

# Novel coronavirus seropositivity and related factors among healthcare workers at a university hospital: a cross-sectional study

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## Research

**Keywords:** COVID-19, pandemic, antibody

**Posted Date:** March 2nd, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-255849/v1>

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# Abstract

## Background

In this study, it is aimed to investigate the specific risk factors for the transmission of novel coronavirus (SARS-CoV-2) among healthcare workers in different campuses of a university hospital and to reveal the risk factors for antibody positivity.

## Methods

In this cross-sectional study, 2988 (82%) of 3620 healthcare workers in a university hospital participated. The Coronavirus Disease (COVID-19) antibody was investigated by taking serum to the healthcare workers who accepted for the COVID-19 antibody test.

The antibody test results of the participants were evaluated according to the campus they work, their profession and their workplace.

Statistical significance level was accepted as  $p < 0.05$  in all analyzes.

## Results

Of the antibody test results of the participants in this study, 108 (3.6%) were positive and 2880 (96.4%) were negative. Antibody positivity were higher in nurses than in other healthcare workers ( $p < 0.001$ ). When examined according to work places, antibody positivity was higher in those working in intensive care compared to those working in other places ( $p < 0.001$ ).

## Conclusions

Healthcare workers are at the highest risk of being infected with COVID-19. Those who have a higher risk of infection among healthcare workers and those working in high-risk areas should be vaccinated early and take care to work with personal protective equipment during the pandemic period.

## Trial Registration:

Retrospective permission was obtained from both the local ethics committee and the Turkish Ministry of Health for this study.

(IRB No:71522473/050.01.04/370, Date: 05.20.2020)

## Background

Coronavirus Disease (COVID-19) has affected many people in the world. This infection by SARS-CoV-2 caused disease in more than 80 million people as of December 2020 and caused nearly two million deaths., The disease can easily spread from person to person in the society by respiratory droplets (coughing, sneezing, speech, etc) and close contact of the infected person. Also, it is transmitted by touching the eyes, nose, or mouth with contaminated hands after contact with contaminated surfaces (1). In healthcare facilities, airborne contamination occurs during aerosol-generating applications, as well as droplet-induced or contact spread.

SARS-CoV-2 is highly contagious and healthcare workers (HCWs) work with a significant risk of transmission when caring for suspected or certain COVID-19 patients (2). HCWs in contact with COVID-19 patients are at high risk. Various reports show that many HCWs in many hospitals worldwide are infected with SARS-CoV-2 (3). Over time, the pandemic has seriously affected life in our country and many HCWs fell ill or died in this epidemic. Health care workers have higher risk of COVID-19 transmission compared to the community (4).

Many guidelines have been published to prevent HCWs from becoming infected (5). Despite infection control measures, it is not sufficient to prevent the spread of SARS-CoV-2 among HCWs. Unknown risk factors can also contribute to virus transmission in hospitals. Despite all the precautions taken, HCWs continue to be infected. The most important way to determine the number of infected HCWs is to determine the frequency by serosurvey. This study, it was aimed to examine the antibody distribution of those working in a university hospital in May 2020 and the relationship of antibody frequency according to the profession and workplace.

## Methods

This study was performed in a university hospital with 1200 inpatient beds, including 160 (adult:100, neonatal:50, pediatric:10) intensive care unit beds. The hospital consists of four different campuses. After the first COVID-19 case was seen in Turkey (March 11), these four campuses; The Central Campus and Toyota Campus have been transformed into pandemic hospitals. Maternity and Pediatrics Campus and Korucuk Campus continued their routine operation. This study was carried out with healthcare workers in these hospitals in May 2020.

3620 HCWs were actively working on these four campuses as of May 2020. All HCWs working on four campuses were informed about the antibody screening to be performed at the hospital. A list of all HCWs was made and a collecting blood sample appointment was given to everyone. The appointments were determined by giving priority to the campuses and clinics where COVID-19 patients were treated. Antibody test results of 2988 HCWs whose blood samples were taken from among 3620 HCWs were evaluated. In this cross-sectional type of research, 82.5% of the participants were reached.

The first laboratory-confirmed COVID-19 case in Sakarya Province was detected on March 20. A flexible working model has created all campuses. All HCWs were provided with personnel protective equipment that should be used while caring for the COVID-19 patient. And they were trained on the use of personnel

protective equipment. It was asked to wear an isolation gown first, then a mask, then goggles or face shield, and finally gloves. While taking off the equipment, these operations were requested to be done in reverse order.

Blood collection teams were established in the hospital.

These teams, in groups of two, simultaneously took blood samples from participants working in intensive care and COVID-19 clinics to prevent contamination and density.

A screening outpatient clinic was opened for those working in other units of campuses. Other blood samples were taken at this outpatient clinic, at the appointment times given to the HCWs. All blood samples taken were submitted to the sample acceptance unit.

The kit used [COVID-19 IgM / IgG Antibody Rapid Test (Beijing Hotgen Biotech Co. Ltd, China)] was based on the principle of colloidal gold immunochromatographic technology. It uses the double antigen sandwich method to detect SARS CoV-2 IgM / IgG antibody in serum or plasma sample. Peripheral blood samples taken from the patient were studied from the sera after being centrifuged at 4000 rpm / 10 min. Studies were conducted in biosafety level 2 cabinets. After taking 10 µl of serum and adding the cassette to the well on the test, 3 drops of diluent were added on it. After 15 minutes incubation at room temperature, the test result was evaluated within 30 minutes. Studies were conducted in line with the manufacturer's recommendations.

## Statistical Analysis

All categorical variables were compared by the Chi-Square test. The odds ratio and 95% confidence intervals for the odds ratio were calculated to determine the risk levels for their professions, workplace, and hospital of the HCWs in terms of SARS-CoV-2 positivity. Categorical variables were presented as a frequency and percentage. A p-value < 0.05 was considered significant. Analyses were performed using commercial software (IBM SPSS Statistics, Version 23.0. Armonk, NY: IBM Corp. and MedCalc Statistical Software version 19.6, MedCalc Software bvba, Ostend, Belgium).

Permission was obtained for this study from both the local ethics committee (IRB No:71522473/050.01.04/370, Date: (05.20.2020) and the Turkish Ministry of Health.

## Results

In total, 2988 HCWs in our hospital were included in this study. 72.8% of the employees were from the main campus, 16.3% from Maternity and Pediatrics Campus, while the remaining from Toyota 10.5% and Korucuk 0.4% campuses. The distribution of HCWs, their professions, and working places are summarized in Table 1. Of the personnel tested for antibody, 108 (3.6%) were positive, while 2880 (96.4%) were antibody negative.

The probability of antibody positivity in nurses was 3.36 times higher than in other occupational groups (Table 2). We found that among the staff groups, nurses were the riskiest (Fig. 1 and Table 3).

Table 1  
Distribution of HCWs tested with suspicion of SARS-CoV-2 by hospital, duty, and place of duty.

<b>Features</b>		<b>n</b>	<b>%</b>
<b>Hospitals</b>	<b>Center Hospital</b>	2176	72.8
	<b>Maternity and Pediatrics Hospital</b>	486	16.3
	<b>Toyota Hospital</b>	315	10.5
	<b>Korucuk Hospital</b>	11	0.4
<b>Profession</b>	<b>Medical Doctor</b>	496	16.6
	<b>Nurse</b>	982	32.9
	<b>Other Health Personnel</b>	352	11.8
	<b>Medical secretary</b>	311	10.4
	<b>Cleaning staff</b>	474	15.9
	<b>Administrative / Technical Staff</b>	265	8.9
	<b>Security guard</b>	108	3.5
	<b>Workplace</b>	<b>Covid-19 Clinics</b>	202
	<b>Intensive Care Units</b>	595	19.9
	<b>Emergency Services</b>	381	12.8
	<b>Clinics / Polyclinics</b>	910	30.5
	<b>Laboratories / Radiodiagnostic</b>	264	8.8
	<b>Administrative / Technical Units</b>	445	14.8
	<b>General</b>	191	6.4

Table 2

Distribution of SARS-CoV-2 antibody positivity according to the professions, work place, and hospitals in which healthcare professionals work

		Antibody Test Results		OR	95% CI for OR	p
		Negative	Positive			
		(n = 2880)	(n = 108)			
Profession	Medical Doctor	481 (%97.0)	15 (%3.0)	0.804	0.462– 1.400	0.441
	Nurse	916 (%93.3)	66 (%6.7)	<b>3.369</b>	<b>2.270– 5.000</b>	<b>&lt; 0.001</b>
	Other Health Personnel	346 (%98.3)	6 (%1.7)	0.465	0.203– 1.067	0.071
	Medical Secretary	305 (%98.1)	6 (%1.9)	0.497	0.216– 1.141	0.099
	Cleaning Staff	459 (%96.8)	15 (%3.2)	0.851	0.489– 1.481	0.567
	Security / Administrative / Technical Staff	373 (%100.0)	0 (%0.0)	0.031	0.002– 0.499	0.014
Work place	COVID-19 Clinics	190 (%94.1)	12 (%5.9)	1.770	0.954– 3.283	0.070
	Intensive Care Units	540 (%90.8)	55 (%9.2)	<b>4.497</b>	<b>3.049– 6.633</b>	<b>&lt; 0.001</b>
	Emergency Services	374 (%98.2)	7 (%1.8)	0.464	0.214– 1.007	0.052
	Clinics / Polyclinics	889 (%97.7)	21 (%2.3)	0.541	0.334– 0.876	0.013
	Laboratories / Radiodiagnostic	258 (%97.7)	6 (%2.3)	0.598	0.260– 1.375	0.226
	Administrative / Technical Units	439 (%98.7)	6 (%1.3)	0.327	0.143– 0.750	0.009
	General	190 (%99.5)	1 (%0.5)	0.132	0.018 * 0.953	0.045
Hospitals	Center Hospital	2081 (%95.6)	95 (%4.4)	2.806	1.563– 5.038	<b>&lt; 0.001</b>
	Maternity and Pediatrics Hospital	482 (%99.2)	4 (%0.8)	0.191	0.070– 0.522	0.001

		Antibody Test Results		OR	95% CI for OR	p
		Negative	Positive			
		(n = 2880)	(n = 108)			
	<b>Toyota Hospital</b>	306 (%97.1)	9 (%2.9)	0.765	0.383– 1.529	0.448
	<b>Korucuk Hospital</b>	11 (%100.0)	0 (%0.0)	1.150	0.067– 19.641	0.923
<b>Hospitals</b>	<b>Pandemic Hospitals</b>	2387 (%95.8)	104 (%4.2)	<b>5.370</b>	<b>1.969– 14.646</b>	<b>0.001</b>
	<b>Standard Hospitals</b>	493 (%99.2)	4 (%0.8)			

OR: odds ratio, CI: confidence interval

\*: Odds ratios of each profession, workplace, and hospital were calculated according to all other professions, workplaces, and hospitals.

Table 3

COVID-19 risk ratio of doctors, nurses and cleaning staff compared to other healthcare professionals

Professions		OR	95% CI for OR	p
<b>*Medical Doctor</b>	<b>Nurse</b>	0.433	0.244–0.766	0.004
	<b>Other Health Personnel</b>	1.798	0.691–4.682	0.229
	<b>Medical secretary</b>	1.585	0.608–4.130	0.346
	<b>Cleaning staff</b>	0.954	0.461–1.974	0.897
	<b>Security / Administrative / Technical Staff</b>	24.047	1.434–403.207	<b>0.027</b>
<b>*Nurse</b>	<b>Medical Doctor</b>	<b>2.311</b>	<b>1.305–4.091</b>	<b>0.004</b>
	<b>Other Health Personnel</b>	<b>4.155</b>	<b>1.785–9.671</b>	<b>0.001</b>
	<b>Medical secretary</b>	<b>3.663</b>	<b>1.572–8.533</b>	<b>0.003</b>
	<b>Cleaning staff</b>	<b>2.205</b>	<b>1.245–3.905</b>	<b>0.007</b>
	<b>Security / Administrative / Technical Staff</b>	<b>54.201</b>	<b>3.346–877.929</b>	<b>0.005</b>
<b>*Cleaning staff</b>	<b>Medical Doctor</b>	1.048	0.507–2.168	0.897
	<b>Nurse</b>	0.453	0.256–0.804	0.007
	<b>Other Health Personnel</b>	1.885	0.724–4.907	0.194
	<b>Medical secretary</b>	1.661	0.638–4.329	0.299
	<b>Security / Administrative / Technical Staff</b>	25.198	1.503–422.541	0.025
OR: odds ratio, CI: confidence interval				
*: Odds ratios of medical doctors, nurses, and cleaning staffs were calculated according to related professions				

## Discussion

In this study, the frequency of COVID-19 antibodies in hospital staff was investigated in the tests taken as of May 2020, and as a result of the tests, antibody positivity was found in the staff at a rate of 3.6%. It has been observed that the most risky group among the HCW's is nurses. The probability of antibody positivity in nurses was 3.36 times higher than in other occupational groups. When antibody positivity is investigated according to the professions in the research, the detection of virus-specific antibodies indicates the encounter with COVID-19. Antibodies generally reach detectable levels 1 to 2 weeks after infection. Therefore, antibody tests are not suitable to show acute infection (6). In a study from the US, about 6% of adults hospitalized with COVID-19 were HCWs, and 72% of them were women. More than two-thirds of the HCWs hospitalized with COVID-19 generally work in positions that involve direct contact with patients, and more than one-third were nurses (7).

However, it should not be forgotten that a negative antibody test does not exclude infection. Antibody tests are mainly used in serological surveillance studies. Antibody tests are not suitable for use as immune indicators or to relax preventive measures (6).

One study found that healthcare workers providing healthcare to COVID-19 patients had a higher risk of getting COVID-19. The risk of hospitalization related to covid-19 was compared among the healthcare workers who provided health services to the patient with Covid-19, other healthcare workers, household members of healthcare professionals and the general population,. In the first 3 months, the probability of hospitalization with COVID-19 was three times higher in healthcare workers providing direct care for COVID-19 patients than other healthcare workers. In analyzes adjusted for gender, age, ethnicity, socioeconomic status and comorbidity, the risk was twice as high among household members of employees who directly cared for a COVID-19 patient.(8).

According to our findings, those working in intensive care units (9.2%) and those working in the COVID-19 service had the highest antibody positivity. Because the employees in this group care for more serious patients and are exposed to a more intense virus load. Therefore, this group of HCWs with high risk should be included in the vaccination scope in terms of COVID-19 first. Apart from high-risk areas such as emergency and intensive care, the use of personnel protective equipment should be maintained meticulously, and employees working in this field should not experience any lack of equipment. Also, a limitation should be placed on the number of daily patients to reduce the intense patient contact and flexible work should be created to reduce the virus load on HCWs. It is expected that the positivity in the household of infected HCWs, not only the age-old HCWs, is also expected to be high. Considering this situation, the household of the HCWs should be included in the scope of screening.

In our country, COVID-19 positivity was examined in the general population months after the date of this research. In that study, the COVID-19 antibody positivity in the population was found to be 0.81% in June 2020. However, the 3.6% rate we found in May 2020, when COVID-19 was limited in the population, was well above the average of the general population. (9).

Nurses had the highest antibody positivity among healthcare workers. Most patients with COVID-19 who need hospitalization are patients with significant dyspnea. For this reason, patients who need oxygen support and nursing care the most. Therefore, we think that nurses' intensive work and intense patient contact with these patients may be related to the higher antibody positivity in this occupational group. In a study conducted in Denmark, the group with the highest antibody positivity was nurses (10). It shows that approximately one-tenth of the HCWs screened in this study were diagnosed with acute SARS-CoV-2 infection; about half of them were nurses. The high number of nurses who were positive for SARS-CoV-2 in our study can be explained by the fact that their nurses generally spend more time with direct patient care, the longer the time spent working at the bedside and the practices that require direct patient contact. One of the reasons it is more common in nurses may be that they have to eat during the working period and nurses get together more in social areas during rest periods.

Burnout has also increased in this population due to the increased workload and difficult working hours in HCWs. Increasing burnout causes negative effects on physical and mental health. Any measure to help reduce the burnout levels of HCWs can reduce stress levels and provide effective strategies to improve physical and mental health (11, 12).

## Conclusions

As a result, antibody positivity is high in HCWs. Given the fact that some HCWs are asymptomatic, all healthcare professionals should be screened in a continuous, systematic manner. Practices that encourage early isolation are required to prevent cross-infection. Among HCWs, nurses and intensive care workers are riskier for COVID-19.

## Declarations

### Ethics approval and consent to participate

Retrospective permission was obtained from both the local ethics committee and the Turkish Ministry of Health for this study. IRB No:71522473/050.01.04/370, Date: 05.20.2020

### Consent for publication

Not applicable

### Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due but are available from the corresponding author on reasonable request. The reason why the data is not available to the public is that antibody test results made to healthworkers can only be used with the permission of the Ministry of Health and the relevant hospital.

### Competing Interests

The authors declare that they have no competing interests.

### Funding

No funds were used during the research.

### Authors' contributions

AO: Have drafted the work, Revision, Design of the work

OK: Revision

UE: Data analysis

EG: Revision

SS: Interpretation of data

AA: Design of the work, Revision

MK: Interpretation of data, Design of the work

## Acknowledgements

Not applicable

## Abbreviations

SARS-COV-2: Novel Coronavirus

COVID-19: Coronavirus Disease

HCWs: Healthcare Workers

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## Figures

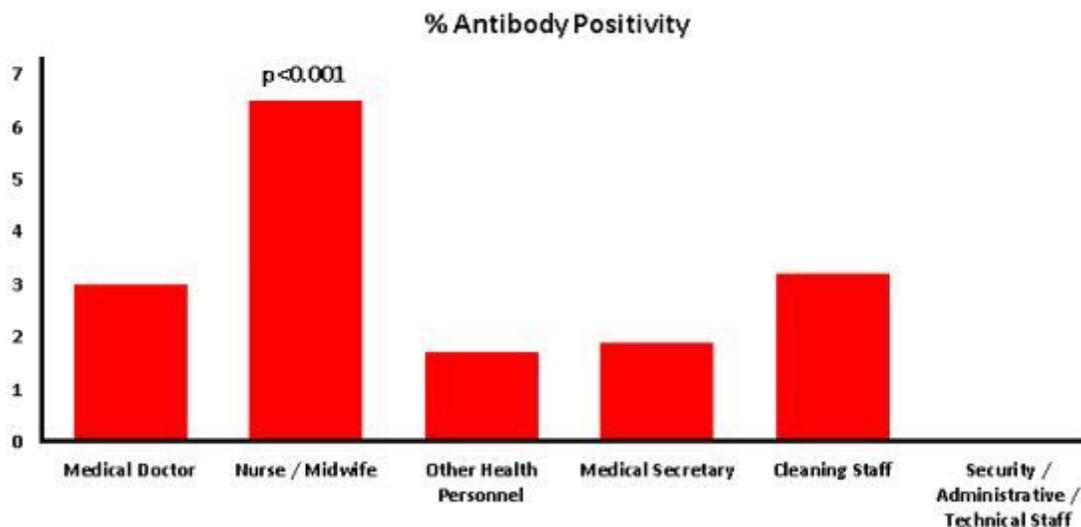


Figure 1

Antibody positivity according to the profession of HCWs