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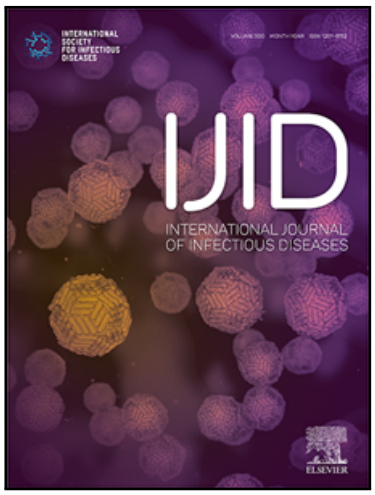

SARS-CoV-2 seropositivity among pediatric health care personnel just after the first peak of pandemic: A nationwide surveillance

Pembe Derin Oygar , Ayşe Büyükçam , Zümrüt Şahbudak Bal , Nazan Dalgıç , Şefika Elmas Bozdemir , Adem Karbuz , Benhur Şirvan Çetin , Yalçın Kara , Ceren Çetin , Nevin Hatipoğlu , Hatice Uygun , Fatma Deniz Aygün , Selda Hançerli Törün , Dicle Şener Okur , Dilek Yılmaz Çiftdoğan , Tuğçe Tural Kara , Aysun Yahşi , Arife Özer , Sevliya Öcal Demir , Gülşen Akkoç , Cansu Turan , Enes Salı , Semra Şen , Emine Hafize Erdeniz , Soner Sertan Kara , Melike Emiroğlu , Tuğba Erat , Hacer Aktürk , Sibel Laçinel Gürlevik , Murat Sütçü , Zeynep Gökçe Gayretli Aydın , Başak Yıldız Atikan , Edanur Yeşil , Gizem Güner , Emel Çelebi , Kadir Efe , Didem Kızmaz Işançlı , Habibe Selver Durmuş , Seher Tekeli , Ayşe Karaaslan , Lida Bülbül , Habip Almış , Özge Kaba , Yıldız Ekemen Keleş , Bahadır Yazıcıoğlu , Şerife Bahtiyar Oğuz , Hüsnü Fahri Ovalı , Hazal Helin Doğan , Solmaz Çelebi , Deniz Çakır , Burcugül Karasulu , Gülsüm Alkan , İrem Yenidoğan , Doruk Gül , Burcu Parıltan Küçükalioğlu , Gülhadiye Avcu , Musa Gürel Kukul , Melis Bilen , Belma Yaşar , Tuğba Üstün , Ömer Kılıç , Yasemin Akın , Sinem Oral Cebeci , Ibrahim Hakan Bucak , Mehpare Sarı Yanartaş , Aslıhan Şahin , Sertaç Arslanoğlu , Murat Elevli , Rabia Çoban , Şadiye Kübra Tüter Öz , Halil Hatipoğlu , İlyas Tolga Erkum , Mehmet Turgut , Asuman Demirbuğa , Taha Özçelik , Diclehan Çiftçi , Emine Ergül Sarı , Gökhan Akkuş , Sadık Sami Hatipoğlu , Ener Çağrı Dinleyici , Mustafa Hacımustafaoğlu , Ferda Özkınay , Zafer Kurugöl , Ali Bülent Cengiz , Ayper Somer , Hasan Tezer , Ateş Kara

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Highlights:

- The seropositivity for SARS-CoV-2 is found to be 6.1% among healthcare personnel.
- Most of them were healthy young adults.
- Surveillance for healthcare personnel should involve routine nucleic acid testing.
- Monitoring PPE adherence is important for protection from COVID-19.

SARS-CoV-2 seropositivity among pediatric health care personnel just after the first peak of pandemic: A nationwide surveillance.

Pembe Derin Oygar[1] , Ayşe Büyükçam[2], Zümrüt Şahbudak Bal[3], Nazan Dalgıç[4], Şefika Elmas Bozdemir[5], Adem Karbuz[6], Benhur Şirvan Çetin[7],Yalçın Kara[8], Ceren Çetin[9], Nevin Hatipoğlu[10], Hatice Uygun[11], Fatma Deniz Aygün[12], Selda Hançerli Törün [13], Dicle Şener Okur[14], Dilek Yılmaz Çiftdoğan[15+], Tuğçe Tural Kara[16], Aysun Yahşi[17], Arife Özer[18], Sevliya Öcal Demir[19], Gülşen Akkoç[20], Cansu Turan[21], Enes Salı[22], Semra Şen [23], Emine Hafize Erdeniz[24], Soner Sertan Kara[25], Melike Emiroğlu[26], Tuğba Erat[27], Hacer Aktürk[28], Sibel Laçinel Gürlevik[1], Murat Sütçü[29], Zeynep Gökçe Gayretli Aydın[30], Başak Yıldız Atikan[31], Edanur Yeşil[32], Gizem Güner[3], Emel Çelebi[4], Kadir Efe[5], Didem Kızmaz İşançlı[6], Habibe Selver Durmuş[7], Seher Tekeli[8], Ayşe Karaaslan[9], Lida Bülbül[10], Habip Almış[11], Özge Kaba[13], Yıldız Ekemen Keleş[15], Bahadır Yazıcıoğlu[17], Şerife Bahtiyar Oğuz[18], Hüsnü Fahri Ovalı[19], Hazal Helin Doğan[20], Solmaz Çelebi[21], Deniz Çakır[22], Burcugül Karasulu[23], Gülsüm Alkan[26], İrem Yenidoğan[28], Doruk Gül[29], Burcu Parıltan Küçükalioğlu[30++], Gülhadiye Avcu[31], Musa Gürel Kukul[1], Melis Bilen[3], Belma Yaşar[4], Tuğba Üstün[6], Ömer Kılıç[8], Yasemin Akın[9], Sinem Oral Cebeci[10], Ibrahim Hakan Bucak[11] , Mehpare Sarı Yanartaş [13], Aslıhan Şahin[15], Sertaç Arslanoğlu[19], Murat Elevli[20], Rabia Çoban[22], Şadiye Kübra Tüter Öz[26], Halil Hatipoğlu[29], İlyas Tolga Erkum[10], Mehmet Turgut[11], Asuman Demirbuğa [13], Taha Özçelik[19], Diclehan Çiftçi[22], Emine Ergül Sarı[10], Gökhan Akkuş[19], Sadık Sami Hatipoğlu[10], Ener Çağrı Dinleyici[8], Mustafa Hacımustafaoğlu[21], Ferda Özkınay[3], Zafer Kurugöl[3], Ali Bülent Cengiz[1], Ayper Somer[13], Hasan Tezer [33], Ateş Kara[1*]

[1*] Corresponding Author : Dr. Ateş Kara

Hacettepe University Faculty of Medicine Pediatric Infectious Diseases Department

06100 Sıhhıye Ankara Turkey

Telephone: +90 312 305 11 66 Fax: +90 312 310 82 41 e-mail: ateskara@hacettepe.edu.tr

[1] Hacettepe University Faculty of Medicine Pediatric Infectious Diseases Department

[2] Gaziantep Cengiz Gökçek Obstetrics and Children's Hospital

[3] Ege University Faculty of Medicine Pediatric Infectious Diseases Department

[4] Health Sciences University Sarıyer Hamidiye Etfal Training and Research Hospital Pediatric Infectious Diseases Department

[5] Bursa Dörtçelik Children's Hospital Pediatric Infectious Diseases Unit

[6] İstanbul Prof. Dr. Cemil Taşcioğlu City Hospital Pediatric Infectious Diseases Unit

[7] Erciyes University Faculty of Medicine Pediatric Infectious Diseases Unit

[8] Osmangazi University Faculty of Medicine Pediatric Infectious Diseases Department

[9] İstanbul Kartal Dr. Lütfü Kırdar State Hospital Pediatric Infectious Diseases Unit

[10] İstanbul Dr. Sadi Konuk Training and Research Hospital Pediatric Infectious Diseases Unit

[11] Adıyaman University Faculty of Medicine Pediatric Infectious Diseases Department

[12] Istanbul Health Sciences University Kanuni Sultan Süleyman Training And Research Hospital Pediatric Infectious Diseases Unit

[13] İstanbul University İstanbul Faculty of Medicine Pediatric Infectious Diseases Department

[14] Denizli State Hospital Pediatric Infectious Diseases Unit

[15] İzmir Health Sciences University Tepecik Training And Research Hospital Pediatric Infectious Diseases Unit

[15+] İzmir Health Sciences University Tepecik Training And Research Hospital Pediatric Infectious Diseases Department and İzmir Katip Çelebi University Faculty of Medicine Department of Pediatrics

[16] Akdeniz University Faculty of Medicine Pediatric Infectious Diseases Unit

[17] Health Sciences University Samsun Training and Research Hospital Pediatric Infectious Diseases Unit

[18] Van State Hospital Pediatric Infectious Diseases Unit

[19] İstanbul Medeniyet University Göztepe Training and Research Hospital Pediatric Infectious Diseases Unit

[20] İstanbul Haseki Training and Research Hospital Pediatric Infectious Diseases Unit

[21.] Uludağ University Faculty of Medicine Pediatric Infectious Diseases Department

[22.] Health Sciences University Ümraniye Training and Research Hospital Pediatric Infectious Diseases Unit

[23] Manisa Celal Bayar University Pediatric Infectious Diseases Unit

[24] Health Sciences University Erzurum Regional Training and Research Hospital

[25] Aydın Adnan Menderes University Faculty of Medicine Pediatric Infectious Diseases Unit

[26] Konya Selçuk University Faculty of Medicine Pediatric Infectious Diseases Unit

[27] Sanlıurfa Training and Research Hospital Pediatric Infectious Diseases Unit

[28] Koç University Faculty of Medicine Pediatric Infectious Diseases Department

[29] İstinye University Faculty of Medicine Pediatric Infectious Diseases Unit

[30] Karadeniz Technical University Faculty of Medicine Pediatric Infectious Diseases Unit

[30++] Health Science s University Trabzon Kanuni Training and Research Hospital Pediatrics Department

[31] Balıkesir Atatürk State Hospital Pediatric Infectious Diseases Unit

[32] Mersin State Hospital Pediatric Infectious Diseases Unit

[33] Gazi University Faculty of Medicine Pediatric Infectious Diseases Department

Abstract:

Background: COVID-19 pandemic affected every single person on earth one way or the other. The healthcare personnel were no exception, their responsibilities as well as their risks being immense.

Methods: 4927 healthcare personnel all working in pediatric units at 32 hospitals from seven different regions of Turkey enrolled to the study to determine the seroprevalence of SARS Co-V-2 after the first peak wave. Point of care serologic lateral flow rapid test kit for IgM/IgG was used (Ecotest CE Assure Tech. Co. Ltd.). Seroprevalence and its association with demographic characteristics and possible risk factors were analyzed.

Results: Nearly 6.1% of healthcare personnel were found to be seropositive for SARS Co-V-2. Seropositivity was more common among those who did not universally wear protective masks (10.6% vs 6.1%). Having a COVID-19 co-worker increased the likelihood of infection. The least and the most experienced personnel affected more. Most of the seropositive healthcare personnel (68%) did not have any suspicion that they had COVID-19 previously.

Conclusions: Health surveillance for healthcare personnel involving routine point-of-care nucleic acid testing as well as monitoring PPE adherence would be important strategies to protect healthcare personnel from COVID-19 and to reduce nosocomial SARS-CoV-2 transmission.

Key words: *SARS Co-V-2; healthcare personnel; serology; COVID-1; personnel protective equipment use*

Introduction: SARS-CoV-2 had a huge impact on every single person's life on earth since December 2019. Many people experienced isolation, fear, loss, depression. However, the burden experienced by health care personnel was probably more than anyone can imagine. Apart from working against a new pathogen, trying to save lives they had to protect themselves from the virus in order to continue to work, and in order not to spread the virus to their patients, colleagues, friends and families. Being in the frontline many healthcare personnel lost their lives (Zhan et al., 2020).It is reported that as of 01 May 2020 there were 12,526 COVID-19 related deaths among residents in care homes and hospitals of England and Wales and, as of 20 April 2020, 106 deaths among their healthcare workers (HCWs) while in Italy, as of 01 June 2020, 27,952 HCWs were officially recognized as infected by the Italian National Health Institute and 167 physicians and 40 nurses had died (Chirico, Nucera, 2020).

It is suggested that repeated exposure to the virus during the care of patients most probably puts additional risk for infection(Ran et al,2019; Chou et al., 2019).Certain studies postulated that it would be essential to determine the risk factors for healthcare personnel in order to take precautions to minimize the risk (Zhan et al., 2019; Abou-Abbas, 2020). Furthermore COVID-19 is suggested to be accepted as an occupational injury and accepted as such in Italy (Chirico, Magnavita, 2019). Detection of SARS-CoV-2 RNA is the accepted standard approach for COVID-19 diagnosis since the beginning of pandemic (CDC a 2020).Unlike nucleic acid tests designed to detect SARS-CoV-2 genetic material during acute infection, serological assays measure antibodies that remain detectable after acute infection, thus providing a useful method to detect cases that were not identified during the acute infectious phase (Li, 2020).There are numerous n of point of care tests developed since the beginning of pandemic with variable sensitivity and specificity.

With this multicenter study we aimed to determine the seropositivity at a relatively early time of the pandemic in order to explore potential risk factors for transmission among health care personnel and develop strategies to eliminate them and form an opinion about the necessity and frequency of surveillance for the upcoming months of pandemic which seems to last longer than expected. We conducted the study solely on healthcare personnel working with children. Since the beginning of the pandemic, children are considered to be mildly affected (Abbasi et al. 2020; CDC b 2020; Dong et al.,2020) compared to adults for reasons that are still obscure, and they are less likely to transmit the infection (Wu, McGoogan, 2020).

Consensus agreements are obtained from all 32 centers and the study was approved by the Institutional Review Board and the Ethics Committee of Hacettepe University (approval number 2020/11-57)

Material Method:

Design and setting:

The study is conducted as a cross-sectional seroprevalence study for antibodies to SARS-CoV-2 among healthcare personnel all working only in pediatric units at 32 hospitals from seven different regions of Turkey.

The participants were enrolled to the study between 25 May and 10 June 2020. The first confirmed case of COVID-19 was reported on 11 March in Turkey in Marmara Region and by the time of the study the total number of cases was 173 958, April being the peak month when the number of newly diagnosed cases exceeded 5000s per day.

Population: Healthcare personnel at each study hospital were eligible if they regularly had direct or indirect contact with pediatric patients with COVID-19 disease, who were cared in ED (emergency department), intensive care unit (ICU), and inpatient and outpatient COVID-

19 units. Physicians including professors to residents, nurses, radiology technicians and other medical staff enrolled to the study. Participants were informed about the study through staff meetings. Healthcare personnel volunteered to participate by presenting to the assigned person for each center, where they were screened for inclusion criteria, gave written informed consent for volunteer participation, completed a brief survey, and underwent a prick test. Survey data included demographics, medical history, occupation, years in occupation, workplace (clean or contaminated area), working hours per week, dates and results of prior nucleic acid and serologic tests and PPE and face shield wearing practices, adoption of social distancing, colleague or family COVID- 19 diagnosis as well as whether they believed or suspected they previously had COVID-19 . Participants were asked if they had symptoms like fever, runny nose, cough, myalgia, loss of taste and smell for the last 3 months as well as a contact history with a COVID-19 patient without wearing a mask.

Emergency departments, Intensive care units, outpatient clinics and wards reserved for potential or confirmed COVID-19 patients were considered as 'contaminated areas' while 'clean areas' were administrative areas and wards where PCR negative patients were accepted.

Universal mask usage , wearing masks of the personnel through the entire shift and patients older than two years and with no contraindications where breathing would be compromised was mandatory nationwide. The health care personnel from each center had similar working days and working hours per week, physicians and nurses with the longest working hours with a mean 24 hours/ week.

Point of care tests were carried out for all participants by the same assigned person at each center.

Ecotest CE rapid test for IgM/IgG Assure Tech. Co. Ltd was used for serologic tests. The relative sensitivity and specificity for Ig M is reported to be 93.7% and 99% respectively

while it is reported as 98.8% and 98.7% for Ig G by the manufacturers . Tests were applied and interpreted according to the manufacturer's instructions by the same person previously assigned for each center. Ig M, Ig G or both Ig M/ Ig G positivity was considered to be a positive result.

Data Analysis:

All participants' data were collected and analyzed by using SPSS IBM version 26. We compared groups using Fisher's Exact Test for categorical variables and Wilcoxon Cox for continuous variables to identify potential factors associated with positive serology.

Results:

We enrolled 4927 healthcare personnel, all working in pediatric units including 2123 (43.1%) physicians, 1702 (34.5%) nurses and 1079 (21.9%) other healthcare personnel from 32 different hospitals located in 20 different cities and seven different regions throughout Turkey. The median number of participants was 171 (34-289) from each center. The study is carried out at the end of the third month and the beginning of the fourth month of pandemic, just after reaching the peak numbers of national cases. Most were young adults (median age, 32 years; range 19–67 years, mean age 34.4) without chronic medical illnesses, 80.3% (n=3958) had no comorbidities. Among enrolled personnel, 2854 (57.9%) worked primarily in the contaminated areas including Emergency Department (ED), Intensive care Unit (ICU) or COVID-19 wards and 1720 (34.9%) in clean areas. Among 4927 healthcare personnel 299 (6.1%) of them tested seropositive for SARS-CoV-2. Among seropositive healthcare personnel, mostly affected group was nurses (41.4%) followed by physicians (38 %). The brief survey results given in Table 2 of both seropositive and negative participants were similar in terms of age, sex, working areas comorbidities except diabetes mellitus (n= 21), which was more frequent in seronegative group (n=18 , 3.1%). Seropositive participants worked median four days per week while seronegative ones worked six days per week but

working hours were similar (mean 24 hours per week). Seropositivity was more common among those participants who did not universally wear protective masks, surgical or PPE (n=180, 10.4%) versus those who did (n= 4697, 6.1%) (p=0.036). Among those participants who wore face shields (n=2597) the seropositivity was lower compared to the ones who did not (n=2046) (5.2% vs 7.7%) (p=0.001).

Having a SARS-CoV-2 positive co-worker history (n=299, %44.1), appear to increase the likelihood of seropositivity more than to household contacts (n= 299, 25.3%).Only 38.4% of seropositive participants stated that, they previously had COVID-19 while 61.6% of seropositive participants reported they did not suspect they had COVID 19 previously. Among the participants 1527 (32.4%) had a prior SARS-CoV-2 nucleic acid test of whom 189 (4%) were positive and 69 (23.2%) of these patients were also tested positive for SARS-Co V2 antibodies. Seventy-six (24.9%) participants who had previously tested negative for SARS CoV2-PCR were also tested positive for SARS-CoV-2 antibodies.

Being the least and the most experienced in profession seemed to affect seroconversion, the ones in their first five to ten years of profession were tested positive for SARS-CoV-2 antibodies with the highest positivity rate (6.5%) followed by the ones with more than 20 years in profession (6.2%).Seropositivity for those in their one to five years of profession was still high (6.2%) only decreasing for 10-20 years interval (5.4%) (Figure1).

Where people work in terms of regions of the country also showed variations in terms of seropositivity. The most seropositivity prevalence being in South East Anatolia followed by Marmara region. Aegean and Mediterranean regions being the least prevalent regions for SARS-CoV-2 antibody formation among health care personnel (Figure 2).

Discussion:

Among 4927 healthcare personnel from 32 centers distributed throughout seven regions in Turkey with mild to moderate local SARS-CoV-2 activity, 299 (6.1%) of them tested

seropositive for SARS-CoV-2 69 days after the first national COVID-19 case was reported and 30 days after the peak wave of 5234 new cases per day were diagnosed (figure2).

Only 38% of the healthcare personnel who had antibodies detected reported any symptoms consistent with SARS -CoV-2 or believed they previously had COVID-19. The percentage of asymptomatic SARS-CoV-2 infected people is estimated to be around 40-45% (Oran et al., 2020; CDC c, 2020). Our study revealed a higher percentage of asymptomatic healthcare personnel. It is a possibility that healthcare personnel might have underestimated mild symptoms or attributed them to tiredness.

Only 1527 (31%) healthcare personnel had prior PCR testing for SARS-CoV-2, all either symptomatic or with an unprotected close contact history with a confirmed COVID-19 case. Only 23.2% of PCR positive participants had antibodies against SARS-CoV-2. A further 24.9% who were previously reported to be PCR negative were also found to be seropositive. It is suggested that healthcare providers should be tested regularly with serological test and swabs and symptom monitoring in order to protect healthcare workers from the disease as well as preventing nosocomial transmission (Chirico et al., 2021).

Our study showed that healthcare personnel with five to ten years of experience and more than 20 years of experience had similar seropositivity for SARS -CoV-2 while there was a tendency among the inexperienced ones to be tested positive. This could be because although working hours were the same, the most inexperienced ones usually work more and possibly have longer durations of contact with the patients. The reason behind the high seropositivity among the healthcare personnel with more than 20 years of experience could be due to a false sense of overconfidence gained over years leading to a laxity in self-protection. In our study the place where healthcare personnel worked in terms of clean or contaminated areas or number of working days were not related with seropositivity. Hence inexperience and over experience seemed to be risk factors by themselves. Widespread health surveillance of

healthcare personnel could be considered as a strategy to protect and prevent transmission. Conducting health surveillance programs with the intervention of occupational health professionals in the hospital setting could prevent both workers and patients from getting sick (Chirico, Magnavita b, 2020).

We should develop strategies for educating the less experienced and warning the most experienced healthcare personnel on self-protection as well as conducting health care surveillance programs among healthcare workers in the hospital setting in order to prevent both workers and patients from getting sick.

Although it was not statistically meaningful (p= 0.024) the ones who did not universally wear a mask, surgical or PPE, are tested positive for SARS-CoV-2 antibodies more frequently. Wearing a face shield affected seropositivity as well, those not wearing face shields were tested positive more than those who did.

Colleagues rather than household contact led to infection more frequently among those who were tested positive for SARS-CoV-2 antibodies.

One of the limitations of the study is that we did not ask the prior PCR timing. Most healthcare personnel with PCR positivity were seronegative. Either these people did not develop antibodies at all, or the antibodies declined to levels where the test kit we used could not measure or declined completely (Patel et al., 2020).

In our study 6.1% of healthcare personnel had SARS-CoV-2 antibodies within three to four months of COVID-19 being reported nationally . The majority with positive serology tests did not suspect that they had been infected nor had been tested for SARS-CoV-2 with PCR. In conclusion our study results suggest developing health surveillance strategies for healthcare personnel involving routine point-of-care nucleic acid testing as well as monitoring PPE adherence would be important strategies to protect healthcare personnel from COVID-19 and to reduce nosocomial SARS-CoV-2 transmission.

Conflict of interest: All contributing authors declare no conflict of interest.

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The study is approved by Hacettepe University Ethics Committee (Approval No: 2020/11-57).

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Table 1. Demographic characteristics of health care personnel by profession

Occupation	*Number (%)*	*Age Mean Years (Range)*	*Sex F/M*	*Years In Profession Mean Years (Range)*	*Comorbidities*								*Serology*	
					None	**HT**	**DM**	**Isupp Tx**	**Cancer**	**ESRD**	**Asthma**	**Other**	**Positive (N)**	**Negative(N) (%)**
Prof. Dr.	149 (3)	52·7 (42-67)	81/65	28·44 (15-44)	92	6	26	0	0	0	10	14	2(1·4)	146 (98·6)
Assoc. Prof. Dr.	188 (3·8)	44·17 (36-64)	134/50	20·32 (9-40)	140	10	12	2	2	0	7	13	13(6·9)	173 (93·1)
Asst. Prof. Dr.	149 (3)	36·01 (25-59)	108/41	10·64 (1-37)	116	4	8	1	0	0	6	13	14(10·1)	134 (89·9)
Consult. Dr.	654 (13.3)	38·64 (25-67)	395/222	13·87 (1-44)	521	20	30	4	3	0	26	45	41(6·9)	593 (93·1)
Resident	983 (20)	28·25 (20-34)	654/280	3·57 (0-32)	861	7	4	2	2	0	22	84	39(13·1)	982 (20·7)
Nurse	1702 (34.5)	32·38 (19-62)	1460/211	10·37 (1-42)	1377	34	36	11	9	1	68	157	122(7·3)	1677 (92·7)
Others	1079 (21·9)	37·77 (19-64)	622/42	10·88 (0-39)	841	40	34	6	8	0	50	87	61(5·7)	994 (93·4)

F: Female

M: Male

HT: Hypertension

DM: Diabetes mellitus

Isupp tx: Immunsuppresive treatment

ESRD: End-stage renal disease

Table 2. Demographic Characteristics of Healthcare Personnel by Seroconversion

Characteristics of personnel (n=4927)	Serology+ n (%) = 299 (6.1)	Serology – n (%) = 4584	p
Age (median) (range 9-67years)	32	32	
F/M	229/70	3316/1268	0·1
Chronic medical conditions n (%)			
None	240 (82·5)	3540 (81·1)	
HT	8 (2·1)	105 (2·5)	
DM	4 (1·4))	137 (3·1)	
Immune suppressive treatment	3 (1·1)	18 (0·4)	
Cancer	1 (0·3)	22 (0·5)	
ESRD	0 (0)	1(0)	
Asthma	10 (3·4)	172 (9·1)	
Other	25 (8·6)	372 (8·5)	
Primary location of clinical work, n (%)			
Contaminated Areas (ER ICU COVID Wards)	176 (60·5)	2750 (63·2)	0·35
Clean Area	115 (39·5)	1601 (36·8)	
Clinical role, n (%) 4710			
Physician, 2025 (43)	105 (36·8)	1920 (43·4))	
Nurse 1671(35·5)	123 (43·2)	1548 (35)	0·018
Other 1014 (21·5)	57 (20)	957 (21·6)	
Typical number of clinical work- days/week (median)	4	6	
Typical number of clinical work hours /week (mean+SD)	25·74±31·7	23·88±29·41	
Did not universally use a surgical mask, N-95 respirator, or PAPR during all clinical encounters, n (%)	18 (10·2)	279 (6·4)	0·036
Did not use face shield, n (%)	153 (52·3)	1833 (42·3)	0·001
Did use face shield n (%)	138 (47.·4)	2496 (57·7)	
Social distancing			
Yes	277 (93·3)	4135 (93·7)	0·7
No	20 (6·7)	277(6·3)	

Participants belief he/she had COVID-19			
Yes	114 (38·1)	999 (22·7)	
No	183 (6)	3405 (77·3)	
SARS Co-V-2 + co-worker contact	132 (44·4)	1669 (37·8)	
SARS Co-V-2 + household contact	37 (12·5)	105 (2·4)	
Previous SARS Co-V-2 PCR			
positive	69 (23·2)	120 (2·7)	
negative	74 (24·9)	1264 (28·7)	
not done	154 (51·9)	3027 (68·6)	
Geographic distribution			
Middle Anatolia region	31 (4·4)	668(95·6)	
Marmara region	133 (6·9)	1806 (93·1)	
Aegean region	25 (3)	820 (97)	
East Anatolia region	13 (5·2)	236 (94·8)	
South-east Anatolian region	68 (12)	500 (88)	
Black Sea region	13 (6·4)	190 (93·6)	
Mediterranean region	3 (1·5)	202 (98·5)	
Years in profession			
1-5 years	124 (42·9)	1834 (42·4)	
5-10 years	61 (21·1)	855 (19·7)	
10-20 years	61 (21·1)	1057 (24·4)	
>20 years	43 (14·9)	585 (13·5)	

n: Number

HT: Hypertension

DM: Diabetes mellitus

Isupp tx: Immunsuppresive treatment

ESRD: End-stage renal disease

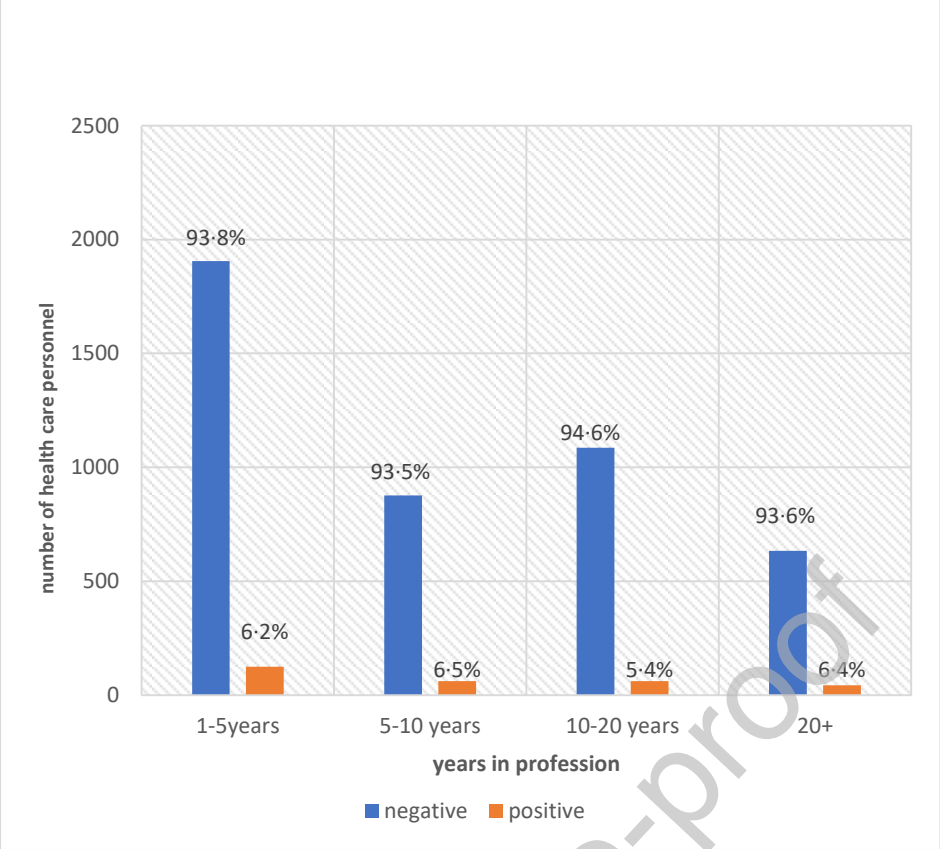

Figure 1. Healthcare personnel serology results by years in profession

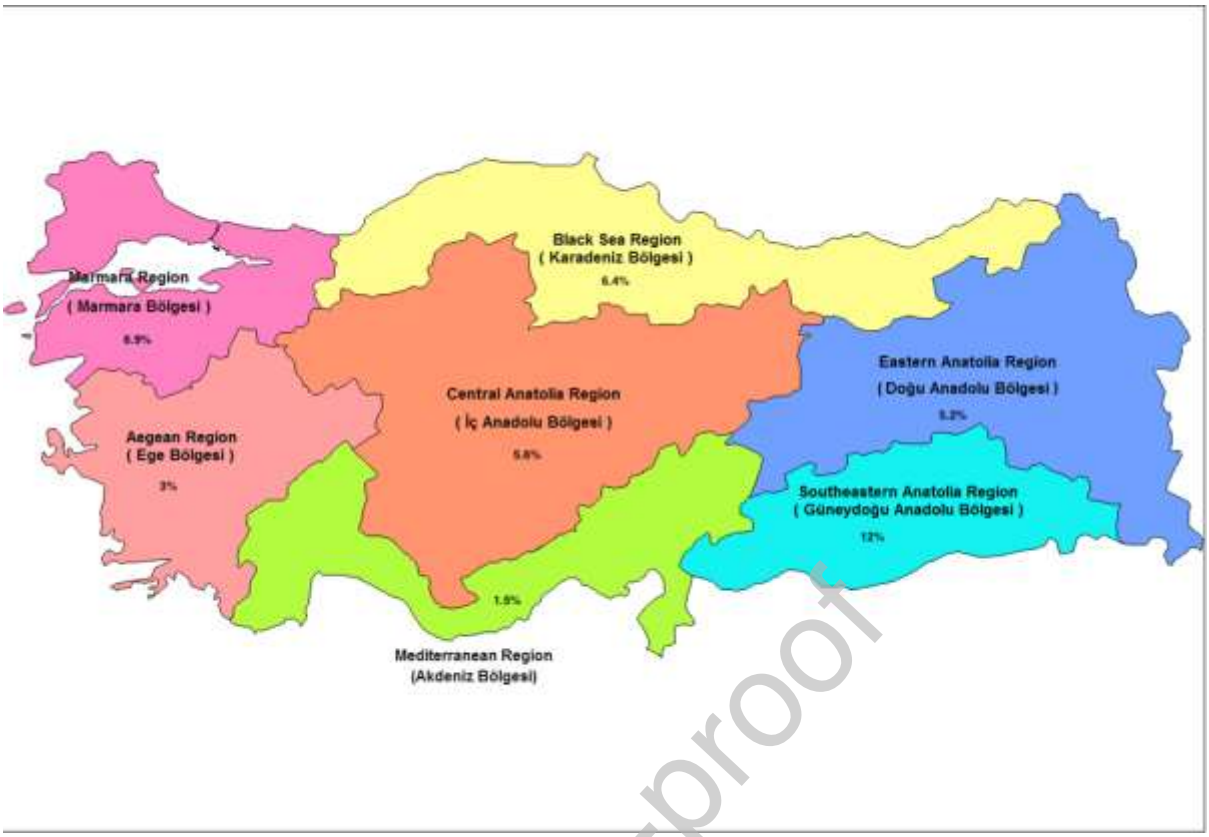

Figure 2.Distribution of Seroprevalence of Healthcare Personnel by Regions