

High prevalence of SARS-CoV-2 Infection Among Symptomatic Healthcare Workers in a large university tertiary hospital in São Paulo, Brazil

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Abstract

Background: Latin America became the epicenter of the COVID-19 pandemic in May 2020, mostly driven by Brazil's situation. Healthcare workers are at increased risk of SARS-CoV-2 infection, experiencing a significant burden from COVID-19. Identifying and understanding the clinical characteristics and risk factors associated with infection are of paramount importance to inform screening strategies and infection control practices in this scenario. The aims of this study were to investigate the prevalence and clinical characteristics of healthcare workers with COVID-19 symptoms.

Methods: Between March 21st and May 22nd, 2020 a cross-sectional study was performed in a tertiary university hospital in São Paulo. Prevalence of SARS-CoV-2 infection among health care workers with COVID-19 symptoms was determined by RT-PCR testing on nasopharyngeal and oropharyngeal samples. Participants were asked to complete an electronic structured questionnaire including clinical and demographic data.

Results: Overall, 125 (42.37%) of 295 symptomatic healthcare workers tested positive for SARS-CoV-2. Over the 10-week study period, positivity rates varied from 22.2% (CI 95% 15.9% - 60.3%) in the second week to 55.9% (CI 95% 43.2% - 68.6%) in the sixth week, reaching a plateau (38% - 46%) thereafter. Median (SD) age was 34.2 (9.9) years and 205 (69.5%) were female. We did not find significant differences in the prevalence of the most commonly reported underlying medical condition among healthcare workers that tested positive or negative for SARS-CoV-2 infection. After multivariate analysis, using logistic regression, anosmia (OR 4.4 95% C.I. 2.21 - 8.74) and ocular pain (OR 1.95 C.I. 95% 1.14 - 3.33) were the only symptoms independently associated with positivity for SARS-CoV-2 infection. Follow-up information on clinical outcomes showed that 9 (7.2%) healthcare workers were hospitalized (seven were male) and 2 (1.6%) died.

Conclusions: The findings of this study confirmed the high burden of SARS-CoV-2 infection among healthcare workers in the hardest hit city by the pandemic in Latin America. Anosmia and ocular pain were symptoms independently associated with COVID-19 diagnosis. In low and middle-income countries, where limited availability of tests is frequent, these findings may contribute to optimize a targeted symptom-oriented screening strategy.

Introduction

Since the emergence of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in China, in December 2019, the coronavirus disease 2019 (COVID-19) has affected almost 12 million people from 213 countries and territories around the world ¹. In Brazil, the second hardest hit country in the world, less than four months after the first case was confirmed in the city of São Paulo, more than 1.6 million cases and 63,000 deaths were confirmed.².

Underestimation of the true burden of disease is particularly important in places like Brazil, where only hospitalized patients can be tested for SARS-CoV-2 in the public health system. This approach of limited testing compromises the quality of the data, preventing the identification of a substantial proportion of the cases that, despite being infected, develop asymptomatic or oligosymptomatic forms of the disease.

Healthcare workers (HCWs) are at increased risk of healthcare-associated infections, due to the frontline nature of their work. According to WHO, during the SARS epidemic, in 2002–2003, rates as high as 20% of all persons affected were HCWs³.

Although several studies already investigated the epidemiology of and risk factors for SARS-CoV-2 infection among HCWs in high-income countries, there is a lack of data from low and middle-income countries, where shortage of personal protective equipment (PPE), diagnostic tests and other vital supplies represent one of the most urgent challenges faced by public health systems^{4–9}.

Identifying and understanding the clinical characteristics, outcomes and risk factors associated with SARS-CoV-2 infection among HCWs are of paramount importance to mitigate the spread of the virus in the hospital setting, for high risk patients and other HCWs. This information will be critical to inform screening strategies and infection control practices, particularly in places experiencing challenging scenarios, with high burden of disease and limited resources and protective supplies.

In this context, we aimed to estimate the prevalence and the clinical presentations of SARS-CoV-2 infection among symptomatic HCWs from a tertiary university hospital during the pandemic in São Paulo, Brazil, the current epicenter of the COVID-19 pandemic in Latin America.

Methods

Between March 21st and May 22nd, 2020, HCWs from Santa Casa de São Paulo Hospital were defined as symptomatic and invited to participate in the study if presented with self-reported fever or any of the following: acute respiratory symptoms, loss or changed sense of smell or taste, ocular symptoms, diarrhea, nausea, and vomiting.

Santa Casa de São Paulo Hospital (SCSP) is a 600-bed university hospital, with primary, secondary, and tertiary care facilities and approximately 4,500 HCWs.

An electronic questionnaire (supplementary file 1), developed for this study, was performed, including information on clinical and demographic data, with a 15-day follow-up after onset of symptoms (supplementary file 2).

Nasopharyngeal and oropharyngeal swabs in 3 ml saline 0,9% were collected ² and sent daily to the Laboratory of Clinical and Molecular Virology (LVCM) of the University of São Paulo-Brazil for molecular testing. The real time reverse transcriptase– polymerase chain reaction (RT-PCR) tests for SARS-CoV-2 were carried out using assays developed at the Charité (Institute of Virology, University of Berlin, Germany) and modified by LVCM⁸.

Samples were collected between the second and the seventh day after the symptom's onset and 50 µl viral nucleic acid was obtained from 400 µl of swabs out on the NucliSens easyMag® platform fully automated (BioMerieux, Lyon, France).

Study approval was given by the Ethics Committee of SCSP and written informed consent was obtained from all participants.

Statistical Analysis

The Chi-square test and the contingency table were used to verify the possible association with the qualitative variables. A significant level of 5% was established ($p < 0.05$). For the quantitative variables, we used the Shapiro-Wilk test. For the variables that were not normally distributed, the non-parametric Mann-Whitney test was used. We used Stata Statistics Software version 13.1 for this analysis.

Multivariate analysis using logistic regression compared qualitative variables (variables with $P < 0.20$ in the bivariate analysis were considered in the pre-selection). We used a Stepwise Forward method. For this analysis, we used the SPSS program version 13.0.

Results

In the period of the study, between March 21st and May 22nd, 2020, a total of 295 symptomatic HCWs were tested for SARS-CoV-2, of whom 125 (42.37%) were found positive.

Over the 10-week study period, positivity rates varied from 22.2% (CI 95% 15.9% – 60.3%) in the second week to rates as high as 55.9% (CI 95% 43.2% – 68.6%) in the sixth week, reaching a plateau in the following weeks (38% – 46%).

Among the 295 HCWs included, 163 (55.3%) were physicians (residents, fellows, and assistants), 105 (35.6%) from the nursing staff, and the remaining 27 (6.4%) were physiotherapists, radiology technicians and others.

The median age was 34.2 years (SD 9.9); 130 (44%) were younger than 30 years of age, and 205 (69.5%) were female. The average time between the onset of the symptoms and the RT-PCR testing was 6.3 days (SD 4.1). Presence of known underlying medical conditions was identified in 57 (19.3%) HCWs, of which 23 (7.8%) were persons with chronic lung disease or asthma, 12 (4%) metabolic disorders including Diabetes Mellitus, 9 (3%) with cardiovascular diseases and 15 (5%) obesity with $BMI \geq 40$. Only 7 (2.3%) were individuals over 60 years old. (Table 1).

The median age of the HCWs that tested positive for SARS-CoV-2 was similar to the group that tested negative, (34.5 and 34 years, respectively). A higher proportion of male HCWs was found among HCWs who tested positive for SARS-CoV-2 (40% vs 23.6%. $p = 0.002$). We did not find significant differences in the prevalence of the most commonly reported underlying medical condition among HCWs that tested positive or negative for SARS-CoV-2 infection: chronic lung disease or asthma (7.2% vs 8.2%. $p = 0.91$), metabolic disorders including Diabetes Mellitus (3.2% vs 4.7%. $p = 0.56$), cardiovascular diseases (3.2% vs 2.9%. $P = 0.98$), obesity with $BMI \geq 40$ (4.8% vs 4.7%. $p = 0.73$). The proportion of individuals over 60 years was also similar in both groups (0.8% vs 3.5%. $p = 0.24$). There was no association for testing positive with profession, medical specialty or reporting contact with a confirmed case of COVID-19.

Table 1

Demographic Characteristics of symptomatic HCWs tested for SARS-CoV-2 in Sao Paulo (N = 295).

N (%)	All HCWs 295 (100)	SARS-CoV-2 Positive 125 (42.37)	SARS-CoV-2 Negative 170 (57.63)	P value
Gender	90 (30.5%)	50 (40%)	40 (23.6%)	0.002
Male	205 (69.5%)	75 (60%)	130 (76.4%)	
Female				
Age, mean (SD) years	34.2 (9.9)	34.5 (9.9)	34 (9.9)	0.817
Days of symptoms mean (SD)	6.3 (4.1)	6 (3.8)	6.5 (4.2)	0.565
Underlying medical conditions	57 (19.3%)	21 (16.8%)	36 (15.1%)	0.34
Chronic lung disease or asthma	23 (7.8%)	9 (7.2%)	14 (8.2%)	0.91
Diabetes Mellitus	12 (4%)	4 (3.2%)	8 (4.7%)	0.56
Cardiovascular	9 (3%)	4 (3.2%)	5 (2.9%)	0.98
Obesity (BMI ≥ 40)	15 (5%)	6 (4.8%)	8 (4.7%)	0.73
Age > 60 years	7 (2.3%)	1 (0.8%)	6 (3.5%)	0.24
Professional category	163 (55.3%)	69 (55.2%)	94 (55.2%)	0.32
Medical team		48 (38.4%)	57 (33.5%)	
Nursing team	105 (35.6%)	8 (6.4)	19 (10.7%)	
Other	27 (9.2%)			
Medical Specialists	56 (34.3%)	25 (36.2%)	31 (32.9%)	0.7
General Practice	38 (23.3%)	15 (21.7%)	23 (24.5%)	0.69
Pediatrics	23 (14.1%)	10 (14.4%)	13 (13.8%)	0.91
Surgery	13 (7.9%)	7 (10.1%)	6 (6.4%)	0.39
Otorhinolaryngology	9 (5.5%)	4 (5.7%)	5 (5.3%)	1
Gynecology and Obstetrics				
Close contact with confirmed COVID-19	218 (73.9%)	91 (72.8%)	127 (74%)	0.79
Total	295	125	170	

The most frequent symptoms reported among HCWs who tested positive and negative for SARS-CoV-2, respectively, were headache (92.8% and 90.5%. p = 0.5), nasal congestion (88.8% and 87%. P = 0.76), cough

(85.6% and 85%. P = 0.94), fatigue (89.6% and 81.7%. p = 0.06) and myalgia (84% and 78.2%. p = 0.21).

Among the symptoms reported by the HCWs, bivariate analysis with qualitative variables found fever (p = 0.042), anosmia (p < 0.01) and shortness of breath (p = 0.047) associated with positivity for SARS-CoV-2 infection (Table 2).

Table 2

Association of Symptoms with SARS-CoV-2 positivity among symptomatic HCWs in Sao Paulo. (N = 295)

N (%)	All HCWs	SARS-COV-2 Positive	SARS-COV-2 Negative	P value
	295	125	170	
	(100)	(42.37)	(57.63)	
Symptoms				
Headache	260 (88.1%)	111 (88.8%)	149 (87%)	0.76
Nasal congestion	252 (85.4%)	107 (85.6%)	145 (85%)	0.94
Cough	251 (85%)	112 (89.6%)	139 (81.7%)	0.06
Fatigue	238 (80.6%)	105 (84%)	133 (78.2%)	0.21
Myalgia	230 (77.9%)	96 (76.8%)	134 (78.8%)	0.67
Sore throat	224 (75.9%)	101 (80.8%)	123 (72.3%)	0.09
Chills	194 (65.7%)	90 (72%)	104 (61.1%)	0.053
Ocular pain	208 (70.5%)	96 (76.8%)	112 (65.8%)	0.042
Fever	173 (58.6%)	81 (64.8%)	92 (54.1%)	0.066
Arthralgia	165 (55.9%)	69 (55.2%)	96 (56.4%)	0.82
Diarrhea	151 (51.1%)	68 (54.4%)	83 (48.8%)	0.3
Abdominal pain	143 (48.4%)	69 (53.6%)	74 (44.1%)	0.047
Shortness of breath	126 (42%)	58 (46.4%)	68 (40%)	0.272
Cutaneous rash	50 (16.9%)	35 (28%)	15 (8.8%)	0.001
Anosmia				
Total	295	125	170	

After multivariate analysis, using logistic regression, anosmia (OR 4.4 95% C.I. 2.21–8.74) and ocular pain (OR 1.95 C.I. 95% 1.14–3.33) were associated with positivity for SARS-CoV-2 infection.

Among the 125 HCWs that tested positive for SARS-CoV-2 infection, follow-up information on clinical outcomes showed that 9 (7.2%) were hospitalized (seven were male) and 2 (1.6%) died. Although none of the 9 hospitalized COVID-19 HCWs were aged > 60 years, their median age (41.8 y) was higher than the median

age of the COVID-19 HCWs that were not hospitalized (34.2 y). The first death was a 37-year old male, with a BMI \geq 40. The second death was a 38-year old male with BMI $>$ 40, hypertension and severe asthma (Table 3).

Table 3
Hospitalizations and deaths, by age group among health care workers with COVID-19 – São Paulo, 2020.

Age group (number of cases)	Hospitalization Number (%)	Death Number (%)
< 40 y (81)	3 (3.7)	2 (2.4)
40–60 y (37)	6 (16.2)	0
> 60 y (7)	0	0
Total (125)	9 (7.2)	2 (1.6)

Discussion

Our results, showing a high prevalence of SARS-CoV-2 infection among HCWs, are in line with previous data that demonstrated that HCWs have higher susceptibility to respiratory infections. These findings were also observed in other zoonotic coronavirus outbreaks (SARS and MERS), when a substantial proportion of the infected population were HCWs⁹. They are repeatedly exposed to COVID-19 patients, particularly those working on frontline, where certain procedures (intubation, contact with secretions, aerosol-generating procedures) increase the risk of infection, highlighting the importance of using the recommended personal protective equipment (PPE) measures¹⁰. However, household and community transmission are also relevant, particularly during the period of the study, when an intense activity of community transmission was occurring in São Paulo.

The rates of hospitalization among HCWs with COVID-19 (7.2%), as well as case fatality rates (1.6%) found in our study are similar to those reported in US among HCWs patients with data available on age and health outcomes (respectively 8% and 0.6%)¹¹. Interestingly, these rates are lower than those found in non-HCWs population with COVID-19 in Brazil¹², probably reflecting the younger median age of the HCWs of our hospital. Furthermore, it is likely that among HCWs the level of suspicion to the disease symptoms is higher, enabling them to an earlier diagnosis and treatment, which may improve COVID-19 outcomes, and identifying a higher proportion of mild cases. Similar to earlier findings¹³, our data also showed that male gender was associated with a higher risk of severe outcomes (78% of the HCWs that were hospitalized and both that died were men).

In the city of São Paulo, the current epicenter of the pandemic in Latin America, on June 14th, there were 98,000 confirmed cases of COVID-19, of which, 1,902 (1.94%) were HCWs, with 26 confirmed deaths (CFR of 1.3%), similar to the CFR found in our study¹⁴. Data from China showed that a total of 3,387 of 77,262 patients with COVID-19 (4.4%) were HCWs, with 23 deaths (CFR of 0.67%)¹⁵.

The sustained high weekly prevalence rates of SARS-CoV-2 infection among symptomatic HCWs observed in our study (from 22.3–55.9%), when compared to similar studies from Asia, Europe and US^{11,16–18} is

concerning (Fig. 1). The majority of our cohort had a mild illness, which could potentially represent a risk of continued routine of working throughout the illness, facilitating the transmission of the virus into the hospital to patients and other HCWs. These findings highlight the importance of having not only well-established guidance for all HCWs on the use of PPE, but also clear recommendations on sick leave policies for all HCWs with suspected COVID-19.

Limitations of this study include the single-hospital design and testing only symptomatic HCWs. This approach limited the possibility of a better understanding on the transmission dynamics as well as the true prevalence of SARS-CoV-2 infection among HCWs. However, to our knowledge this is the first report describing prevalence, clinical characteristics, and outcomes of SARS-CoV-2 infection among HCWs in Latin America.

One of the great challenges we faced in Brazil, and probably one of the reasons that contributed to the high burden of COVID-19 in the country, was the limited availability of virologic testing. Only suspected cases that were hospitalized could be tested for SARS-CoV-2 in the public health system. During the initial phase of the pandemic, even symptomatic HCWs were not able to be tested for the virus in our hospital as well as several others in the country. These limited testing clearly compromises the strategies to contain nosocomial transmission of the virus to inpatients and to other HCWs¹⁹. Expanding capacity of testing among HCWs, including not only symptomatic, but also asymptomatic (facilitating detection of those that are in the presymptomatic phase, when transmission is already occurring) is the logical strategy in places where budget-resource constraints are not present, particularly among groups like HCWs, susceptible to high exposure to infected patients. Recent data from a large UK teaching hospital demonstrated the value of a comprehensive screening, including asymptomatic and oligosymptomatic HCWs, emphasizing the importance of this expanded strategy for protecting patients and hospital staff²⁰.

COVID-19 has a wide spectrum of clinical manifestations ranging from asymptomatic illness to severe cases with multi-organ failure and death. Our study provides valuable information on symptoms in the early phase of COVID-19 among HCWs. Anosmia and ocular pain were symptoms independently associated with SARS-CoV-2 test positivity. In low and middle-income countries, where limited availability of tests is frequent, these findings may contribute to optimize a targeted symptom-oriented screening strategy.

Abbreviations

COVID-19

Coronavirus disease 2019

SARS-CoV-2

Severe acute respiratory syndrome coronavirus 2

SARS

Severe Acute Respiratory Syndrome

MERS

Middle East Respiratory Syndrome

RT-PCR

Real time reverse transcriptase–polymerase chain reaction

HCWs

Healthcare workers

PPE

personal protective equipment

SCSP

Santa Casa de São Paulo Hospital

LVCM

Laboratory of Clinical and Molecular Virology

BMI

Body Mass Index

SD

Standard Deviation

Declarations

Ethics approval and consent to participate

Study approval was given by the Ethics Committee of Santa Casa de São Paulo and written informed consent was obtained from all participants.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

These patients have not been reported in any other submission by the authors.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

MAPS and FJA contributed to study conception and design, data analysis and interpretation. BNMP, CPB, SFM, COM, GGG and MVVM carried out the data collection. DBO, ELD, FBL and BLT performed the laboratory evaluation. BNMP and CPB drafted the manuscript. MAPS and FJA revised the manuscript. All authors read and approved the final manuscript.

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21. files
Additional files.
22. Questionnaire_1. SARS-CoV-2 prevalence study. Data on demographical and epidemiological information.
23. Followup-Questionnaire. Follow-Up for HCWs who tested Positive for SARS-CoV-2. Questionnaire to be completed after 15 days since the onset of symptoms, with information on symptoms and duration,

including interventions.

Figures

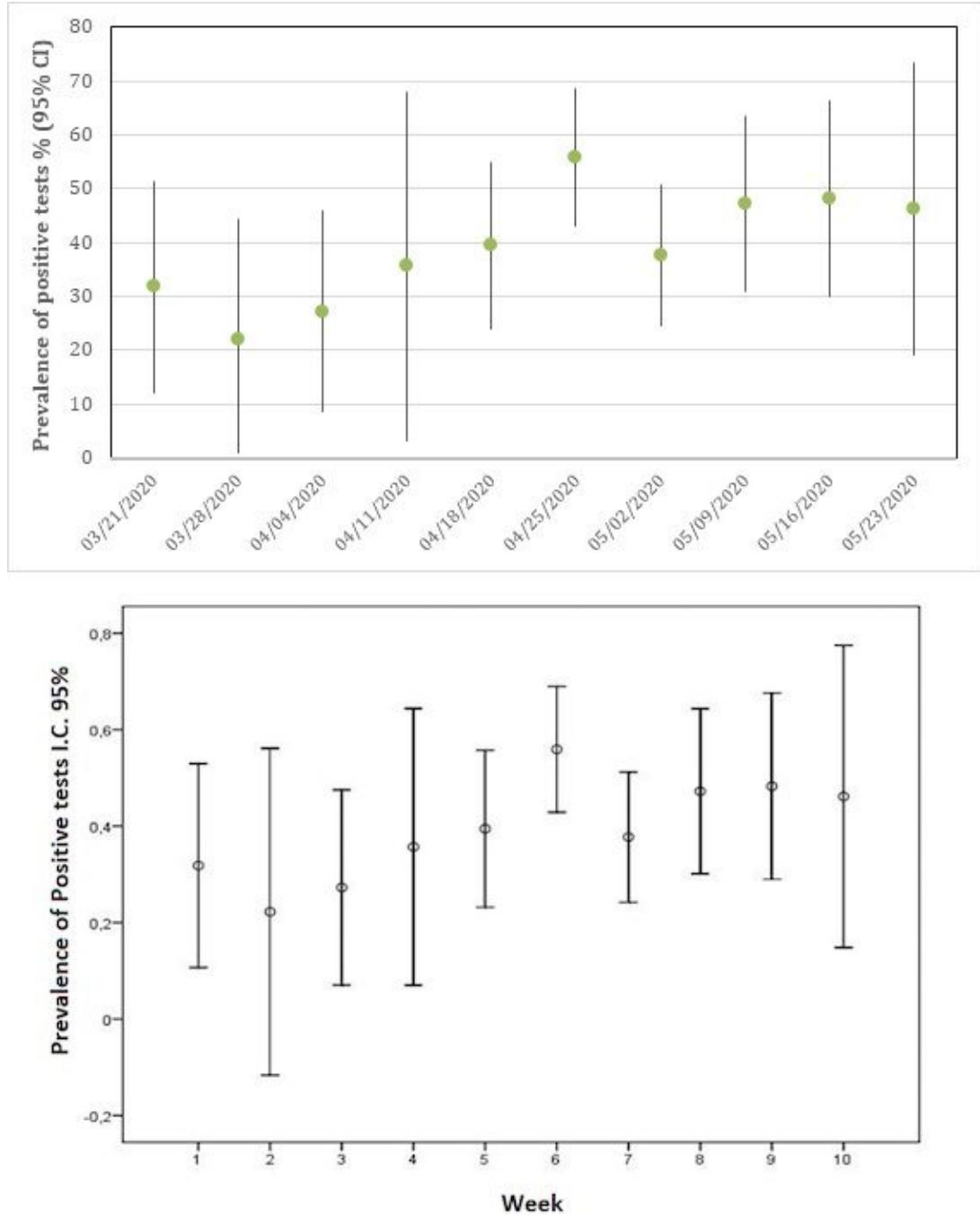


Figure 1

Weekly positivity rate (95% CI) of SARS-CoV-2 test results among symptomatic HCWs during the study period in Sao Paulo (N=295).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [FollowupQUESTIONNAIRE.docx](#)
- [Questionnaire1.docx](#)