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ORIGINAL ARTICLE / ORİJİNAL MAKALE

SARS-CoV-2 seroprevalence in health care workers in a third level hospital in Turkey

Türkiye'de bir üçüncü basamak hastanede sağlık çalışanlarında SARS-CoV-2 seroprevalansı

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ABSTRACT

Objective: The aim of this study is to investigate the previous four months (March-July 2020) SARS-CoV-2 infection rate, seroprevalence and the variables affecting these in HCWs in a university hospital. **Methods:** The present study is a SARS-CoV-2 seroprevalence study on HCWs working in a tertiary hospital during the first stage (March-July 2020) of the outbreak in Turkey. The presence of IgM and IgG antibodies against the spike structure of the virus was investigated by the chemiluminescent enzyme immunoassay (CLIA) method using the commercial antibody kit (COV2T, Siemens®, Tarrytown, NY, US). Participants' socio-demographic characteristics, health status, lifestyle, risky occupational and social and personal protective equipment (PPE) usage were independent variables of the study. Chi-square test and Fisher's exact test were used in univariate analyzes, and accepted type 1 error value was 0.05. The analyzes were made using the SPSS 23.0 package program. **Results:** 1177 out of a total of 1702 health workers participated in the study. Participation rate was 69.1% . The mean age of the study group was 35.3 ± 9.8 and 62.7% were females. SARS-CoV-2 infection rate detected by nucleic acid amplification test (NAAT-PCR) or antibody test (Elisa) was (18/1177) 1.5%; The seroprevalence of SARS-CoV-2 was 1.01%. 17% of the entire SARS-CoV-2 cases were asymptomatic. The highest infection prevalence was significantly higher in auxiliary health workers (3.7%) compared to other groups. The presence of symptoms HCW's and their family members that did not exist before in the last 15 days, being overweight or obese and consulting as contacted person in surveillance unit were significantly related to having SARS-CoV-2 infection ($p<0.05$). **Conclusion:** The infection rate and seroprevalence was low in the first stage of the outbreak. Low level of education and being obese increase possibility of infected by SARS-CoV-2 in HCWs.

Keywords: SARS-CoV-2, health personnel, seroepidemiologic studies, infections, Turkey

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ÖZ

Amaç: Bu çalışmanın amacı, salgının ilk dalgasında (Mart-Temmuz 2020) Türkiye'deki bir üniversite hastanesinde sağlık çalışanlarının SARS-CoV-2 enfeksiyon sıklığı ve seroprevalansını araştırmaktır. **Yöntem:** Bu çalışma, Türkiye'deki salgının ilk aşamasında (Mart-Temmuz 2020) üçüncü basamak bir hastanedeki çalışan sağlık çalışanlarında yapılan SARS-CoV-2 seroprevalans çalışmasıdır. Virüsün spike yapısına karşı IgM ve IgG antikorların varlığı Kemilüminesan enzim immünoassay (CLIA) yöntemi ile hazır ticari antikor kiti (COV2T, Siemens®, Tarrytown, NY, US), kullanılarak araştırılmıştır. Katılımcıların sosyodemografik özellikleri, sağlık durumu, yaşam tarzı, sosyal ve mesleki riskli davranışları, kişisel koruyucu ekipman (KKE) kullanımı çalışmanın bağımsız değişkenleridir. Tek değişkenli analizlerde Ki-kare ve Fisher'in kesin testi kullanılmış ve tip 1 hata değeri 0.05 olarak kabul edilmiştir. Analizler SPSS 23.0 paket programı kullanılarak yapılmıştır. **Bulgular :** Toplam 1702 sağlık çalışanından 1177'si çalışmaya katılmış, katılım oranı %69.1 olarak gerçekleştirilmiştir. Çalışma grubunun yaş ortalaması 35.3 ± 9.8 , %62.7'si kadındır. Nükleik asit amplifikasyon testi (NAAT-PCR) veya antikor testi (Elisa) ile tespit edilen SARS-CoV-2 enfeksiyon sıklığı (18/1177) %1.5; SARS-CoV-2'nin seroprevalansı %1.01'dir. Tüm SARS -CoV-2 vakalarının %17'si asemptomatiktir. En yüksek enfeksiyon prevalansı yardımcı sağlık çalışanlarında (%3.7) diğer gruplara göre anlamlı olarak daha yüksektir. Son 15 gün içinde sağlık çalışanları ve aile bireylerinde herhangi bir semptom olmaması, aşırı kilolu veya obez olması ve sürveyans birimine temaslı kişi olarak başvurmuş olması SARS-CoV-2 enfeksiyonu arasında anlamlı düzeyde ilişkilidir ($p<0.05$). **Sonuç:** Salgının ilk aşamasında enfeksiyon oranı ve seroprevalans düşüktür. Düşük eğitim seviyesi ve obez olmak, sağlık çalışanlarında SARS-CoV-2 ile enfekte olma olasılığını artmaktadır.

Anahtar kelimeler: SARS -CoV-2, sağlık çalışanları, seroprevalans çalışmaları, enfeksiyon, Türkiye

Introduction

Seroprevalences reported in SARS-CoV-2 seroprevalence studies have been mentioned as total antibody (Ig G and IgM) and microneutralization (neutralizated antibodies) prevalences. SARS-CoV-2 infection results with enough levels of neutralizated antibody formation. So, on the evaluation of SARS-CoV-2 seropositivity, it is enough to examine total antibody levels. But, some PCR + cases could not develop antibody. This situation may be due to the infection does not effect cellular level in those cases, so seropositivity can not obtain.[1] In a report performed by Fudan University Hospital of Shangai, China on February 2020, 10 of 175 patients did not develop neutralizated antibody and it has been detected that older patients had much more antibody response.[2]

Previous studies suggested that asymptomatic patients show undetectable antibody levels after two months from infection. In a prevalence study performed by a hospital of USA, the seropositivity rate has decreased from 7,6% to 3.2% after 60 days from beginning.[3] In another study, it has been estimated that antibody levels decrease fifty percent every 73 days and disappear almost in a year.[4] In a public based seroprevalence study performed in Newyork, 160 (6.3%) of SARS-CoV-2 infected 2547 patients were seronegative.[5]

Determining the rate of SARS-CoV-2 infection rate and seroprevalence in healthcare workers is essential for planning healthcare services and patient safety. The overall seroprevalences were reported as 8.7%[6] and 10.1%[7], in two separate systematic reviews, analyzing SARS-CoV-2 seroprevalence studies in healthcare workers. These percentages range between 4.0% and 12,7%.[6] Asymptomatic health workers working in public hospitals of Malasia, seropositivity has been detected as 0.0%.[8] In health workers of a tertiary hospital of India, SARS-CoV-2 seroprevalences were 11,1%

and 19.9% in corona clinics of this hospital. In the other clinics working on other than SARS-CoV-2 patients in the same hospital, the highest seroprevalence rate was observed on gastroenterology department as 11.9%.[9] Two different SARS-CoV-2 studies performed in health workers of Germany, prevalences have been detected as 1,6% and 2.7%.[10,11] Seroprevalence rates of symptomatic and asymptomatic health workers of Birmingham, UK were as 24.4% and 17,1%, respectively.[12] In another study on health workers of UK performed on April-June 2020, seroprevalence rate was 8%. This value was 44.7% in symptomatic ones and 10.6% in asymptomatics.[13]

In the present study, we aimed to evaluate SARS-CoV-2 infection rate, seroprevalence and the factors affecting these in health workers (academic, doctors, nurses, auxiliary health workers and other staff) of a University Hospital in Turkey between March and July 2020.

Methods

In this article, SARS-CoV-2 infection rate and seroprevalence in the four-month period between March 15 and July 15, 2020 in healthcare workers (HCW) at Manisa Celal Bayar University Hospital is presented. The population of this cross-sectional study consists of academic personnel, health service workers, and auxiliary HCW at Manisa Celal Bayar University Hospital, who are likely to be exposed to SARS-CoV-2 infection (n = 1702). All employees were invited to participate to the study. There were no exclusion criteria in the study.

Diagnostic methods and procedures

HCWs were asked to answer a questionnaire simultaneously with the blood sampling. Within two hours of blood collection, blood samples were centrifuged at 5000 rpm for 5 minutes and the sera were separated. Serum samples that could not be tested on the same day were taken to the refrigerator at +4 °C to be tested within 72 hours. The remainder of the sera was stored in 1.5 ml aliquots in Eppendorf tubes at -20 ° C.

Questionnaire

Socio-demographic characteristics, presence of chronic disease, lifestyle (smoking, alcohol usage, physical activity) factors were questioned. Taking covid measures, comply with the national restrictions and being in crowded environments were questioned with the survey questions. People were asked how they evaluated themselves regarding the usage of PPE at work. Participants according to their occupation; they filled out whether they perform in different level of risky transactions (high risk contact, moderate risk contact, low risk contact) and PPE usage. (for example pyhsicians and nurse CPR, procedures such as respiratory tract sampling, for Auxiliary health worker accompanying a covid positive patient were questioned.)

SARS-Cov2 Antibody testing

To test anti- SARS-CoV-2 antibodies in serum, a commercial antibody kit (COV2T, Siemens®, Tarrytown, NY, United States) was used to detect total IgM and IgG antibodies against the virus spike structure by chemiluminescent enzyme immunoassay (CLIA) method. The test kit was studied with the ADVIA Centaur XP® analyzer (Siemens®) in accordance with the manufacturer's recommendations. Accordingly, in the test system containing solid phase streptavidin coated microparticles and biotinylated SARS-CoV-2 S1 recombinant antigens (RBD (Receptor Binding Domain)), incubation, washing and chemiluminescence reaction initiation and measurement were performed automatically by the analyzer using 50 µl of serum. The system reports COV2T assay results in Index Values and as nonreactive or reactive. Nonreactive: < 1.0 Index, these samples were considered negative for SARS-CoV-2 antibodies; reactive: ≥ 1.0 Index; these samples were considered positive for SARS-CoV-2 antibodies. Measuring Interval is 0.05–10.00 Index. During this study, among the HCWs those had a positive PCR test previously were included in the study. PCR testing was performed 0-7 days later for asymptomatic seropositive participants.

Ethical Declaration

This study was approved by the Turkish Ministry of Health, General Directorate of Health Services (the approval code: 2020-06-15T16_24_25) and the Manisa Celal Bayar University Clinical Research Ethics Committee Clinical Research Ethics Committee (date/number: 01/07/2020 / 20.478.486 / 423).

The written informed consents of the participants were obtained. With this consent, special measures have been taken to protect the privacy of personal data.

Statistical analyses

Where appropriate, Chi-square test and Fisher's exact test were used in the univariate analyses. Multivariate analyzes could not be applied because the infection rate and seroprevalence level was as low as 1-2% and only two variables gave significant results in univariate analyzes. In univariate analyses, type 1 error value was accepted as 0.05. The analyses were made using the SPSS v. 23.0.

Results

The rate of participation in the study was 69.1%. Sociodemographic and life style characteristics of the study group are presented in Table 1.

42.7% of the study group had a flu-like illness between October 2019 and February 2020. 9.5% of them had new symptom(s) that had not occurred before in the past 15 days. Most of the participants (91.8%) stated that they strictly adhered to the rules such as wearing masks and physical distance in crowded environments and 77.3% fully comply with the national restrictions (Table 2).

When the participants were asked how did they behave in case of PPE was inadequate, 54.8% stated that they reused their old equipment, 40.8% purchased the necessary equipment themselves, 17.6% continued to operate with the missing equipment and 4.1% refused to do the operation in case of lack of equipment. While 0.3% of the participants did not feel safe at all in terms of PPE use; 60.2% of them feel quite / completely safe. On the other hand, 55.6% of physicians, 66.6% of nurses and 65.8% of auxiliary health workers feel fully safe in terms of using PPE (Table 3).

27.9% of the participants has performed high-risk procedures (intense contact with a COVID-19 patient; covers contacts that occur while performing any of the procedures such as respiratory tract sampling, intubation, cardiopulmonary resuscitation, endoscopic procedures, etc.) multiple times to Covid-19 positive / suspected patients in the last 4 months and 91.7% of them stated that they used PPE during the transactions. 36.1% of the health workers applied to the hospital surveillance (contact-tracing) unit as a contact HCWs in the last 4 months, and 20.2% of the applicants were evaluated in high-risk contact of SARS-CoV-2, 36.8% in moderate-risk contact, and 42.9% in low-risk/non-risk contact category (Table 4).

The prevalence of SARS-CoV-2 infection in the hospital detected by PCR or antibody test was (18/1177) 1.5% in the last 4 months. Among 18 SARS-CoV-2 infected HCW'S;, 6 (33%) of them were auxiliary HCWs, 4 (22%) of them were physicians, 4 (22%) of them were nurses and 4 were other hospital workers. The highest prevalence of infection (PCR positives or antibody positives) was found in auxiliary health workers (3.7%) which is significantly higher than the other health personnel (Chi Square=8.1; DF=3; p=0.043). PCR positives, antibody positives and both positives are presented in table 5.

SARS-CoV-2 seroprevalence is 1.01%. Six of the 18 cases infected with SARS-CoV-2 were positive for both PCR and antibody tests. However, although the PCR result was negative, SARS-CoV-2 antibodies were sufficiently positive in six cases, while no antibodies were detected in other six who were PCR positive (Figure 1).

Table 1. Sociodemographic, professional and lifestyle features of the heath care workers

	n	%
Age		
Mean±SD= 35.3±9.8 , Min-Max=18.0-66.0 ; IQR* = 28.0 – 42.0		
Gender		
Female	737	62.6
Male	440	37.4
Residency		
Manisa city	971	82.5
İzmir city	206	17.5
Household size		
1-2	398	33.8
3	350	29.7
4 and over	429	36.5
Section		
Basic Medical Sciences	64	5.4
Internal Medical Sciences	593	50.4
Surgical Sciences	428	36.4
Administration and maintaining	92	7.8
Occupation		
Faculty	140	11.9
Specialist M.D.	16	1.4
Resident/research assistant	232	19.7
Nurse	331	28.1
Biology/lab staff	121	10.3
Physiotherapist / Audiologist / Psychologist	15	1.3
Auxiliary health worker	161	13.7
Medical secretary	81	6.9
Administrative staff	24	2.0
Technics and maintaining	6	0.5
Security staff	50	4.2
Work duration in the hospital(years)	Mean±SD= 8.4±7.3	
Having any chronic disease	338	28.7
Current Smokers	398	33.8
Regular (daily) *alcohol users*	72	0.6
Occasional alcohol users	434	36.9
BMI*		
Normal (BMI<25.0)	621	52.8
Overweight (BMI=25.0-29.99)	419	35.6
Obese (BMI>≥30.0)	136	11.6
Exercise		
Do not exercise at all	452	38.4
Four or more days a week	117	9.90
Overall	**1177**	**100.0**

**IQR: Inter Quartil Range; **Body Mass Index*

Table 2. Risky behaviors in the social/everyday life

	Physician (n=387) %	Nurse/Health tech. (n=467) %	Auxiliary health worker (n=161) %	Others (n=162) %	Overall (n=1177) %
Using public transport in the last four months	34.3	56.3	71.4	45.6	49.7
Having been in a crowded environment (dinner, funeral, wedding) in the last four months	76.8	78.6	67.7	60.0	74.0
Paying attention to rules such as wearing masks and physical distance in crowded environments	89.9	93.1	91.3	93.1	91.8
To comply with national epidemic restrictions	74.7	78.8	77.0	79.4	77.3

The PCR test dates were more than three months earlier than the antibody test date in three of these six cases who gave a positive PCR result and no antibody was detected. PCR antigen test was performed 7 days after the antibody test in asymptomatic seropositive cases, and no PCR positivity was found in any of them, and only one of the six asymptomatic SARS-CoV-2 seropositive cases had an illness with flu-like symptoms in the last 15 days.

Table 6 presents the relations between the SARS-CoV-2 infection status and some variables during the four-month research period.

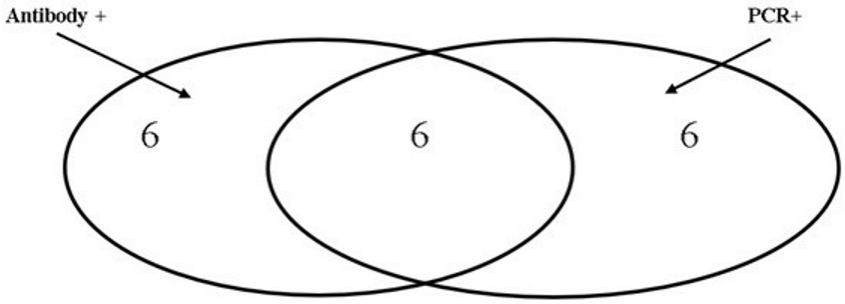
In addition to being an auxiliary health worker (mentioned above), "the presence of symptoms of a new disease that did not exist before in the last 15 days ($p= 0.021$)"; "the presence of a family member who had symptoms before the last 15 days ($p=0.004$)"; "being overweight or obese ($p=0.001$)" and "consulting to the hospital surveillance unit as a potential contacted person ($p<0.001$)" were significantly related to having SARS-CoV-2 infection. SARS-CoV-2 seropositivity was not found to be significantly associated with all other variables questioned in this study.

On the other hand, only six of 18 cases evaluated as high risk contact by the

Table 3. Risk perception and PPE* supply

	Physician (n=387) %	Nurse/ Health tech. (n=467) %	Auxiliary health worker(n=161) %	Others (n=162) %	Overall (n=1177) %
How frequently was proper PPE provided in risky situations?					
Never	0.8	0.2	0.6	0.6	0.5
Sometimes	26.5	8.1	9.9	16.9	15.6
Most of the time	50.8	45.4	18.6	32.5	41.8
Always	21.9	46.3	70.8	50.0	42.1
How safe did you feel in terms of PPE use?					
Never	0.0	0.2	0.6	0.6	0.3
Very little	3.1	2.8	1.2	8.1	3.4
Somewhat	41.2	30.4	32.3	44.4	36.1
Quite	46.1	50.5	35.4	29.4	44.1
Exactly	9.5	16.1	30.4	17.5	16.1

**PPE: Personal Protective Equipment*



(*Two cases with positive PCR test results on 27th July 2020 gave positive SARS-Cov2 seropositive result within one month and were included in seroprevalence)

Figure 1. Relationship between PCR test positivity* and antibody positivity during the study period(n=18)

hospital surveillance unit were found to be seropositive for SARS-CoV-2. Nevertheless, 14 of 18 confirmed SARS-CoV-2 patients infected with SARS-CoV-2 were evaluated by the hospital surveillance unit during this period (77.8%). Six of these 14 cases were evaluated as high-risk contact (42.9%), five as medium-risk contact (35.7%), and three as low-risk contact (21.4%) in the SARS-CoV-2 surveillance unit of the hospital.

Three of these six cases whose SARS-CoV-2 antibody test was positive but the disease could not be confirmed by PCR test were evaluated in the hospital surveillance unit, and two of them were considered as high-risky contact and one was considered as in medium-risk contact, and four of these six cases were auxiliary health workers.

Discussion

The overall infection rate was calculated as 1.5%, considering the 12 SARS-CoV-2 cases diagnosed by PCR test plus six antibody positive but PCR negative cases

Table 4. The section worked in the last 4 months and the assessment status by the hospital SARS-CoV-2 surveillance (contact tracing) unit

The section worked / procedure done in the last 4 months	**Physician (n=387) %**	**Nurse/ Health tech. (n=467) %**	**Auxiliary health worker (n=161) %**	**Others (n=162) %**	**Overall (n=1177) %**
COVID-19 clinic	30.5	25.1	19.3	11.1	24.1
Emergency clinic	17.6	17.1	18.0	25.9	18.6
COVID-19 triage unit	24.5	16.1	6.8	10.5	16.8
COVID-19 PCR procedure	11.6	8.6	3.7	1.9	8.0
Consultation to COVID-19 positive / suspected patient	53.5	19.5	0.0	0.0	25.3
COVID-19 radiology unit	12.4	16.9	9.9	9.9	13.5
Performing multiple high-risk procedures with COVID-19 patients	43.9	23.3	30.4	0.0	27.9
Always using the necessary PPE in high risk transactions	91.8	90.7	93.5	0.0	91.7
Applying to the surveillance unit as COVID contacted health personnel	27.1	40.7	60.9	19.4	36.1
Evaluated as a high-risk contact HCW by the COVID surveillance unit	16.3	21.1	23.5	18.2	20.2

Table 5. Distribution of SARS-CoV-2 cases detected by PCR or Antibody testing by employee categories

Occupation category	Test result (PCR or Antibody test)								Overall	
	PCR Test Positive		*Antibody Test Positive*		*Both Tests Positive*		*Negative*		*n**	*%**
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*		
Physician	1	0.3	2	0.5	1	0.3	383	99.0	387	32.9
Nurse/Biolog/Health tech.	2	0.4	0	0.0	2	0.4	463	99.1	467	39.7
Auxiliary health worker	0	0.0	4	2.5	2	1.2	155	96.3	161	13.7
Others (Lab., Administrative, maintainence services)	3	1.9	0	0.0	1	0.6	158	97.5	162	13.8
Overall	6	0.5	6	0.5	6	0.5	1159	98.5	1177	100.0

**Column percentage*

added to them by antibody screening. This figure will be 1.77% (18/1016) when administrative and maintenance staff are excluded from among the hospital staff. This infection rate ranks low in the spectrum of prevalence found in healthcare workers in other countries.[6,8,10,14,15] In another study conducted in a tertiary hospital in Germany, similar to our study, the SARS-CoV-2 seroprevalence in healthcare workers was found to be 1.6%.[10] In studies conducted in China in the first period of the epidemic, infection rates of 1.16% and 2.14% were found close to our

Table 6. Relationship of the participants' infection with SARS-CoV-2 and possible risk factors

		SARS-CoV-2 Infection		
		Infected (PCR + or Antibody +) (n=18)	Non-infected (n=1159)	
		%	%	p*
The presence of symptom in the last 15 days (n=1121)	Presence (n=112)	4.5	95.5	0.021
	Absence (n=1009)	1.2	98.8	
The presence of someone in the family who had symptoms before the last 15 days (n=1138)	Presence (n=47)	8.5	91.5	0.004
	Absence (n=1091)	1.2	98.8	
Evaluated by the hospital COVID-19 surveillance unit (n=1177)	Evaluated (n=425)	3.3	96.7	<0.001
	Non-evaluated (n=752)	0.5	99.5	
Body weight (n=1177)	Overweight-Obese (n=595)	2.7	97.3	0.001
	Normal (n=582)	0.5	99.5	
Working in the COVID-19 service in the last 4 months (n=1177)	Working (n=284)	0.7	99.3	>0.05
	Not Working (n=893)	1.8	98.2	
Working in the Emergency Service in the last 4 months (n=1177)	Working (n=219)	2.7	97.3	>0.05
	Not Working (n=958)	1.3	98.7	
Working in the COVID-19 triage unit in the last 4 months (n=1177)	Working (n=198)	2.0	98.0	>0.05
	Not Working (n=979)	1.4	98.6	
Working in the COVID-19 microbiology lab. in the last 4 months (n=1177)	Working (n=94)	1.1	98.9	>0.05
	Not Working (n=1083)	1.6	98.4	
Consultation with suspected SARS-CoV-2 patient in the last 4 months (n=1177)	Do (n=298)	0.7	99.3	>0.05
	Not (n=879)	1.8	98.2	
Working in the COVID-19 specific radiology unit in the last 4 months (n=1177)	Working (n=159)	0.6	99.4	>0.05
	Not Working (n=1018)	1.7	98.3	
Having done high risk transaction related to SARS-CoV-2 in the last 4 months (n=1177)	Have Done (n=397)	1.3	98.7	>0.05
	Haven't Done (n=780)	1.7	98.3	

**Chi square / Fisher's Exact test*

results.[14,15] During the first four months of the outbreak, the number of detected SARS-CoV-2 cases was not high enough to create an excessive burden on the health system in Turkey. In two separate studies conducted during March-May 2020 period in tertiary hospitals of Izmir and Zonguldak provinces of Turkey, SARS-CoV-2 infection rate was found as 6.2% [16] and 7.1% [17] respectively. The incidence of SARS-CoV-2 in healthcare institutions is closely related to the epidemic stage of the country and the burden of SARS-CoV-2 cases in the society. In this hospital, the number of SARS-CoV-2 cases diagnosed with PCR or antibody tests was 18 on 15th July 2020, increased to 299 on 10th December 2020. These figures are in line with the increase in cases from 215 940 on July 15, to 1748 567 on 10th December 2020 in Turkey.

Although it has been shown in other studies that the SARS-CoV-2 infection rate in healthcare workers is 2.3 - 38.0 times higher than the population,[18] this large (16.7 times) increase is striking when compared to that of the country (8.1 times). The reasons for this are the subject of another article. The increase in the number of SARS-CoV-2 cases in a health institutions is associated with the increase in the number of cases in the community[19,20] ; It has been reported that healthcare workers caught infection through exposure to the community rather than patients.[21,22,23]

Six of the 18 cases found in our study were only PCR positive but seronegative; six were only seropositive but PCR negative, and six were both PCR positive and total antibody positive. In the study conducted by Korth et al.[10] in Germany, SARS-CoV-2 PCR tests were negative in four of 5 hospital workers (80%) who were found to have SARS-CoV-2 antibodies. Seropositive cases with no history of disease symptoms or no positive PCR results in the past may be asymptomatic true seropositive individuals having previous disease, as well as false positives due to the low sensitivity of the kits developed in the early stages of the epidemic or cross-reactions. In our findings, 6 of 12 seropositive cases were negative for PCR test (50%). In three out of six cases who were positive with the PCR test and had negative results with the antibody test. When we look at the PCR test dates of these three cases we see that the date of PCR tests were all at least four months before the antibody tests. This may be because the antibody protection decreases three to six months after PCR positivity. As a matter of fact there are publications that support this. [3,4,5,7,24] So, by excluding these three patients, we obtain a seronegative rate of 25.0% which is still higher found in other studies.[2,18,25] SARS-CoV-2 surveillance unit classified three -symptomatic- PCR negative (at the 7th day of the first symptom arise), but antibody positive cases in "high risk contact" category. Insufficient swap samples may have been taken from these three PCR negative patients. Under these conditions, the rate of asymptomatic cases (3/18) was 16.7%. In a comprehensive meta-analysis study, the rate of asymptomatic cases was reported to be 20% (95% CI = 17-25).[7] This rate was reported as 36% in a study conducted in Germany.[11] Our finding is consistent with the meta-analysis results. The hospital surveillance unit classified 11 of 14 PCR positive cases as high risk contact (49.2%), which is a close figure of the Ege University surveillance unit reporting the high risk contact prevalence as 59.3%.[26] It may have been found to be low due to the small number of cases at the end of the first wave. The fact that the employees use PPE properly in the workplace (73-92%) and maintain protective behaviors to a large extent (92%) outside the workplace, explains the low seroprevalence of SARS-Cov 2 found in our study. The infection rate of auxiliary health workers is significantly higher than the other health workers in our study. Auxiliary health workers rank first with 33.3% in terms of the percentage of assessment as high risk contact in the hospital surveillance unit. Auxiliary health workers work for minimum wage and live in crowded households in poor areas of the city where the epidemic is more common. Relatively high infection rate of auxiliary health workers reported in Zonguldak/ Turkey (PCR positivity for cleaning staff was 9.1%), India (seroprevalence rate for

housekeeping staff, food and beverage staff etc. was 26.11%) and the United Kingdom (seroconversion rate for housekeeping staff was 34.5%) are consistent with the findings of our study.[9,12,17]

Only 4.7% of those who applied to the hospital SARS-CoV-2 Surveillance unit was evaluated as high risk contact and was detected as SARS-CoV-2 seropositive. The results of a study conducted in Singapore support this finding. In Singapore study, the SARS-CoV-2 secondary attack rate in high-risk contacts has been shown to be 5.9% (95% CI = 4.9-7.1).[27]

We found that the frequency of SARS-CoV-2 infection was significantly higher in those HCWs who were overweight or obese compared to those with normal weight. In a large community-based cohort conducted in the United Kingdom, life behaviors such as BMI, physical activity and smoking were reported to affect hospitalizations due to SARS-CoV-2.[28] While the high mortality of SARS-CoV-2 in obese individuals is known, it is a new evidence that obesity is a risk factor in terms of getting the disease. There are three possible explanations for this fact: Firstly, overweight and obese individuals may experience symptoms due to their weaker immune resistance. The second possible explanation for the higher prevalence of infectivity in overweight and obese people is the common health promotion behavior patterns such as preventive behaviors, nutrition and exercise. People either do all of this or none. It can be thought that individuals who do not take care of their nutrition also neglect protective behaviors such as mask, distance and hand hygiene related to SARS-CoV-2. The third possible explanation of the high infection rate in overweight/obese people is the epidemiological association between obesity and low educational attainment. Both SARS-CoV-2 infection and obesity are more common in segments of the society that do not have adequate education. Individuals with inadequate education were both overweight[29] and SARS-CoV-2 infection was more common in individuals in lower social classes.[30] In this study, the highest infection rate of the auxiliary health workers having the lowest level of education among health workers supports our third possible hypothesis.

The most powerful aspect of this study is that, this is the first SARS-CoV-2 seroprevalence studies representing health workers at a hospital in Turkey with a considerably high participating rate. However, the study has some important limitations. First, the fact that this study was conducted in the first period of the epidemic, which was relatively mild compared to the second period, limited the statistical power of its results. The second limitation of the study is that seroprevalence is evaluated with total antibodies and IgM and IgG cannot be differentiated. This limitation was tried to be overcome by eliminating the possibility of acute infection (IgM) by performing PCR confirmation test on seropositive cases. And finally, the seropositivity of the SARS-CoV-2 PCR positive and antibody positive cases was given with cross-sectional findings, and findings related to the seropositivity of the infected cases in the later period were not included. This study continues with antibody monitoring of SARS-CoV-2 cases that have increased exponentially in the second period of the epidemic, corresponding to the autumn and winter months of 2020.

To conclude, in the first period of the epidemic between March and July, the rate of SARS-CoV-2 infection is low in the health workers in this tertiary hospital. 17% of the cases are asymptomatic. SARS-CoV-2 infection rate (18/1177) is 1.5% and seroprevalence is 1.01%. Healthcare workers have a moderate-to-high level of security perception in terms of PPE, but the highest rate of infection was detected in auxiliary health workers, suggesting that those having poor education are at higher risk of infection and protective measures should be addressed to these groups.

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