USA). Parametric and nonparametric continuous variables were analyzed by Student's *t*-test and Mann–Whitney U test, respectively. Categorical variables were analyzed using the Chi-square and Fisher's exact test. A two-sided $P < 0.05$ was considered to be statistically significant.

Results

In this study, 141 (70.5%) women and 59 (29.5%) men with mean age 36.4 ± 7.7 years participated. Seventy seven (38.5%) were IgG, and 12 (6%) were IgM-positive antibodies. Furthermore, 9 HCWs had developed both IgG and IgM (4.5%). The history of previous COVID-19 infection was reported in 81 ones (48 PCR+, 9 computed tomography +, and 24 both of them). IgG seropositivity was significantly more prevalent in higher ages. Furthermore, the direct contact with the patients with COVID-19 was significantly related to IgG seropositivity [Table 1]. The reported previous COVID-19 infection through PCR and/or CT scan was significantly associated with the male gender ($P = 0.003$). Among the reported symptoms in the past 2 weeks, muscle pain and loss of taste and smell were associated with IgG seropositivity. Fever, anosmia/ageusia, and cough were the main symptoms associated with IgM [Table 2]. No one with IgM seropositive had PCR positive.

One hundred and eighty-nine ones had been participated in educational sittings about self-protection against COVID infection. However, there was no relationship between the IgG or IgM seropositivity and joining in these classes.

Discussion

The results of this study demonstrated that nearly 45% of HCWs working in COVID reference hospitals in Isfahan

Table 1: The relationship between demographic variables and antibodies against coronavirus disease 2019 in health-care workers

Variables	IgG		*P*	IgM		*P*
	Positive, *n* (%)	Negative, *n* (%)		Positive, *n* (%)	Negative, *n* (%)	
Gender						
Female	52 (26)	89 (44.5)	0.28	8 (4)	133 (66.5)	0.49
Male	25 (12.5)	34 (17)		4 (2)	55 (27.5)	
Age (years), mean±SD	38 (8)	35.6 (7.5)	0.049*	36 (5.3)	36.5 (8)	0.8
Contact with patient**						
Direct	66 (33)	91 (45.5)	0.035*	11 (5.5)	146 (73)	0.22
Indirect	11 (5.5)	32 (16)		1 (0.5)	42 (21)	
Work experience, mean±SD	13.7 (7.6)	11.7 (8)	0.09	10.3 (5)	12.6 (8)	0.3

*Statistically significant differences, **Direct contact: Having prolonged or short-term directly contact with COVID-19 patients including physicians, nurses, radiology, and laboratory staff, indirect contact: Having minimal to no patient contact including driver, security guard, crew, administrative staff. SD: Standard deviation, COVID-19: Coronavirus disease 2019, IgM: Immunoglobulin M, IgG: Immunoglobulin G

province developed IgG and/or IgM against SARS-CoV-2. There are different reports in other studies around the world. The seropositivity in HCWs in Denmark was reported to be 4.04%.[7] In a large hospital in Spain, 9.3% of HCVs were seropositive for IgM and/or IgG and/or IgA against COVID-19.[5] In one of the NYC's public hospitals, the prevalence of SARS-CoV-2 IgG antibodies was 27%.[12] The IgG/IgM positivity rate by the immunoassay has been reported 2.36% in HCWs in Saudi Arabia.[13] In a clinic in Germany, 2.7% of HCWs were positive for IgG Ab against SARS-CoV-2.[14] The IgG and IgM positivity in an Italian hospital was 7.4% and 14.4%, respectively.[15] In a study in 18 cities of Iran, 2401 front-line and nonfront-line HCWs were assessed for SARS-CoV-2 IgG or IgM antibodies; seroprevalence was 15.45%.[16] In another study in the north of Iran, the seroprevalence of IgG and IgM antibodies was reported 34% and 5.6%, respectively.[17] In a hospital in Tehran, 15.3% and 27.8% of HCWs were positive for IgM and IgG antibodies against SARS-CoV-2, respectively.[18] This range in prevalence of seropositivity of SARS-COV-2 may reflect the difference in the study period, disease burden, and the policy regarding handwashing and the use of personal protective equipment in health-care settings. In our study, the seropositivity was higher than most studies. We believe that the higher seroprevalence seen in our survey could be a combination of higher exposure and lower self-protection in our HCWs. We began our study when Isfahan was severely affected by SARS-COV-2 during the third wave of the pandemic, and it may be why our results were higher than expected. However, it is estimated that 67% seropositivity is needed to achieve herd immunity to SARS-CoV-2, which we hope to accomplish by widely vaccination.

We found that nearly 40% of HCWs developed SARS-CoV-2 IgG antibodies, which is in line with the persistence of COVID-related PCR and/or CT scan previously. In our study, the IgG seropositivity was associated with the higher age and direct contact with COVID-19 patients, similar to the other studies.[5] Hence, higher availability of personal protective equipment, adherence to physical distancing rules, and hand hygiene, especially in older staff, could minimize the infection transmission among HCWs in our society.

In the current study, many seropositive HCWs had no clinical symptoms. It means that these staff would not have been self-isolating during the infected period and could have transmitted the disease. Therefore, better strategies must be suggested to assess the immunity in HCWs to protect both HCWs and patients.

Besides the viral nucleic acid detection based on real-time-PCR, immunoassay tests were developed to detect of IgG/IgM antibodies against COVID-19 in sera samples. Our results showed that no HCWs with seropositive IgM against COVID-19 had PCR positive. It is recommended to use both serologic tests and PCR to increase sensitivity in diagnosing COVID-19.[19]

Limitations

Received Flu vaccine could impact IgM and IgG antibody, titers which may be a confounder variable. However, the vaccination against Flu did not assess in this study.

Conclusion

Our findings indicated that the seroprevalence of COVID-19 in HCWs may be higher than expected, and a large number of HCWs in Isfahan are at high risk of acquiring SARS-COV-2 infection. Therefore, implementing safety protocols is needed to reduce exposure and transmission of infection among HCWs. The development of screening and vaccination strategies in the frontline health soldiers must also be implemented. Further studies are warranted to evaluate whether these findings are representative of all Isfahan hospitals.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Table 2: The relationship between symptomatic reports during the past two weeks and antibodies against coronavirus disease 2019 in health-care workers

Symptoms	IgG		*P*	IgM		*P*
	Positive	Negative		Positive	Negative	
Fever (*n*)						
Yes	2	3	0.64	2	3	0.03*
No	75	120		10	185	
Muscle pain (*n*)						
Yes	7	3	0.042*	2	8	0.11
No	70	119		10	179	
Nasal discharge (*n*)						
Yes	2	4	0.36	1	4	0.27
No	76	119		11	185	
Sore throat (*n*)						
Yes	3	7	0.42	1	9	0.47
No	74	116		11	179	
Cough (*n*)						
Yes	6	3	0.08	3	6	0.01*
No	71	120		9	182	
Shortness of breath (*n*)						
Yes	3	3	0.42	1	5	0.31
No	74	120		11	183	
Tremor (*n*)						
Yes	0	2	0.37	1	1	0.11
No	77	121		11	187	
Head ache (*n*)						
Yes	6	13	0.35	2	17	0.32
No	71	110		10	171	
Nausea/vomiting (*n*)						
Yes	0	1	0.61	0	1	0.94
No	77	122		12	187	
Stomach ache (*n*)						
Yes	0	0		0	0	
No	77	123		12	188	
Diarrhea (*n*)						
Yes	1	2	0.76	0	3	0.83
No	76	121		12	185	
Loss of taste/smell sense (*n*)						
Yes	5	0	0.008*	2	3	0.03*
No	72	123		10	185	
Weakness (*n*)						
Yes	3	4	0.55	2	5	0.06
No	74	119		10	183	
Dizziness (*n*)						
Yes	0	1	0.61	0	1	0.94
No	77	122		12	187	

*Statistically significant differences. IgM: Immunoglobulin M, IgG: Immunoglobulin G

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