

SARS-CoV-2 seroprevalence in healthcare workers: The experience of a Portuguese COVID-19 front-line hospital during the 1st pandemic wave

Angélica Ramos^{a,b,*}, Beatriz Araújo^a, Luísa Lacerda^a, Ana Lúcia Flora^a, Luís Ribeiro^a, Emília Patrício^a, Maria João Cardoso^a, João Tiago Guimarães^{a,b,c}

Abstract

Background: Healthcare workers (HCW) are at increased risk of SARS-CoV-2 infection. Here, we describe the SARS-CoV-2 seroprevalence in HCW who work daily at a COVID-19 front-line hospital in Portugal.

Methods: To this end, the seroprevalence of 1027 HCW, assessed after the peak of the first pandemic wave, was determined using the following immunoassays: Euroimmun Anti-SARS-CoV-2 ELISA IgG (Euroimmun, Luebeck, Germany), Abbott SARS-CoV-2 IgG (Abbott Laboratories, Chicago), and Elecsys Anti-SARS-CoV-2 Total (Roche Diagnostics, Basel, Switzerland).

Results: We found a 2.7% seroprevalence, very close to the one determined in the community (2.9%) for the same period.

Conclusions: This low SARS-CoV-2 seroprevalence highlights the effectiveness of infection prevention and control measures implemented very early in the pandemic, namely the use of appropriate personal protective equipment.

Keywords: SARS-CoV-2, seroprevalence, healthcare workers

Introduction

Healthcare workers (HCW) are at an increased risk of SARS-CoV-2 infection. Several scientific reports, including one that assesses 2055 HCW distributed by 476 Chinese hospitals infected early in the pandemic, came to call attention to this problem.¹⁻⁵ In a letter to the editor, J Wang and colleagues list a set of reasons that explain this increased risk. Among these reasons are (i) the inadequate personal protection at the beginning of the epidemic; (ii) the long-time exposure to large numbers of infected patients as well as the pressure of treatment, work intensity, and lack of rest; (iii) the shortage of personal protective equipment (PPE), and (iv) the inadequate training on infection prevention and control for front-line HCW (except in case of infectious disease doctors).⁴

The Portuguese Health Authority reported 54,234 cases and 1779 deaths as of July 13, 2020. The Centro Hospitalar Universitário de São João (CHUSJ), a hospital in the north of Portugal which covers around 3.7M residents and with about 6000 HCW working daily, was designated as a COVID-19 front-line hospital.

SARS-CoV-2 serological surveys are the best tool to determine the spread of the disease and access who, when, and for how long produces antibodies. Thus, through a prospective study after the peak of infection in Portugal, we determined the SARS-CoV-2 seroprevalence in a set of HCW from different CHUSJ departments, with different degrees of SARS-CoV-2 infection risk.

Material and methods

From April 9 to May 30 of 2020, SARS-CoV-2 seroprevalence of CHUSJ professionals was evaluated. To this end, 1027 HCW were tested for the presence of anti-SARS-CoV-2 antibodies. Among these professionals, 720 were women and 307 men, with an average age of 40 and 33 years-old, respectively. The studied population was distributed by the following hospital departments: Emergency, Infectious Disease, Intensive Care, Clinical Pathology, Surgery, Ophthalmology, and Nephrology. Detection of anti-SARS-CoV-2 antibodies was performed using the following immunoassays: Euroimmun Anti-SARS-CoV-2 ELISA IgG (Euroimmun, Luebeck, Germany) (n=519); Abbott SARS-CoV-2 IgG (Abbott Laboratories, Chicago, Illinois, EUA) (n=455), and Elecsys Anti-SARS-CoV-2 Total (Roche Diagnostics, Basel, Switzerland) (n=53). The BioPlex 2200 SARS-CoV-2 IgG Panel (BIO-RAD, Hercules, California, USA) was used as an alternative immunoassay for positive results confirmation. All tests were performed according to the manufacturer's instructions.

^a Serviço de Patologia Clínica, Centro Hospitalar e Universitário de São João, Porto, Portugal, ^b EPIUnit – Instituto de Saúde Pública, Universidade do Porto, Portugal, ^c Departamento de Biomedicina, Faculdade de Medicina, Universidade do Porto, Portugal.

* Corresponding author. Serviço de Patologia Clínica, Centro Hospitalar e Universitário de São João, Alameda Professor Hernâni Monteiro, 4200-319 Porto, Portugal. E-mail address: angelicacostamos@gmail.com; angelica.ramos@chsj.min-saude.pt (Angélica Ramos)

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EUROIMMUN Anti-SARS-CoV-2 ELISA IgG

The EUROIMMUN Anti-SARS-CoV-2 ELISA IgG (Euroimmun, Luebeck, Germany) is an enzyme-linked immunosorbent assay that provides semi-quantitative in vitro determination of human IgG against recombinant S1 domain of the SARS-CoV-2 spike protein. Results are evaluated semi-quantitatively by calculation of a ratio of the extinction of the control or patient sample over the extinction of the calibrator. This ratio is interpreted as follows: <0.8 negative, ≥0.8 to <1.1 borderline, and ≥1.1 positive.

Abbott SARS-CoV-2 IgG

The Abbott SARS-CoV-2 IgG assay (Abbott Laboratories, Chicago, Illinois, USA) is a chemiluminescent immunoassay for the qualitative detection of human IgG against the nucleocapsid protein of SARS-CoV-2. A signal/cutoff (S/CO) ratio of ≥1.4 was interpreted as reactive and a S/CO ratio of <1.4 was interpreted as non-reactive.

Elecsys Anti-SARS-CoV-2 Total

The Elecsys Anti-SARS-CoV-2 Total: The Elecsys Anti-SARS-CoV-2 Total assay (Roche Diagnostics, Basel, Switzerland) is an electrochemiluminescence immunoassay for the qualitative detection of total immunoglobulins against the nucleocapsid protein of SARS-CoV-2. Results are reported as numeric values in form of a cutoff index (COI; signal S/CO) as well as in form of qualitative result non-reactive (COI < 1.0; negative) and reactive (COI ≥ 1.0; positive).

This study was approved by the ethics committee of the CHUSJ.

BioPlex 2200 SARS-CoV-2 IgG Panel

The BioPlex 2200 SARS-CoV-2 IgG Panel (BIO-RAD, Hercules, California, USA) is a multiplex immunoassay for the qualitative detection and semi-quantitative differentiation of IgG class antibodies against the following targeted viral antigen: receptor-binding domain of SARS-CoV-2 spike protein, S1 domain of the SARS-CoV-2 spike protein, S2 domain of the SARS-CoV-2 spike protein and nucleocapsid (N) protein of SARS-CoV-2. SARS-CoV-2 IgG assay results are expressed as U/mL and as negative or positive. Results of <10 U/mL are reported as negative and results of ≥10 U/mL are reported as positive. The measuring range for the assays is 1–100 U/mL. Results outside of this range are reported as either <1 or >100 U/mL.

Results

In a group of 1027 HCW, about 1/6 of the total number of professionals who work daily at CHUSJ, a seroprevalence of 2.7% was found (28/1027). All positive samples were confirmed by an alternative immunoassay to exclude false-positive results. Among the positive participants, 15 were women and 13 men, with an average age of 45 and 44 years, respectively. Four of them work daily in emergency, 15 in the wards, 3 in the intensive care units, and 6 in other support services. Nineteen of these participants had a previous positive SARS-CoV-2 RT-PCR, 7 a negative SARS-CoV-2 RT-PCR, and 2 did not perform any molecular screening for the presence of viral SARS-CoV-2 RNA. Fourteen of these results were found by the Euroimmun Anti-SARS-CoV-2 ELISA IgG assay, 13 by the Abbott SARS-CoV-2 IgG test, and 1 by the Elecsys Anti-SARS-CoV-2 immunoassay. In

Table 1

Characterization of SARS-CoV-2 seropositive healthcare workers.

HCW	Gender	Age	Category	RT-PCR	Link	Symptoms
1	M	24	Nurse	–	Unknown	+
2	F	36	Nurse	–	Hospital	+
3	M	44	Medical doctor	–	Relatives	+
4	M	37	Nurse	–	Hospital	+
5	F	55	Nurse	Unknown	Hospital	–
6	F	50	Nurse	–	Hospital	–
7	F	37	Nurse	+	Hospital	+
8	M	50	Nurse	+	Hospital	+
9	F	36	Nurse	+	Hospital	Unknown
10	M	53	Support staff	+	Hospital	Unknown
11	F	53	Nurse	+	Hospital	+
12	M	66	Medical doctor	+	Hospital	+
13	M	51	Support staff	+	Hospital	Unknown
14	M	67	Support staff	+	Unknown	+
15	F	43	Nurse	+	Hospital	Unknown
16	M	63	Medical doctor	+	Hospital	Unknown
17	F	60	Medical doctor	+	Hospital	+
18	M	58	Nurse	–	Hospital	Unknown
19	M	45	Medical doctor	+	Hospital	+
20	F	36	Nurse	+	Relatives	Unknown
21	F	32	Nurse	+	Relatives	+
22	F	26	Medical doctor	+	Hospital	+
23	M	26	Medical doctor	+	Relatives	+
24	F	33	Nurse	–	Hospital	+
25	F	28	Nurse	+	Unknown	Unknown
26	M	73	Support staff	+	Unknown	Unknown
27	F	41	Support staff	Unknown	Unknown	Unknown
28	F	68	Support staff	+	Unknown	Unknown

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Table 1, we show the participant's characterization regarding epidemiological link, professional category, RT-PCR results, and symptoms.

Discussion

Through 3 automated immunoassays previously validated in our lab (data not shown), we determined a 2.7% SARS-CoV-2 seroprevalence in 1027 HCW who work daily at CHUSJ, a COVID-19 front-line hospital in Portugal.

When compared to a set of studies that, after the first ones from China,^{1,3} were carried out on Europe and USA hospitals, we found a lower seroprevalence among CHUSJ healthcare workers. Plebani et al describe a 4.6% seroprevalence in HCW of the Veneto Region.⁶ The SARS-CoV-2 antibody screening in 281 HCW in a tertiary center in North West England, found a 6% seroprevalence.⁷ Another study, conducted in 3056 HCW from a tertiary center in Belgium, revealed a similar seroprevalence (6.4%).⁸ Moscola et al reported a 13.7% seroprevalence in 40,329 HCW from the New York City area.⁹ Additionally, in a systematic review and meta-analysis, including 49 studies and 127,480 HCW, Galanis et al reported a seroprevalence of 12.7%, 8.5%, 8.2%, and 4% in HCW from North America, Europe, Africa, and Asia, respectively.¹⁰

However, there are some other studies that describe HCW seroprevalence values similar to the one we found in CHUSJ. Namely, in HCW from hospitals in Greece, California, Germany, and Saudi Arabia, the SARS-CoV-2 seroprevalence ranged between 1.26% and 2.36%.¹¹⁻¹⁴

Although the number of positive HCW is small to draw definitive conclusions, we can see here the importance of serological tests to increase the COVID-19 molecular diagnosis, since some of these cases were previously RT-PCR negative, as well as the importance of tracking asymptomatic infections.

Although the HCW are exposed to an increased risk of infection, we believe that this low seroprevalence found can be explained by the infection prevention and control measures implemented to the whole CHUSJ at a very early stage of the pandemic, some of those anticipating what would later become national guidelines. Namely, mandatory use of mask, temperature control, cancellation of all non-urgent patient care appointments, teleworking for all suitable activities, prohibition of visitors, molecular screening for all pre-surgical and new inpatients, at-home treatment of COVID-19 asymptomatic patients, in-hospital cafeteria and restaurant operating only with takeaway services, and availability of new and larger areas for rest and meals with restricted capacity, ensuring social distance.

Additionally, SARS-CoV-2 seroprevalence found in CHUSJ HCW was practically the same described to the community (2.9%), according to the national serological survey conducted by the *Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA)* in July, 2020.¹⁵ Also consistent with this INSA study, which has a seroprevalence of 4.1% and 1.8% for men and women, respectively, we found a higher seroprevalence in men (4.2%) than women (2.1%).¹⁵ The low viral transmission in the community, most likely related to the lockdown process between March 18 and May 2, 2020, may also contribute to the low SARS-CoV-2 seroprevalence found in our HCW.

This study provides useful information since there are few data^{16,17} about the SARS-CoV-2 infection in HCW from Portugal. However, assessment of infection cases only through serological testing is a limitation of the study. The sensitivity of these immunoassays depends on the number of days since the

onset of symptoms and the clinical presentation of the disease. In addition, only 1/6 of the institution's health professionals were tested, which is another limitation of the study.

In conclusion, the burden of SARS-CoV-2 infection among HCW from a COVID-19 front-line hospital in Portugal at the end of the first pandemic wave is low, consistent with the low burden of seroprevalence in the country for the same time. The infection prevention and control measures implemented at a very early stage of the pandemic were effective in preventing patient-to-staff and staff-to-staff COVID-19 transmission. SARS-CoV-2 antibodies screening in HCW can help to monitor transmission dynamics, namely of asymptomatic infections, and to evaluate the implantation of infection control policies.

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Conflicts of interest

None.

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