



COVID-19 Seroprevalence among Healthcare Workers in a University Hospital in Southeastern Turkey

Tekin Karşlıgil¹ , Hüseyin Akdoğan² 

¹Department of Medical Microbiology, Gaziantep University Faculty of Medicine, Gaziantep, Turkey

²Department of Medical Microbiology, Gaziantep University Institute of Health Science, Gaziantep, Turkey

ABSTRACT

Objective: In our study, IgG and IgA antibodies were investigated by using the ELISA method, especially in healthcare workers (HCWs) who were more likely to encounter infection as of June 2020, and it was aimed to determine the level of HCWs being affected by the pandemic.

Methods: A total of 186 volunteer HCWs from different professions working in different departments were included in the study. Serum was obtained by taking 5 mL of blood samples from the volunteers. The presence of IgA and IgG antibodies against the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) virus was investigated in the sera by using the ELISA method.

Results: The mean age of the participants in the study was 34.22 (± 7.85), and 71 (38.2%) were female. One hundred and eighty participants tested for SARS-CoV-2 IgA antibodies, and eight (4.4%) of them were found positive. One hundred and eighty-six participants tested for SARS-CoV-2 IgG antibodies, and five (2.7%) of them were found positive. The highest antibody positivity was detected in the intensive care unit and doctors.

Conclusion: At the end of the study, low seropositivity rates were found. However, the risk of infection in HCWs increased in proportion to the continuation of the pandemic and the increase in cases. HCWs took the necessary precautions to minimize the infection. Investigating the presence of antibodies in HCWs at regular intervals will help to calculate the risk among HCWs.

Keywords: COVID-19, healthcare workers, seroprevalence

INTRODUCTION

COVID-19 is an infectious disease caused by SARS-CoV-2 (severe acute respiratory syndrome coronavirus-2), which appeared in Wuhan, China, in late 2019 and now causing worldwide outbreak.¹ The World Health Organization (WHO) announced COVID-19 as a pandemic on March 11, 2020.² As of October 25, over 43 million cases and over 1 million deaths occurred worldwide.³ The first case was reported on March 11 in Turkey. Until today (November 1), a total of 377,473/14,125,157 (2.67%) confirmed cases, 10,326 deaths, and 325,486 recoveries were reported in Turkey.⁴

Currently, the detection of SARS-CoV-2 RNAs by using molecular methods is applied as a standard for the diagnosis of COVID-19. In addition, reliable serological methods are needed to identify people who are infected or have had the disease. As a result of the last studies, serological tests based on the detection of antibodies specific for SARS-CoV-2 were identified.⁵⁻⁸ In a study, receptor binding domain (RBD)-specific IgA, IgM, and IgG kits showed 98.6%, 96.8%, and 96.8% sensitivity and 98.1%, 92.3%, and 99.8% specificity, respectively. After 4-10 days fol-

lowing the onset of symptoms, IgA showed the highest positive diagnostic rate. After 11-41 days after the onset of symptoms, both RBD IgA and IgG had the same positive diagnostic rate as 99.5%, while IgM was low.⁹

The main mode of transmission of COVID-19 occurs from person to person.¹⁰ Healthcare workers (HCWs) are the most important people for clinical monitoring of suspected or confirmed cases. For this reason, they contact with patients more frequently and are more likely to get sick and spread the disease to other HCWs.¹¹

Seroprevalence studies on HCWs can provide infection recently or in the past. In addition, determining the frequency of infection among HCWs will help in identifying high-risk departments and important for efficient use of HCWs.¹²

The aim of this study is to investigate the presence of antibodies against SARS-CoV-2 of HCWs working at University Hospital of Gaziantep during the pandemic and the effect of the disease on profession groups and units.

How to cite: Karşlıgil T, Akdoğan H. COVID-19 Seroprevalence among Healthcare Workers in a University Hospital in Southeastern Turkey. *Eur J Ther* 2021; 27(2): 106-112.

ORCID iDs of the authors: T.K. 0000-0001-7672-3625; H.A. 0000-0002-0536-4300.

Corresponding Author: Tekin Karşlıgil **E-mail:** karşlıgil@gantep.edu.tr

Received: 03.11.2020 • **Accepted:** 17.12.2020

METHODS

Study Population

Doctors, nurses, laboratory technicians, radiology technicians, assistant nurses, emergency medical technicians (EMT), and cleaning staff who have been working at the University Hospital of Gaziantep since the beginning of the pandemic were included in this study. These HCWs were randomly and voluntarily selected among the HCWs working in the emergency, infectious diseases, radiology, pulmonary diseases and otolaryngology departments, intensive care unit (ICU), and laboratory.

Serological Analysis

Five milliliters of the blood sample was collected from HCWs who agreed to participate in the study. Sera samples were stored until used. SARS-CoV-2 IgG and SARS-CoV-2 IgA antibodies were detected in sera samples using a semiquantitative anti-SARS-CoV-2 IgA and IgG enzyme-linked immunosorbent assay kits (Euroimmun Medizinische Labordiagnostika, Lübeck, Germany) with an automated device according to the manufacturer’s instructions. The results obtained were recorded for statistical analysis.

This study was performed after the ethical approval from Ethics Committee of Gaziantep University and the Republic of Turkey Ministry of Health (06.05.2020, 2020/165).

Participants in the study were informed about the study, and their participation approvals were obtained.

RESULTS

Overall, 186 HCWs including seven different profession groups, who have been working since the beginning of the pandemic, participated in the study, in which 115 (61.8%) were male and 71 (38.2%) female. The mean age of participants was 34.22 (± 7.85). In 186 participants, 64 (34.4%) were doctors, 45 (24.2%) nurses, 31 (16.7%) laboratory technicians, 50 (26.9%) working in emergency department, 41 (22%) working in laboratory, and 32 (17.2%) working in ICU. Sixty-four (34.4%) HCWs stated that they smoke. Thirty (16.1%) had chronic diseases (respiratory disease, cardiovascular diseases,

Main Points

- Seroprevalence studies conducted on HCWs during the pandemic provide information on the extent to which the pandemic affected HCWs.
- In this study, we investigated the presence of SARS-CoV-2 IgA and IgG antibodies in HCWs working in units that can be considered as risky for infection.
- Results of the study showed a low level of seropositivity in HCWs.
- The department with the highest seropositivity was intensive care. The profession with the highest seropositive rate was doctors.
- Regular antibody screening of HCWs is important for both providing information about the status of the epidemic and the effective use of HCWs.

Table 1. Subject Characteristics

<i>Sex</i>	
Male	115 (61.8%)
Female	71 (38.2%)
<i>Age</i>	34.22 \pm 7.85
<i>Profession</i>	
Doctor	64 (34.4%)
Nurse	45 (24.2%)
Laboratory technician	31 (16.7%)
EMT	6 (3.2%)
Radiology technician	7 (3.8%)
Assistant nurse	24 (12.9%)
Cleaning staff	9 (4.8%)
<i>Departments</i>	
Emergency	50 (26.9%)
Infectious diseases	25 (13.4%)
Pulmonary diseases	12 (6.5%)
Otolaryngology	15 (8.1%)
Laboratory	41 (22%)
Radiology	11 (5.9%)
ICU	32 (17.2%)
<i>Smoking</i>	
Yes	64 (34.4%)
No	122 (65.6%)
<i>Chronic diseases</i>	
Yes	30 (16.1%)
No	156 (83.9%)
<i>Symptoms of COVID-19</i>	
Yes	88 (47.3%)
No	98 (52.7%)
Total	186 (100%)

EMT, emergency medicine technician; ICU, intensive care unit.

diabetes mellitus, gastrointestinal diseases, etc.). Eighty-eight (47.3%) HCWs stated that they experienced mild COVID-19 symptoms such as fatigue and malaise, sore throat, cough, headache, and general pain, during the pandemic period, but only three had a PCR test for severe symptoms (Table 1). They

Table 2. Results of IgA and IgG Tests

Result	IgA	IgG
Positive (ratio ≥ 1.1)	8 (4.4%)	5 (2.7%)
Border (ratio ≥ 0.8 - < 1.1)	6 (3.3%)	2 (1.1%)
Negative (ratio < 0.8)	166 (92.3%)	179 (96.2%)
Total	180	186

Table 3. Seropositivity by Sex

Sex	IgA*			IgG		
	Positive	Border	Negative	Positive	Border	Negative
Male	4 (3.5%)	4 (3.5%)	105 (93%)	3 (2.6%)	1 (0.9%)	111 (96.5%)
Female	4 (6%)	2 (3%)	61 (91%)	2 (2.8%)	1 (1.4%)	68 (95.8%)

*180 HCWs were evaluated for SARS-CoV-2 IgA.

Table 4. The Presence of Contact, Contact Time, and the Effect of PPE Use on SARS-CoV-2 Antibody Positivity

		IgA*			IgG		
		Positive	Border	Negative	Positive	Border	Negative
Contact							
Yes	161 (86.6%)	7 (4.5%)	6 (3.8%)	143 (91.7%)	4 (2.5%)	2 (1.2%)	155 (96.3%)
No	25 (13.4%)	1 (4.2%)	-	23 (95.8%)	1 (4%)	-	24 (96%)
Contact time							
<2 minutes	10 (6.2%)	-	-	10 (100%)	-	-	10 (100%)
2-5 minutes	44 (27.3%)	2 (4.9%)	2 (4.9%)	37 (90.2%)	1 (2.3%)	1 (2.3%)	42 (95.4%)
>5 minutes	107 (66.5%)	5 (4.8%)	4 (3.8%)	96 (91.4%)	3 (2.8%)	1 (0.9%)	103 (96.3%)
PPE							
Yes	117 (72.7%)	4 (3.5%)	3 (2.6%)	107 (93.9%)	1 (0.9%)	2 (1.7%)	114 (97.4%)
Partially	25 (15.5%)	1 (4.3%)	2 (8.7%)	20 (87%)	1 (4%)	-	24 (96%)
No	19 (11.8%)	2 (10.5%)	1 (5.3%)	16 (84.2%)	2 (10.5)	-	17 (89.5%)

*180 HCWs were evaluated for SARS-CoV-2 IgA.

have previously had the disease and confirmed by PCR. One of them (33.3%) was working in ICU as a nurse, one of them (33.3%) was working in laboratory as a technician, and one of them (33.3%) was working in otolaryngology as a doctor. All of these HCWs were found to be seropositive for both antibodies.

The data obtained at the end of the study were evaluated according to the manufacturer's instructions as negative if ratio < 0.8 , border if ratio ≥ 0.8 - < 1.1 , and positive if ratio ≥ 1.1 .

Hundred and eighty participants tested for SARS-CoV-2 IgA antibodies. Of these, eight (4.4%), six (3.3%), and 166 (92.3%)

Table 5. The Range of IgA Results According to Profession Groups and Departments

Departments	Results	Professions						
		Doctor	Nurse	Laboratory technician	EMT	Radiology technician	Asst. nurse	Cleaning staff
Emergency	Positive	-	1	-	-	-	-	-
	Border	1	1	-	-	-	-	-
	Negative	19	14	-	6	-	5	3
Infect. dis.	Positive	1	-	-	-	-	-	-
	Border	1	-	-	-	-	-	-
	Negative	6	11	-	-	-	6	-
Pulmonary dis.	Positive	1	-	-	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	3	2	-	-	-	2	1
Otolaryngology	Positive	1	-	-	-	-	-	-
	Border	1	-	-	-	-	-	1
	Negative	9	2	-	-	-	1	-
Laboratory	Positive	-	-	1	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	8	-	28	-	-	-	1
Radiology	Positive	-	-	-	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	3	-	-	-	7	-	1
ICU	Positive	1	1	-	-	-	1	-
	Border	-	-	-	-	-	1	-
	Negative	9	12	-	-	-	6	1

EMT: emergency medicine technician; ICU: intensive care unit.

HCWs were detected for SARS-CoV-2 IgA as positive, border, and negative, respectively. Hundred and eight six participants tested for SARS-CoV-2 IgG antibodies. Of these, five (2.7%), two (1.1%), and 179 (96.2%) HCWs were detected for SARS-CoV-2 IgG as positive, border, and negative, respectively (Table 2).

The SARS-CoV-2 IgA was positive in four of 113 (3.5%) male and four of 67 female (6%) HCWs. SARS-CoV-2 IgG was positive in three of 115 (2.6%) male and two of 71 female (2.8%) HCWs (Table 3). No significant difference was found between male and female in terms of SARS-CoV-2 positivity.

One hundred and sixty-one of 186 (86.6%) participants stated that they had contact with a sample or patient (confirmed or suspected), and it was determined that seven (4.5%) were posi-

tive for SARS-CoV-2 IgA and four (2.5%) were positive for SARS-CoV-2 IgG. The contact time of the HCWs with the patient or sample (confirmed or suspected) was determined: for <2 minutes, 10 of 161 (6.2%) participants had contact and all of them were negative for both the antibodies; between 2 and 5 minutes, 44 of 161 (27.3%) had contact of which two (4.9%) were positive for SARS-CoV-2 IgA and two (4.9%) were positive for SARS-CoV-2 IgG; and for >5 minutes, 107 of 161 (66.5%) had contact of which five (4.8%) were positive for SARS-CoV-2 IgA and three (2.8%) were positive for SARS-CoV-2 IgG. Of these HCWs, 117 of 161 (72.7%) had full personal protective equipment (PPE), 25 of 161 (15.5%) partially, and 19 of 161 (11.8%) had no PPE, in which 4 (3.5%), 1 (4.3%), and 2 (10.5%) were positive for SARS-CoV-2 IgA and 1 (0.9%), 1 (4%), and 2 (10.5%) were positive for SARS-CoV-2 IgG, respectively. A laboratory

Table 6. The Range of IgG Results According to Profession Groups and Departments

Departments	Results	Professions						
		Doctor	Nurse	Laboratory technician	EMT	Radiology technician	Asst. nurse	Cleaning staff
Emergency	Positive	-	-	-	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	20	16	-	6	-	5	3
Infect. dis.	Positive	1	-	-	-	-	-	-
	Border	1	-	-	-	-	-	-
	Negative	6	11	-	-	-	6	-
Pulmonary dis.	Positive	-	-	-	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	4	3	-	-	-	4	1
Otolaryngology	Positive	2	-	-	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	9	2	-	-	-	1	1
Laboratory	Positive	-	-	1	-	-	-	-
	Border	-	-	1	-	-	-	-
	Negative	8	-	29	-	-	-	2
Radiology	Positive	-	-	-	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	3	-	-	-	7	-	1
ICU	Positive	-	1	-	-	-	-	-
	Border	-	-	-	-	-	-	-
	Negative	10	12	-	-	-	8	1

EMT, emergency medicine technician; ICU, intensive care unit.

technician was positive for both the antibodies despite not making contact (Table 4).

The department with the highest SARS-CoV-2 IgA positivity was in the ICU (three of 32, 9.4%), and the positive HCWs had different professions. In the radiology department, no HCW with SARS-CoV-2 IgA positive was found. The profession with the highest SARS-CoV-2 IgA positivity was doctors (four of eight, 50%) and they do not work in the same department (Table 5). The department with the highest SARS-CoV-2 IgG positivity was in the otolaryngology department (two of five, 40%) and both were working as doctors. In the radiology, emergency, and pulmonary diseases departments, no HCW with SARS-CoV-2 IgG positive was found. The profession with the highest SARS-CoV-2 IgG positivity was doctors (three of five, 60%) (Table 6).

DISCUSSION

In our study, we found that the seropositivity prevalence of both the antibodies was low in HCWs. The SARS-CoV-2 IgA seropositivity rate was higher than that of SARS-CoV-2 IgG. Likewise, in the border value range, SARS-CoV-2 IgA was higher than that of SARS-CoV-2 IgG. As a result of some studies, the seropositivity rates of SARS-CoV-2 antibodies on HCW were found to be at low levels. For example, Korth et al.¹³ found a lower level of SARS-CoV-2 IgG positivity in their study on 316 HCW (5/316, 1.6%). In another study conducted in China, 18 of 105 (17.14%) HCWs who contacted four confirmed patients were found to be seropositive.¹⁴ As a result of the study conducted in a large study group in Sweden, 410 (19.1%) HCWs were found to be positive for SARS-CoV-IgG.¹⁵ In the study conducted by Garcia-Basterio et al.,¹⁶ 54 of 578 HCWs were found to be seropositive, and a higher level of

SARS-CoV-2 IgA (8.1%) and SARS-CoV-2 IgG (7.6%) was found. In addition, they detected 6.2% positivity of SARS-CoV-2 IgM. When the effects of SARS-CoV-2 IgA and IgG positivity on sex were examined, no significant difference was observed ($P > .05$). Xu et al.,¹⁷ in their seroprevalence study on a study group including HCWs, stated that there was no significant difference in seropositivity rates between sexes. Rudberg et al.¹⁵ found that there was no difference between seropositive and seronegative individuals in terms of sex as a result of their studies. These results showed that both sexes were equally likely to be infected.

No significant difference was observed for both SARS-CoV-2 IgA and IgG between departments and seropositivity ($P > .05$). While the department with the most SARS-CoV-2 IgA positive HCW was ICU, it was otolaryngology for SARS-CoV-2 IgG. This may be because the virus affects the respiratory tract, and this department directly contacts the nose and throat of the patients. In the radiology department, all HCWs were negative for both the antibodies. Iversen et al.,¹⁸ as a result of their studies, showed that HCWs working in a dedicated COVID-19 department had a higher seroprevalence compared to other departments.

There was no significant difference in seropositivity for both SARS-CoV-2 IgA and IgG among professional groups ($P > .05$). However, the doctors reported most positivity among the HCWs who were positive for both the antibodies, while the EMT and radiology technicians were all negative for both the antibodies. However, this situation showed that the risk level of the professions with close and continuous contact, as in departments, is higher than the others. As a result of the research conducted by Chen et al.,¹⁴ seven of 17 doctors who contacted four patients were found to be positive. In other studies, it was found that those working in the frontline or high and intermediate-risk groups in the hospital had higher seroprevalence than others.^{13,18}

There was also no significant difference between the use of PPE and contact with the patient or sample (confirmed or suspected) and seropositivity ($P > .05$). However, the full use of PPE and the reduction in contact time significantly reduced the rate of seropositivity as it reduced the possibility of infection. In addition, these measures reduced the transmission of infection from the HCW to HCW.

CONCLUSION

In our study, we investigated the rate at which HCWs encountered COVID-19 at the beginning of the pandemic. Although the rates were found to be low at the end of our study, as the number of sick individuals in the community increases, the risk of infection in HCW will increase. Therefore, we think that HCWs should be more careful in their fight against the virus. In addition, we think that antibody tests will be effective in detecting seroprevalence in healthcare professionals and the community.

Ethics Committee Approval: This study was performed after the ethical approval from Ethics Committee of Gaziantep University and the Republic of Turkey Ministry of Health (06.05.2020, 2020/165).

Informed Consent: Participants in the study were informed about the study, and their participation approvals were obtained.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - T.K., H.A.; Design - T.K., H.A.; Supervision - T.K., H.A.; Resources - T.K., H.A.; Materials - T.K., H.A.; Data Collection and/or Processing - T.K., H.A.; Analysis and/or Interpretation - T.K., H.A.; Literature Search - T.K., H.A.; Writing Manuscript - T.K., H.A.; Critical Review - T.K., H.A.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

ACKNOWLEDGMENT

We would like to thank Gaziantep University Hospital microbiology laboratory personnel for helping us.

REFERENCES

- Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med.* 2020;382:727-733. [\[CrossRef\]](#)
- World Health Organization: WHO director-general's opening remarks at the media briefing on COVID-19-11. Accessed 27 October 2020. [\[CrossRef\]](#)
- World Health Organization: WHO coronavirus disease (COVID-19) weekly epidemiological update. Accessed 27 October 2020. [\[CrossRef\]](#)
- Health Ministry of Turkey: Daily report of COVID-19. Accessed 1 November 2020. [\[CrossRef\]](#)
- Zhang W, Du RH, Li B, et al. Molecular and serological investigation of 2019-nCoV infected patients: Implication of multiple shedding routes. *Emerg Microbes Infect.* 2020;9:386-389. [\[CrossRef\]](#)
- To KK, Tsang OT, Leung WS, et al. Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: An observational cohort study. *Lancet Infect Dis.* 2020;20:565-574. [\[CrossRef\]](#)
- Zhao J, Yuan Q, Wang H, et al. Antibody responses to SARS-CoV-2 in patients of novel coronavirus disease 2019. *Clin Infect Dis.* 2020;ciaa344. [\[CrossRef\]](#)
- Li Z, Yi Y, Luo X, et al. Development and clinical application of a rapid IgM-IgG combined antibody test for SARS-CoV-2 infection diagnosis. *J Med Virol.* 2020. [\[CrossRef\]](#)
- Ma H, Zeng W, He H, et al. Serum IgA, IgM, and IgG responses in COVID-19. *Cell Mol Immunol.* 2020;17:773-775. [\[CrossRef\]](#)
- Hoelth S, Rabenau H, Berger A, et al. Evidence of SARS-CoV-2 infection in returning travelers from Wuhan, China. *N Engl J Med.* 2020;382:1278-1280. [\[CrossRef\]](#)
- Ng K, Poon BH, Kiat Puar TH, et al. COVID-19 and the risk to health care workers: A case report. *Ann Intern Med.* 2020;172:766-767. [\[CrossRef\]](#)
- Black JRM, Bailey C, Przewrocka J, Dijkstra KK, Swanton C. COVID-19: The case for health-care worker screening to prevent hospital transmission. *Lancet.* 2020;395:1418-1420. [\[CrossRef\]](#)
- Korth J, Wilde B, Dolff S, et al. SARS-CoV-2-specific antibody detection in healthcare workers in Germany with direct contact to COVID-19 patients. *J Clin Virol.* 2020;128:104437. [\[CrossRef\]](#)
- Chen Y, Tong X, Wang J, et al. High SARS-CoV-2 antibody prevalence among healthcare workers exposed to COVID-19 patients. *J Infect.* 2020;81:420-426. [\[CrossRef\]](#)
- Rudberg AS, Havervall S, Manberg A, et al. SARS-CoV-2 exposure, symptoms and seroprevalence in health care workers. *Nat Commun.* 2020;11:5064. [\[CrossRef\]](#)
- Garcia-Basterio AL, Moncunill G, Tortajada M, et al. Seroprevalence of antibodies against SARS-CoV-2 among health care workers in a large Spanish reference hospital. *Nat Commun.* 2020;11:3500. [\[CrossRef\]](#)

17. Xu X, Sun J, Nie S, et al. Seroprevalence of immunoglobulin M and G antibodies against SARS-CoV-2 in China. *Nat Med.* 2020;26:1193-1195. [\[CrossRef\]](#)
18. Iversen K, Bundgaard H, Hasselbalch RB, et al. Risk of COVID-19 in health-care workers in Denmark: An observational cohort study. *Lancet Infect Dis.* 2020;20:1401-1408. [\[CrossRef\]](#)