Seroprevalence of SARS-CoV-2 in Health-care Personnel from the State of Guanajuato, Mexico: A Cross-Sectional Study

Nicolás Padilla-Raygoza[1], Efraín Navarro-Olivos[2], María de Jesús Gallardo-Luna[1], Gilberto Flores-Vargas[1], María del Rosario Sanchez-Navarro[3], Elia Lara –Lona[4], Eunice Sandoval-Ramirez[5], Francisco J. Magos-Vazquez[6] and Daniel Alberto Díaz-Martínez[7]

[1]Department of Research and Technological Development, Directorate of Teaching and Research, Institute of Public Health from Guanajuato State, Guanajuato, México.
[2]Directorate of Teaching and Research, Institute of Public Health from Guanajuato State, Guanajuato, México.
[3]Secretary of Health form Guanajuato State, Mexico.
[4]Department of Medicine and Nutrition, Division of Health Sciences, Campus Leon, University of Guanajuato, Leon, Mexico.
[5]Service of Immunology and Allergy, Hospital of Pediatrics Specialties from Leon, Institute of Public Health from Guanajuato State, León, Mexico.
[6]Directorate of Health Services, Institute of Public Health from Guanajuato State, Guanajuato, Guanajuato México.
[7]Directorate of Health Services Directorate, Institute of Public Health from Guanajuato State, Guanajuato, Guanajuato México.
*Corresponding Author E-mail: npadillar@guanajuato.gob.mx

https://dx.doi.org/10.13005/bpj/2480

(Received: 10 February 2022; accepted: 24 June 2022)

Guanajuato state in Mexico has high frequency of confirmed cases of COVID-19. Health-care workers are the most exposed to contagion due to contact with patients infected by SARS-CoV-2. The objective was to know the seroprevalence of antibodies (IgG) anti-SARS-CoV-2 in health-care workers from Secretary of Health from Guanajuato State. It was a cross-sectional, retrolective study, using database from the ENSERO-COVID program. It was recollected data about exposure in work and in community by contact with confirmed cases of COVID-19. The anti-SARS-CoV IgG antibody titer was determined, considering 1.4 or higher as positive. It used Chi squared test to show relationship between variables, Z for two proportions to test hypotheses and logistic regression for show the effect of exposure and test positive for antibodies. 4,047 registries were reviewed, 376 (9.29%) were positive for the presence of SARS-CoV-2 antibodies. There is an association between the type of work unit (type determined by hospitalizing COVID-19 patients or not) with seropositivity (P <0.05). There was no effect of performance areas to be seropositive. Community exposure had an effect on being seropositive OR = 1.44 (1.17 - 1.79). Training in the proper use of personal protective equipment had a protective effect on being seropositive with OR = 0.79 (0.64 -0.99). Exposure in the community to a confirmed case to SARS-CoV-2 is found to have a significant association with the presence of anti-SARS-CoV-2 antibodies. Training in the proper use of personal protection equipment is a protector against SARS-CoV-2 infection. There is a significant association between the type of unit and the presence of anti-SARS-CoV-2 antibodies. Given the increase in the number of confirmed cases of SARS-CoV-2, it is vitally important that health workers adequately protect themselves both at the community and workplace level.

Keywords: Antibodies; COVID-19; Infection; population; SARS-CoV-2.

The novel acute respiratory distress syndrome by coronavirus (SARS-CoV-2) was first detected in late 2019 in Wuhan, China[1]. Later, the disease caused by it was named COVID-19[2]. Since then, its expansion has reached practically all regions of the planet.

On March 10, 2020, the first case of COVID-19 was detected in the State of Guanajuato[3]. As part of the measures for containment and mitigation, social distancing campaigns, work from home and dissemination of hygiene measures to be considered were implemented. In addition to the above, an epidemiological surveillance has been carried out, aided by diagnostic tests based on direct detection of the virus.

As of September 13, 2020, the state of Guanajuato registered 38,514 cases, with León, Irapuato, Celaya, Salamanca, Silao, Guanajuato being the municipalities with the highest incidence[4].

Serological surveys are the best tool to determine the spread of an infectious disease, particularly in the presence of asymptomatic cases or in the incomplete identification of those with symptoms. Serologic assays are also needed for evaluation of results of vaccine trials and development of therapeutic antibodies. The first seroprevalence studies of SARS-CoV-2 have been carried out in the most critical points of COVID-19, such as Spain, Switzerland and China[5-7].

The Spanish study, which included more than 60,000 participants, showed a national seroprevalence of 5%[5]. Similar numbers were obtained in the 2,766 participants in the Swiss study, with seroprevalence data from Geneva reaching 10.8% in early May[6]. The results show that seroprevalence is quite low at critical points since both studies are in line with the data from Wuhan, the epicenter and the supposed origin of the SARS-CoV-2 pandemic. The study conducted in Wuhan approximately 8 weeks after the peak of infection reported a low seroprevalence of 3.8% even in highly exposed healthcare workers[7].

In the case of Sweden, they reported seroprevalence figures of 7.3% at the end of April, which left them far from reaching the natural immunity of the herd in the population[8].

The Institute of Public Health of the State of Guanajuato (IPHSG), launched the program for the detection of anti-SARS-CoV-2 antibodies in front-line personnel in the units in the state of Guanajuato (ENSERO-COVID), with the application of a questionnaire and determination of Immunoglobulin G (IgG), which we will use as the basis for this study. To participate in this program, all IPHSG employees were invited to participate and had to sign an informed consent for taking a venous blood sample and answering the ENSERO survey[9].

The current health situation has demanded an effective and efficient response from health personnel. In Mexico, as part of the strategies to respond to the health emergency, different protocols were activated, among which is that of hospital reconversion. This has caused a considerable part of the health personnel to be exposed to the SARS-CoV-2 virus. According to recent WHO statements, the COVID-19 pandemic can take years to eradicate and the noticeable effects can last for decades. Therefore, it is vitally important to know the levels of levels of specific IgG among front-line health personnel. Not only the above, but also those factors that have contributed to these levels: community exposure, exposure in the workplace, among others[10,11].

As part of the actions to better understand the behavior of the pandemic among health workers, it is necessary to know if the IPHSG health personnel who have been working since the beginning of the outbreak were infected and the relation with the availability of personal protective equipment against coronavirus disease; This motivated the State Government, through the Ministry of Health, to implement the State Strategy to determine the prevalence of antibodies anti-SARS-CoV-2.

The determination of anti-SARS-CoV-2 antibodies allows to identify if the patient was infected by SARS-CoV-2[12].

The host's immune system reacts to SARS-CoV-2 infection by producing specific antibodies. These antibodies appear in the serum or plasma of infected individuals after a few days to 2 weeks after the onset of symptoms[15]. Specific IgG antibodies to SARS-CoV-2 are detected in COVID-19 patients during the symptomatic phase of the disease, after the RNA is no longer detectable[12,13]. The sensitivity of combining RNA results with antibody results is> 99%[11]. The persistence of IgG antibodies allows identification of people who have been infected in the past, have recovered from the disease, and are possibly immune[14].

The objective was to analyze the seroprevalence of anti-SARS-CoV-2 antibodies in health personnel in the state of Guanajuato.

MATERIAL AND METHODS

A quantitative, cross-sectional, analytical, observational, retrolective study of seroprevalence in health workers of the SPEG Institute was designed.

The records of the IPHSG front-line care personnel, who participated in the seroprevalence program and the IPHSG survey ENSERO, were reviewed.

Records of all front-line health personnel, consisting of 7,186 people, of which 56.32% participated in the SARS-CoV-2 antibody seroprevalence program.

Sampling was not performed, as all the complete records of first-line health personnel who agreed to participate in the SARS-CoV-2 antibody seroprevalence program were used.

For the selection of participants, the inclusion criteria were considered: records of IPHSG's first-line contact health personnel, to participate in the SARS-CoV-2 seroprevalence program, and who were working in person from the beginning of the pandemic.

There were no non-inclusion criteria, and the incomplete records were removed.

Age and sex were taken as sociodemographic variables; occupation; type of hospital, if it was exclusively for COVID-19 patients, it was not or it was mixed; the work area was the place of work performance of the participant.

It was questioned about contact with confirmed cases in the place of residence; as well as contact with confirmed cases in the workplace.

They were questioned about the availability of protective equipment at their workplace. They were considered to wear full equipment if they used gloves, goggles or face shield, surgical mask or N95 mask and surgical gown or suit, they were considered to use incomplete protection if they used 1 or 2 equipment and absent if they did not use any.

The result variable was the anti-SARS-CoV-2 antibody titer of 1.4 or higher, considered positive.

The sample size calculation was performed, assuming a 10% seroprevalence[12], with a universe of 4,047 records, the minimum sample size is 134 records, with 95% precision (EpiInfo, 7.2.2.16, CDC, Atlanta, GA, USA).

Instruments

The COVID-19 Seroprevalence Survey and exposures in the health personnel of the IPHGS (ENSERO) was designed, which consists of data on employment and residence status, as well as 60 binary items related to the independent variables; To demonstrate reliability, it was applied in 10 first-line health professionals, on two occasions, online and a Cohen's Kappa of 0.80 was obtained (CI9 % 0.70 to 0.90). The validity was construct. It is applied online and is auto-completed. The questionnaire covers questions of general preventive measures and specific protection, in the face of a patient confirmed with SARS-CoV-2 infection.

Procedures

Once the protocol was designed, it was submitted to the Penjamo General Hospital Research Ethics Committee and approved; the records of the participants in the anti-SARS-CoV-2 antibody detection program (ENSERO COVID) were obtained.

The information capture was carried out electronically through the ENSERO COVID web platform, designed ad hoc for this purpose. Through this platform, participants were able to download the informed consent to express their willingness to participate. In addition, in this, participants could fill out the survey. Also, personnel from the state public health laboratory of the state of Guanajuato had access to the platform to enter the result of the antibody test[9].

Participants were referred to medical units close to their work units to take the venous blood sample. From each designated unit, the samples were sent to the state public health laboratory of the state of Guanajuato for testing and entering the results of the antibody tests. Within the anti-SARS-CoV-2 antibody detection program, ISAPEG front-line workers were asked to participate were given the ENSERO questionnaire and a venous blood sample was obtained. The serum samples of the participants were analyzed in the facilities of the State Laboratory of Public Health of Guanajuato (SLPHG), in the Serology Laboratory, with personnel qualified in serology techniques using the ARCHITECT i System platform (Abbot Corp.), by chemiluminescent microparticle immunoassay (CMIA) used for the qualitative detection of IgG antibodies against the SARS-CoV-2 virus. The presence or absence of IgG antibodies against the SARS-CoV-2 virus in the sample was determined by comparing the chemiluminescent Relative Units of Light (RUL) present in the reaction, with the URL of the calibrator.

Results were expressed as the division of the sample result by the stored calibrator result, the units provided for the assay results are a sample / cut-off ratio (S / C). The cut-off point corresponds to an Index (S / C) of 1.4. The results were considered positive when a value e" 1.4 URL was obtained and negative when it was <1.4 URL. The reagent was verified prior to its use in the sampling program to demonstrate quality assurance. Biological samples were not stored. They were discarded according to the usual handling of the sample by the State Public Health Laboratory (SPHL).

For the purposes of this research, only the registration database of the participants in the ENSERO program was used and the participants were not contacted, so informed consent is not required.

Statistical analysis

Descriptive statistics were used for all variables, categorical, frequencies and percentages; quantitative, mean and standard deviation. To find the relationships between the independent variables and the result, the Chi-square test and the value of P were calculated.

A logistic regression model was generated between the independent variables and the result, to identify the effect of exposure to the new coronavirus and the presence of anti-SARS-CoV-2 antibodies, with Odds Ratio (OR) and 95% confidence intervals.

A multivariate logistic regression model was generated to adjust the crude OR, by age, gender and by the variables that were shown to improve the model with the likelihood ratio test and the value of P.

In all cases, the value of á was set at .05, to determine statistical significance of the results. Statistical analysis were performed in STATA 13.0 ® (Stata Corp., College Station, TX, USA)

RESULTS

The participants had an age range of 19 to 65 years, with an average of 37.00 ± 8.66.

Table 1 describes the characteristics of the sample, where men (67.70%) predominated; As a role, the most frequent was that of a nurse (52.13%), and they did not work in another institution (83.35%) and had contact with COVID-19 patients in their work (79.04%) and 46.60% declared having had contact with COVID-19 patients in their area of residence and 42.29% of the participants had at least one training course on the proper use of protective equipment, which included a mask, goggles, gloves, a surgical gown or a Tyvek-type suit.

Among the seropositive, men (66.76%), between 31 and 41 years of age (38.03%), dedicated to nursing (54.26%), did not work in another institution (78.99%), exposed to confirmed COVID-19 patients at work (80.85%), contact with confirmed COVID-19 patients in their place of residence (55.59%), working in hybrid hospitals, those who care for COVID-19 patients and other pathologies (37.50%), their area of performance was in hospitalization (34.57%), 63.30% did not take courses in the use of personal protective equipment and 60.90% used complete personal protective equipment (goggles, mask or face mask, gloves, surgical gown or Tyvek-type suit (Table 2).

Table 3 shows the results of tabulating the use of protective equipment and the type of hospital in which they work by results of the titration of anti-SARS-CoV-2 antibodies. It is found that among the seropositive and working in COVID hospitals they used complete protective equipment (82.65%) similar among the seronegative (87.83%); Among those who work in non-COVID hospitals, those who used incomplete protective equipment predominated 59.85% for the seropositive and 62.15% for the seronegative and for those working in hybrid hospitals, those who used complete equipment predominated, 69.50% for the seropositive and 65.95% for seronegative. There is an association between the type of hospital where they work and the use of protective equipment

Table 1. Distribution of variables of the sample of health workers (n=4,047)

Variable	n	%
Sex		
Male	1,307	32.30
Female	2,740	67.70
Age (years)		
18 – 30	1,056	26.09
31 – 40	1,686	41.66
41 – 50	961	23.75
51 – 60	332	8.20
61 – 70	12	0.30
Occupation		
Nursing	2,058	50.85
Physician	1,428	35.29
Social work	167	4.13
Paramedic	148	3.66
Radiology technician	102	2.52
Biological sample taker	97	2.40
Inhalotherapist	29	0.72
Medical assistant	18	0.44
Work in another health institution		
Yes	756	17.62
No	3,334	82.38
Job exposure to COVID-19 patient		
Yes	3,291	81.32
No	756	18.68
Community exposure to COVID-19 patient		
Yes	1,912	47.24
No	2,135	52.76
Type of hospital		
COVID	517	12.77
Non-COVID	1,709	42.23
Hybrid	1,821	45.00
Work area		
Hospitalization	1,269	31.36
Consulting room	979	24.19
Urgency	642	15.86
Respiratory triage	401	9.91
Intensive therapy	216	5.34
Surgery room	164	4.05
Social work	112	2.77
X rays	106	2.62
Ambulance	80	1.98
Laboratory	78	1.93
Training on the use of personal protective equipment		
Yes	1,690	41.76
No	2,357	58.24
Use of personal protective equipment		
Absent	105	2.59
Incomplete	1,701	42.03
Full	2,241	55.37

Source: ENSERO COVID, IPHGS [13]

Table 2. Distribution of variables accord to titers of antibodies anti-SARS-CoV-2 (IgG)

Variable	Titers of antibodies ≥ 1.4 n	%	Titers of antibodies < 1.4 n	%	X^2 (df) *P*-value	Z for two proportions (*P*-value)
Sex					0.17	
Male	125	33.24	1,182	32.20	-1	-0.41 (.68)
Female	251	66.76	2,489	67.80	0.68	
Age (years)						
18 - 30	126	33.51	930	25.33	Not applicable	3.44 (.006)
31 - 40	143	38.03	1,543	42.03		1.52 (.13)
41 - 50	77	20.48	884	24.08		- 1.56 (.12)
51 - 60	30	7.98	302	8.23		-0.17 (.87)
61 - 70	0	0.00	12	0.33		-1.12 (.26)
Occupation					0.98	
Nursing	204	54.26	1,854	50.50	-1	1.39 (.16)
Physicians	121	32.18	1,307	35.60	0.25	1.32 (.19)
Social work	23	6.12	144	3.92		2.04 (.04)
Paramedic	10	2.66	138	3.76		-1.08 (.28)
Radiology technician	6	1.60	96	2.62		-1.20 (.23)
Biological sample taker	8	2.13	89	2.42		-0.35 (.73)
Inhalotherapist	2	0.53	27	0.74		-0.46 (.65)
Medical assistant	2	0.53	16	0.44		0.25 (.80)
Work in another health institution					3.29	
Yes	79	21.01	634	17.27	-1	
No	297	78.99	3,037	82.73	0.07	1.82 (.07)
Job exposure to COVID-19 patient					0.06	
Yes	304	80.85	2,987	81.37	-1	
No	72	19.15	684	18.63	0.81	-0.25 (.81)
Community exposure to COVID-19 patient					11.57	
Yes					-1	
No	209	55.59	1.703	46.39	0.001	3.41 (.0007)
	167	44.41	1,968	53.61		
Type of hospital					65.77	
COVID	98	26.06	419	11.41	-1	8.12 (.00001)
Non-COVID	137	36.44	1,572	42.82	0.0001	-2.39 (.02)
Hybrid	141	37.50	1,680	45.76		-3.07 (.002)
Work area					13.27	
Hospitalization	130	34.57	1,139	31.03	-9	1.41 (.16)
Consulting room	76	20.21	903	24.60	0.15	-1.90 (.06)
Urgency	67	17.82	575	15.66		1.09 (.27)
Respiratory triage	32	8.51	369	10.05		-0.95 (.34)
Intensive therapy	26	6.91	190	5.18		1.42 (.15)
Surgery room	10	2.66	154	4.20		-1.44 (.15)
Social work	15	3.99	97	2.64		1.52 (.13)
X rays	7	1.86	99	2.70		-0.97 (.33)
Ambulance	6	1.60	74	2.02		-0.56 (.58)
Laboratory	7	1.86	71	1.93		-0.09 (.92)
Training on the use of personal protective equipment						
4.36						
Yes					-1	
No	138	36.70	1,552	42.28	0.04	-2.09 (.04)
	238	63.30	2,119	57.72		
Use of personal protective equipment					5.38	
Absent					-2	
Incomplete	10	2.66	95	2.59	0.07	0.08 (.94)
Full	137	36.44	1,564	42.60		-2.31 (.02)
	229	60.90	2,012	54.81		2.27 (.02)

Source: ENSERO COVID, IPHGS [13]

(P <.05) for both seropositive and seronegative patients.

Table 4 shows that there is no effect of the type of occupation on having anti-SARS-CoV-2 antibody titers. Nor was it found between working in another institution, nor being exposed to COVID-19 patients at work. A significant effect was found between having community contact with COVID-19 patients and antibody titers equal to or greater than 1.4. Working in a non-COVID hospital shows a protective effect to have antibody titers of 1.4 or higher. In the area of job performance, it practically did not show an effect on having antibodies.

The logistic regression model that includes all the variables that improved the model, according to the likelihood ratio test, is shown in Table 5. Even after adjusting for the type of hospital where you work, training on the use of protective equipment personal and age, community exposure has a significant effect on having anti-SARS-CoV-2 antibody titers.

DISCUSSION

The sample of 4, 047 health workers from Secretary of Health from Guanajuato State, were in first line to care of patients in different hospitals in all state. Predominated nurses and physicians. All had contact daily with patients in hospitals. 9.29% of health workers had IgG antibody titers considered positive (e”1.4).

Gracía-Basteiro et al.[15], reported positivity for anti-SARS-CoV-2 antibodies of 9.3% among workers at a referral hospital in Spain. Very similar to the 9.29% obtained among health workers of the Secretary of Health of the state of Guanajuato.

We found no relationship between sex and having anti-SARS-CoV-2 antibodies and in age we did not find significant differences between positive or negative antibodies, by age group, except for the 18 to 30-year-old group, where the proportion with antibodies was higher than in negative antibodies (P <.05) (Table 2).

Regarding occupation, the participants with the highest proportion of positive antibodies were nursing, followed by doctors, but it is important to note that social work has significantly different proportions between positive and negative for antibodies (Table 2). García-Basteiro et al. [15], reported that among nurses, 48% had positive antibodies and 30% of physicians. This could be due to the fact that nursing professionals spend more time in contact with patients than doctors. Most of the participants (78.99%) with positive antibodies for SARS-CoV-2, only work in the health department. Working in another institution could possibly increase the risk of getting SARS-CoV-2 (Table 2).

80.85% of the participants positive for antibodies declared having contact with confirmed COVID_19 patients in their work area, but there is no relationship with the detection of anti-SARS-CoV-2 antibodies (P> .05) (Table 2). It could be due to having personal protective equipment.

About 55.59% of the participants with antibodies, reported having had contact with a confirmed COVID-19 patient in their community, showing a significant association (P <.05) and where the personal protective equipment was no longer used.

By type of hospital, the highest proportion of antibody positives were those that worked in those hospitals that did not treat COVID-19

Table 3. Tabulation among type of hospital and use of personnel protective equipment by antibodies level for SARS-CoV-2

	Antibodies ≥ 1.4						Antibodies < 1.4					
	Personal protective equipment						Personal protective equipe					
	Full		Incomplete		Absent		Full		Incomplete		Absent	
	n	%	n	%	n	%	n	%	n	%	n	%
Type of hospital	60.02 (4) .0001						540.94 (4) .0001					
Covid	81	82.65	14	14.29	3	3.06	368	87.83	48	11.46	3	0.72
Non-covid	50	36.5	82	59.85	5	3.65	536	34.10	977	62.15	59	3.75
Hybrid	98	69.5	41	29.08	2	1.42	1,108	65.95	539	32.08	33	1.96

Source: ENSERO-COVID, IPHGS [13]

patients and the hybrids, that treated COVID-19 patients and patients in general, 36.44% and 37.50% respectively, and found a significant association (P <.05) between the type of hospital and having anti-SARS-CoV2 antibodies (Table 2).

By area of work, it is reported that 34.57% of those positive for antibodies worked in hospitalization and no association was found between area and having anti-SARS-CoV-2 antibodies (P> .05) (Table 2).

Table 4. Logistic regression crude and adjusted by age and sex, between variables and positive titers of antibodies

Variable	OR (CI95%)	OR (CI95%) adjusted by age	OR (CI95%) adjusted by sex
Occupation			
Nursing	Basal	Basal	Basal
Physician	0.84 (0.66 – 1.07)	0.90 (0.71 – 1.14)	0.77 (0.59 – 0.99)
Social work	1.14 (0.26 – 4.98)	1.55 (0.97 – 2.48)	1.49 (0.94 – 2.37)
Paramedic	0.66 (0.34 – 1.27)	0.68 (0.35 – 1.32)	0.57 (0.29 – 1.12)
Radiology technician	0.57 (0.25 – 1.31)	0.62 (0.27 – 1.43)	0.51 (0.22 – 1.19)
Biological sample taker	0.82 (0.39 – 1.71)	0.82 (0.39 – 1.72)	0.78 (0.37 – 1.63)
Inhalotherapist	0.67 (0.16 – 2.85)	0.62 (0.15 – 2.62)	0.62 80.15 – 2.64)
Medical assistant	1.14 (0.26 – 4.98)	1.25 (0.28 – 5.49)	1.12 (0.25 – 4.89)
Work in another health institution			
Yes	1.27 (0.98 – 1.66)	1.30 (1.00 -1.69)	1.27 (0.97 – 1.67)
No	Basal	Basal	Basal
Job exposure to COVID-19 patient			
Yes	0.97 (0.74 – 1.27)	0.93 (0.71 – 1.22)	0.97 (0.74 – 1.27)
No	Basal	Basal	Basal
Community exposure to COVID-19 patient			
Yes	1.44 (1.17 – 1.79)	1.43 (1.15 – 1.76)	1.45 (1.17- 1.79)
No	Basal	Basal	Basal
Type of hospital			
COVID	Basal	Basal	Basal
Non-COVID	0.37 (0.28 – 0.49)	0.39 (0.29 – 0.52)	0.37 (0.28 – 0.49)
Hybrid	0.36 (0.27 – 0.47)	0.37 (0.28 – 0.49)	0.36 (0.27 – 0.47)
Work area			
Intensive therapy	Basal	Basal	Basal
Hospitalization	0.83 (0.53 – 1.31)	0.86 (0.55 – 1.35)	0.83 (0.53 – 1.31)
Consulting room	0.62 (0.38 – 0.99)	0.67 (0.41 – 1.08)	0.61 (0.38 -0.98)
Urgency	0.85 (0.53 – 1.38)	0.89 (0.55 – 1.45)	0.84 (0.52 – 1.36)
Respiratory triage	0.63 (0.37 – 1.09)	0.65 (0.37 – 1.12)	0.63 (0.37 – 1.09)
Surgery room	0.47 (0.22 – 1.01)	0.52 (0.24 – 1.12)	0.47 (0.22 – 1.00)
Social work	1.13 (0.57 – 2.23)	1.24 (0.63 – 2.47)	1.15 (0.58 – 2.29)
X rays	0.52 (0.22 – 2.23)	0.57 (0.23 – 1.35)	0.50 (0.21 – 1.20)
Ambulance	0.59 (0.23 – 1.50)	0.61 (0.24 – 1.54)	0.57 (0.22 – 1.44)
Laboratory	0.72 (0.30 – 1.73)	0.74 (0.31 – 1.79)	0.71 (0.30 – 1.72)
Training on the use of protective equipment			
Yes	0.79 (0.64 -0.99)	0.79 (0.63 – 0.98)	0.79 (0.64 – 0.99)
No	Basal	Basal	Basal
Use of protective equipment			
Absent	0.92 (0.48 – 0.96)	0.98 (0.50 – 1.99)	0.93 (0.48 – 1.81)
Incomplete	0.77 (0.62 – 0.96)	0.80 (0.64 – 1.00)	0.77 (0.62 – 0.96)
Full	Basal	Basal	Basal

Source: ENSERO COVID, IPHGS [13]

Table 5. Logistic regression model including all the variables that improved the model

Variable	OR (CI95%)
Community exposure	1.39 (1.12 – 1.72)
Type of hospital	0.64 (0.55 – 0.74)
Training in the use of personal protective equipment	0.74 (0.59 – 0.92)
Age (years)	0.89 (0.79 – 1.00)

Source: ENSERO-COVID, IPHGS [13]

Around 36.70% of those positive for antibodies had training in the use of personal protective equipment and there is a significant association (P <.05) (Table 2).

60.90% of the antibody positives fully used personal protective equipment, and there is a statistical association with antibody positivity (Table 2).

Using logistic regression to determine the effect of the variables on having anti-SARS-CoV-2 antibodies, it is detected that contact with patients in the community has an effect on having antibodies (OR = 1.44, CI95% 1.17 - 1.79) and the type of hospital work is found that working in a hybrid hospital or not COVID, has a protective effect to have antibodies. Training on the use of personal protective equipment and the incomplete or absent use of such equipment show a protective effect to having antibodies. Occupation, work area, occupational exposure to COVID-19 patients has no effect on the presence of antibodies (Table 4). Age shows a confounding effect in almost all cases, modifying the crude ORs.

An study conducted in Lisbon has shown that those who did not seroconvert within week 2 of COVID-19 symptoms (11/41, 27%), had underlying conditions, such as systemic lupus erythematosus (SLE) (1), lymphoma (1) , chemotherapy (1), or immunosuppressive medication[16].

CONCLUSION

Seroprevalence among first-line health care workers, which is mainly conformed by nursing and medical personnel, was 9.29%.

Although availability of PPE was according to the level of exposure of health care workers (e.g. approximately 80% of the personnel in COVID hospitals had full equipment), it did not show the expected relationship with respect to SARS-CoV-2 infection. This may be because it is not only the availability of PPE that influences, as protective, infection due to SARS-CoV-2 but also its correct use. In addition, the question in the survey was focused on availability in the workplace.

First-line health care workers, in addition to exposure to SARS-CoV-2 infection in their workplaces, are exposed to contagion in their community context. In the present study, this was verified. An association of SARS-CoV-2 infection was detected both with community exposure and with the type of hospital in which participants work (COVID, No COVID, Hybrid). Now, the inference on training, as a protective role against SARS-CoV-2 infection, is of interest. As these are virtual courses and voluntary participation, training through these tools is an indicator of the willingness to know the correct use of PPE. In the face of the active COVID-19 epidemic, it is vitally important to pay attention to the points mentioned above to avoid saturation of health services.

Competing interests disclaimer

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

Ethics approval and consent to participate

The protocol was approved by Ethics Committee for Research from Hospital General Penjamo and waive the informed consent because only it worked with database, with registry HGP/01007/2020.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are available in the Open Science Framework repository, [https://osf.io/nph6v/]

REFERENCES

1. World Health Organization. Rolling updates on coronavirus disease (COVID-19). Update 23 March 2020. 2020. Available in: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen
2. Carlos WG, De la Cruz C, Cao B, Pasnick S, Jamil S. Novel Wuhan (2019-CoV) coronavirus. *Am J Respi Crit Care Med.*; **201**(4):7-8 (2020). Doi: http://doi.org/10.1164/rccm.2014P7
3. Departamento de Epidemiología de la Dirección de Servicios de Salud. Sistema Nacional de Vigilancia Epidemiológica, Dirección General de Epidemiología, Secretaría de Salud. 2020. Available in: http://www.sinave.gob.mx/. Acceso 21 mayo 2020.
4. Secretaría de Salud del Estado de Guanajuato. Coronavirus. 2020. Disponible en http://coronavirus.guanajuato.gob.mx. Acceso 13 de septiembre 2020.
5. Pollán M, Pérez-Gómez B, Pastor-Barriuso R, Oteo J, Hernán MA, Pérez-Olmeda M , et al. Prevalence of SARS-CoV-2 in Spain (ENE-COVID): a nationwide, population-based seroepidemiological study. *Lancet;* **396**: 535–44 (2020). Doi: https://doi.org/10.1016/S0140-6736(20)31483-5.
6. Stringhini S, Wisniak A, Piumatti G, Azman AS, Lauer SA, Baysson H, et al. Seroprevalence of anti-SARS-CoV-2 IgG antibodies in Geneva, Switzerland (SEROCoV-POP): a population-based study. *The Lancet.;* **396**:313-319 (2020). Doi: https://doi.org/10.1016/S0140-6736(20)31304-0.
7. Xu X, Sun J, Nie S, Li H, Kong Y, Liang M, et al. Seroprevalence of immunoglobulin M and G antibodies against SARS-CoV-2 in China. *Nature Medicine,* **26**: 1193-1195 (2020). Doi: https://doi.org/10.1038/s41591-020-0949-6.
8. Eckerle I, Meyer B. SARS-CoV-2 seroprevalence in COVID-19 hotspots. *Lancet.;* **396**(10250):514-515 (2020). Doi: https://doi.org/10.1016/S0140-6736(20)31482-3.
9. Directorate of Information and Communication Technologies. Institute of Public Healt from Guanajuato Satate. Seroprevalence survey. Avaiñlable in: https://salud5.guamajuato.gob.mx/ensero/#
10. Fafi-Kremer S, Bruel T, Madec Y, Grant R, Tondeur L, Grzelak L, et al. Serologic responses to SARS-CoV-2 infection among hospital staff with mild disease in eastern France. *medRxiv mayo* **22**: (2020). preprint doi: https://doi.org/10.1101/2020.05.19.20101832.
11. World Health Organization. COVID-19 Emergency Committee highlights need for response efforts over long term. 2020. Disponible en: https://www.who.int/news-room/detail/01-08-2020-covid-19-emergency-committee-highlights-need-for-response-efforts-over-long-term. Acceso el 14 de septiembre 2020.
12. Zhao J, Yuan Q, Wang H, et al. Antibody responses to SARS-CoV-2 in patients of novel coronavirus disease 2019. *Clin Inf Dis.* ciaa344 (2020). Doi: https://doi.org/10.1093/cid/ciaa344
13. Xiao AT, Gao C, Zhang S. Profile of specific antibodies to SARSCoV-2: the first report. *J Infect;* **81**(1):147-178 (2020). Doi: http://dx.doi.org/10.1016/j.jinf.2020.03.012.
14. Shen C, Wang Z, Zhao F, et al. Treatment of 5 critically ill patients with COVID-19 with convalescent plasma. *JAMA.*; **323**(16):1582–1589 (2020). Doi: http://dx.doi.org/10.1001/jama.2020.4783
15. Garcia-Basteiro AL, Moncunill G, Tortajada M, Vidal M, Guinovart C, Jiménez A, et al. Seroprevalence of antibodies against SARS-CoV-2 among health care workers in a large Spanish reference hospital. *Nature Communications,* **11**:3500 (2020). Doi: https://doi.org/10.1038/s41467-020-17318-x
16. Figueiredo-Campos P, Blankenhaus B, Mota C, Gomes C, Serrano M, Ariotti S, et al. Seroprevalence of anti-SARS-CoV-2 antibodies in COVID-19 patients and healthy volunteers up to 6 months post disease onset. *Eur. J. Immunol.;* **50**(12): 2025–2040 (2020). Doi: https://doi.org/10.1002/eji.202048970.
17. Padilla-Raygoza N. ENSERO COVID IPHGS 2021. Available in: https://osf.io/nph6v/