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Brief Report

SARS-CoV-2 seroprevalence and risk factors among health care workers: Estimating the risk of COVID-19 dedicated units



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We evaluated the seroprevalence of SARS-CoV-2 and risk factors among 1,996 oligo/asymptomatic health care workers. The seroprevalence was 5.5% and risk factors associated with being infected with SARS-CoV-2 was professional category of cleaning (adj odds ratio 2.22, 95% confidence interval: 1.12-4.44, *P*: .023) and male gender (adj odds ratio: 1.54, 95% confidence interval: 1.03-2.32, *P*: .035). Working at dedicated COVID-19 units (high-risk group) was not an independent risk factor for seropositivity.

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INTRODUCTION

Health care workers (HCW) are at high risk of infection as they work on the frontline and early reports already demonstrated that there was a significant proportion of confirmed COVID-19 among them.¹⁻³ It is important identifying the source of risk, because it provides information on preventive measures, especially those related to occupational exposure. In this sense, serological testing provides an opportunity to understand transmission. Our aim was to evaluate the seroprevalence of SARS-CoV-2 and risk factors for oligo/asymptomatic COVID-19 among HCW.

METHODS

Study design

Prospective cross-sectional study conducted at Hospital Sírio-Libanês in São Paulo, Brazil, a private, tertiary hospital comprised 450

beds and 120 beds dedicated to COVID-19 (of which 40 are ICU beds) and 6,000 employees.

Participants

Any professional who worked at the Hospital Sírio-Libanês between March and July, 2020, was invited to participate. HCW were defined as any worker working within the hospital, including hospital and auxiliary services. Our sample of convenience included 2,000 tests. According to the infection control and crisis committee preparedness plan all suspected or confirmed patients were allocated to specific “COVID-19 units.” Thus, when planning for inviting employees, we first excluded those at home office, medical leave or vacation (estimated 2,500). The second step was to invite all HCW of “COVID-19 units” (estimated 1,200 employees); then we randomly choose units dedicated for care of non-COVID patients and some administrative areas (estimated 2,300). Wards (12 units) and ICUs (3 units) dedicated to non-COVID-19 patients are allocated on different floors and we chose some randomly.

Participants were grouped depending on the frequency of contact to COVID-19 patients. High exposure was defined as HCW with daily direct patient contact at COVID-19 units (dedicated wards or

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intensive care units); medium exposure: daily direct patient contact at non COVID-19 units and low exposure: staff without direct patient contact (ie, administrative, security). Our Diagnostic Center was organized as well in dedicate COVID-19 and non-COVID-19 areas. Thus, laboratory and radiology technicians were categorized as high or medium exposure, depending on the Unit they worked: those who have any contact with COVID-19 patients were classified as high and those who perform their activities with non-COVID-19 patients were classified as medium. Those who worked exclusively at technical area were classified as low risk.

Blood collection and survey

Over a 3-week period (starting June 17) blood collection was performed during work shifts. Before blood collection, a survey using Google forms platform was completed. Questions included demographic data, comorbidities, tobacco use, professional category, occurrence of COVID-19 symptoms at any time, type of PPE used, place of work (COVID-19 dedicated unit or not), place of meals, known contact with confirmed cases, and type of transport to the hospital.

Serology

Antibodies of IgG class against SARS-CoV-2 were detected by an ELISA assay as previously described.⁴ The sensitivity of this ELISA assay to diagnose COVID-19 is 86%(sensitivity is increased with time after symptom onset, and at >14 days it was 95% and specificity was 100%).

Infection prevention measures

Our first COVID-19 patient was admitted on March 6, 2020 and before that date numerous safety protocols were implemented according to our crisis committee preparedness plan. All suspected or confirmed cases were allocated to specific “COVID-19 units” (40 ICUs boxes and 120 individual rooms at wards) We adopted standard, contact and droplet precautions. Airborne precautions were used when aerosol-generating procedures (AGPs) were performed. If AGPs were performed outside negative pressure rooms, we considered as exposed to aerosol particles all HCW at the unit and recommend the use of N95 mask and face shield full time, regardless if they participated directly in AGPs.

In person and/or on-line training on the correct use of all appropriate personal protective equipment (PPE) were done for all HCWs and administrative. For cleaners, recommendation on PPE was long sleeve aprons, gloves, surgical masks; and N95 masks and face shields or goggles when working at areas where AGPs was performed.

Visit restriction occurred from March 17 and since March 31, universal use of surgical mask was implemented. Any professional with at least one of the following symptoms: cough, fever, shortness of breath, sudden onset of anosmia, ageusia or dysgeusia was tested to RT-PCR SARS-CoV-2 and received a medical leave for 14 days, if positive.

Cleaning and disinfection of surfaces and equipment was performed using premoistened wipes with hydrogen peroxide or chlorine dioxide. Frequency of cleaning was increased from one to twice every 6 hours.

Data analysis

We compared the 2 groups using the c2 test for dicotomic variables and the Kruskal-Wallis test for continuous variables. Factors associated with a positive serology were evaluated by bivariate analysis, using EpiInfo 6.04 software (CDC, Atlanta, GA). A Pvalue of .05 was considered statistically significant. Multivariate analysis using logistic regression method was performed using SPSS version 19.0(IBM Corp., Armonk, NY) including all variables with Pvalue of .25 or lower in the

bivariate analysis. Adjusted odds ratios (OR) and 95% confidence intervals (95% CI) were calculated for each variable. Variables in which 95% CI did not include 1.0 were maintained in the final model.

This study was approved by the Brazilian national ethics review board (CONEP), registry number 30419620.1.0000.0068.

RESULTS

Overall, 2,000 HCW employees volunteered for antibody testing, 4 were excluded, as they were previously diagnosed with COVID-19, thus resulting on 1,996 individuals eligible for the final analysis. Among these, 110 (5.5%) had a positive serology. The proportion of inclusion for each professional category was: food service worker 18%, cleaning 20%, pharmacist 21%, physician 24%, nursing assistant 28%, nutritionist 35%, nurse 35%, laboratory or radiology technician 38%, administrative job 41%, % physiotherapist 42%, biomedical 59%, speech therapist 60%, and others 3%. Categories as “biomedical” and “speech therapist” seems overrepresented, however, in absolute numbers there was only 80 and 9 professionals respectively.

Regarding the occurrence of previous COVID-19 symptoms, 51% of the volunteers presented it. The most common symptom was fatigue/shortness of breath (773 cases), followed by cough (550), sore throat (347), runny nose (185), fever(65), diarrhea(36), anosmia/ageusia (18). Among these suspected cases, 5% had positive serology.

In bivariable and multivariate analysis, risk factors associated with testing positive was the professional category of cleaning and male gender. Working at dedicated COVID-19 Units (high risk group) was not statistically significantly associated with seropositivity (Table 1).

DISCUSSION

We found a seroprevalence among asymptomatic HCW of 5.5%, similar to the results of some European hospitals.^{5,6} The most interesting finding of this study is that HCW in direct contact with COVID-19 patients did not appear to be at higher risk than employees with no patient contact and that the rate of positivity was similar to that among adults randomly tested in São Paulo city.⁷ In contrast, cleaners were more likely to be infected. This finding was in accordance with a previous report from another hospital of our city.⁸ Our hypothesis to explain the higher risk among cleaners is that this category usually belongs to lower socio-economic classes, living in conditions that might expose them to crowding.

Data from a seroprevalence survey conducted in São Paulo during June 2020 found higher positivity among low-income neighborhoods- 16% compared to 6,5% in higher income neighborhoods. Moreover, individuals who have not completed fundamental school had a 4.5 times higher chance of being positive compared to those with higher education (23% vs 5.1%).⁷

At our hospital, 60% of the workforce is female and our results showed that being men was a risk factor for acquiring COVID-19. There have been reports showing that men and women each account for approximately the same *proportion* of people diagnosed with COVID-19 globally, but most patients with severe disease are male. In São Paulo, the largest city in Brazil, 945,422 cases were diagnosed and 58% were male.⁹ The mechanisms leading to these differences can be hormonal, genetic, or related to differences in mi.¹⁰

Several HCW report having had symptoms of COVID-19, 40% has been previously considered as suspected cases and were submitted to RT-PCR with a negative result. Among these suspected cases, 5% had positive serology, indicating that a small percentage of infections were undetected at our hospital. Regarding symptoms, the presence of anosmia/ageusia was unusual but it was more frequent among seropositive HCW.

Limitations of this study include its single-center setting, convenience sampling and not including HCW already diagnosed with

Table 1

Bivariate and multivariate analysis of factors associated with a positive SARS-CoV-2 serology among 1,996 healthcare workers from a private hospital in São Paulo, Brazil

	Seropositive N = 110 (%)	Seronegative N = 1886 (%)	Odds ratio (95%CI)	P-value	Adjusted odds ratio	Adjusted 95% confidence interval	P-value
Male gender	42 (38)	536 (28)	1,56 (1,04 - 2,32)	0.03	1,54	1.03-2.32	.035
Age (years)							
Mean	37	36					
<=30	26	508	0.84 (0.53-1.32)	.44			
31-40	47	838	0.93 (0.63-1.38)	.73			
41-50	32	447	1.32 (0.86-2.02)	.20			
51-60	5	86	0.99 (0.40-2.50)	.99			
61+	0	7					
Presence of comorbidities	13 (12)	313 (17)	0.67 (0.37-1.21)	.19			
Hypertension	6	133	1.16 (0.38-3.53)	.79			
Diabetes	1	24	1.00 (0.13-8.04)	.99			
Obesity	3	103	0.61 (0.16-2.27)	.46			
Pulmonary disease	5	80	1.82 (0.58-5.73)	.30			
Immunosuppression	0	15					
Professional category							
Physician	3 (2)	134 (98)	0.37 (0.11-1.18)	.08			
Administrative job	19 (5)	388 (95)	0.80 (0.48-1.34)	.40			
Cleaning	11 (12)	82 (88)	2,44 (1,26-4,73)	.006	2,23	1,12-4,44	.023
Lab/radiology technician	4 (6)	62 (94)	1.11 (0.39-3.10)	.84			
Nurse	19 (5)	329 (95)	0.98 (0.59-1.64)	.96			
Food service worker	4 (9)	42 (91)	1.66 (0.58-4.70)	.34			
Nutritionist	0 (0)	37 (100)		.14			
Speech therapist	0 (0)	6 (100)		.55			
Nursing assistant	34 (6)	560 (94)	1.05 (0.69-1.60)	.78			
Physiotherapist	5 (4)	113 (96)	0.74 (0.30-1.87)	.53			
Pharmacist	4 (6)	58 (94)	1.18 (0.42-3.33)	.74			
Biomedic	4 (7)	56 (93)	1.23 (0.43-3.46)	.69			
Others	3 (14)	19 (86)	2.75 (0.80-9.45)	.09			
Previous negative RT-PCR SARS-CoV 2	27 (25)	462 (25)	1 (0.64-1.57)	.99			
Type of hospital exposure							
high risk	76 (6)	1283 (94)	1.05 (0.70-1.60)	.82			
medium risk	16 (4)	346 (96)	0.76 (0.44-1.30)	.31			
low risk	18 (7)	257 (93)	1.24 (0.74-2.09)	.42			
Working or worked at COVID-19 Units	76 (69)	1267 (67)	1.09 (0.72-1.65)	.68	1.079	0.706-1.647	.726
Works in other hospital	17 (15)	273 (14)	1.08 (0.63-1.84)	.77			
Working in COVID-19 Units at other hospital	14 (13)	183 (10)	1.36 (0.76-2.42)	.30			
Contact with COVID-19 confirmed case (not patients)							
Co-worker	98 (89)	1622 (86)	1.33 (0.72-2.45)	.36			
Household	10 (9)	139 (7)	1.26 (0.65-2.46)	.50			
Social	46 (42)	779 (41)	1.02 (0.69-1.51)	.92			
Place of meals							
Hospital canteen	100 (91)	1645 (88)	1.46 (0.75-2.84)	.25			
Home	10 (9)	241 (12)	0.68 (0.35-1.33)	.26			
Type of transport to hospital							
Public transport (Bus, metro)	69 (63)	1111 (59)	1.17 (0.79-1.75)	.43	1.103	0.731-1.665	.640
Individual (car, bicycle, motorcycle, on foot)	41 (37)	775 (41)	0.85 (0.57-1.27)	.43			
Presence > 1 person per bedroom at home	42 (38)	696 (37)	1.06 (0.71-1.57)	.79			
Presence of people > 60 years at home	22 (20)	368 (20)	1.03 (0.64-1.67)	.90			
Presence of children at home	45 (40)	770 (41)	1.00 (0.68-1.48)	.98			

COVID-19. Furthermore, we were not able to quantify the frequency of specific timing of exposure for each participant.

In conclusion, the SARS-CoV-2 seroprevalence among HCW was 5.5%. Cleaners and male gender were more likely to be infected; surprisingly, working at dedicated COVID-19 units was not an independent risk factor for seropositivity.

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