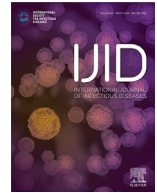




Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# Reduction in COVID-19 prevalence in healthcare workers in a university hospital in southern Brazil after the start of vaccination

Sheila de Castro Cardoso Toniasso<sup>a,\*</sup>, Fernando Schmidt Fernandes<sup>a</sup>, Dvora Joveleviths<sup>b</sup>, Fábio Fernandes Dantas Filho<sup>c</sup>, Anderson Yudi Takahasi<sup>d</sup>, Camila Pereira Baldin<sup>a</sup>, Robson Martins Pereira<sup>a</sup>, Luciana Pereira da Silva<sup>e</sup>, Maria Carlota Borba Brum<sup>a</sup>

<sup>a</sup> Physician, Occupational Medicine Service, Hospital de Clínicas de Porto Alegre, Ramiro Barcelos, Porto Alegre, Rio Grande do Sul 2350, Brazil

<sup>b</sup> Professor of Medicine, Federal University of Rio Grande do Sul, Ramiro Barcelos, Porto Alegre, Rio Grande do Sul 2350, Brazil

<sup>c</sup> Head of the Occupational Medicine Service, Hospital de Clínicas de Porto Alegre, Ramiro Barcelos, Porto Alegre, Rio Grande do Sul 2350, Brazil

<sup>d</sup> Resident, Medical Residency Program in Occupational Medicine, Hospital de Clínicas de Porto Alegre, Porto Alegre, Rio Grande do Sul, Brazil

<sup>e</sup> Nurse, Occupational Medicine Service, Hospital de Clínicas de Porto Alegre, Ramiro Barcelos, Porto Alegre, Rio Grande do Sul 2350, Brazil

## ARTICLE INFO

### Article history:

Received 16 May 2021

Revised 8 July 2021

Accepted 9 July 2021

### Keywords:

COVID-19

SARS-CoV-2

healthcare workers

vaccine

## ABSTRACT

**Introduction:** The quick spread of SARS-CoV-2 led to the development of vaccines that are capable of reducing infection and the number of more severe COVID-19 cases.

**Aim:** To assess COVID-19 prevalence among healthcare workers (HCWs) after vaccination against SARS-CoV-2.

**Methods:** This was a cross-sectional study on the prevalence of COVID-19 diagnosis among 7523 HCWs vaccinated against SARS-CoV-2 with CoronaVac and ChAdOx1 nCoV-19 in a university hospital, in southern Brazil, between January 18 and March 18, 2021. The variables evaluated were: sex, age, work area, role, source of infection, previous diagnosis of COVID-19, date of vaccine administration, type of vaccine, and need for hospitalization. The statistical analysis used Poisson regression and Fisher's exact test with SPSS software version 25, and a level of significance set at 5%.

**Results:** 813 vaccinated HCWs showed symptoms suggestive of COVID-19, of whom 35.4% (288) had a detectable result after undergoing RT-PCR for SARS-CoV-2. There was a reduction of 62% in new cases of COVID-19 among HCWs in the institution 7 weeks after the start of vaccine rollout. **Conclusion:** Our data suggest that the vaccines used by the institution reduced the number of COVID-19 cases among healthcare workers, demonstrating the effectiveness of the vaccines.

© 2021 The Authors. Published by Elsevier Ltd on behalf of International Society for Infectious Diseases. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

## Introduction

There is evidence that vaccines are able to reduce infection and the number of more severe cases of COVID-19 (Bradley et al., 2021; Keehner et al., 2021; Daniel et al., 2021; Benenson et al., 2021). The P1 variant of SARS-CoV-2 is refractory to multiple neutralizing monoclonal antibodies (Wang et al., 2021). This may lead to antigen alterations that impair vaccine protection, leading to a diagno-

sis of infection in individuals in whom vaccine efficacy has been demonstrated (Wang et al., 2021).

## Methods

A cross-sectional study on the prevalence of COVID-19 diagnosis was conducted among 7523 healthcare workers (HCWs) vaccinated against SARS-CoV-2 with CoronaVac inactivated virus vaccine and ChAdOx1 nCoV-19, using chimpanzee adenovirus as a viral vector for the expression of the SARS-CoV-2 spike protein, in a university hospital in southern Brazil. 4260 HCWs received CoronaVac (3676 with two doses and 584 with only one dose) and 3263 received one dose of ChAdOx1 nCoV-19 between January 18 and March 18, 2021. In total, 813 health professionals with symptoms suggestive

\* Corresponding author.

E-mail addresses: [stoniasso@hcpa.edu.br](mailto:stoniasso@hcpa.edu.br) (S.d.C.C. Toniasso), [fscfernandes@hcpa.edu.br](mailto:fscfernandes@hcpa.edu.br) (F.S. Fernandes), [djoveleviths@hcpa.edu.br](mailto:djoveleviths@hcpa.edu.br) (D. Joveleviths), [fffilho@hcpa.edu.br](mailto:fffilho@hcpa.edu.br) (F.F.D. Filho), [atakahasi@hcpa.edu.br](mailto:atakahasi@hcpa.edu.br) (A.Y. Takahasi), [cbaldin@hcpa.edu.br](mailto:cbaldin@hcpa.edu.br) (C.P. Baldin), [rompereira@hcpa.edu.br](mailto:rompereira@hcpa.edu.br) (R.M. Pereira), [lpesilva@hcpa.edu.br](mailto:lpesilva@hcpa.edu.br) (L.P. da Silva), [mccbrum@hcpa.edu.br](mailto:mccbrum@hcpa.edu.br) (M.C.B. Brum).

**Table 1**  
Demographic characteristics of vaccinated HCWs with symptoms suggestive of COVID-19 (N = 813)

Characteristics		RT-PCR result		PR	p-value	95% CI
		Negative N (%)	Positive N (%)			
		525 (64.6)	288 (35.4)			
Work area	Without patient assistance*	68 (63.6)	39 (36.4)	1		
	Non-COVID patient assistance**	316 (65.6)	166 (34.4)	0.94	0.690	0.71–1.25
Role	COVID patient assistance***	141 (62.9)	83 (37.1)	1.02	0.915	0.75–1.38
	Other health professional****	41 (78.8)	11 (21.2)	1		
	Physician	61 (50.4)	60 (49.6)	2.34	< 0.05	1.35–4.08
	Nurse	261 (66.4)	132 (33.6)	1.59	0.095	0.92–2.73
	Care support	114 (68.3)	53 (31.7)	1.50	0.163	0.85–2.65
Origin of contact	Administration	48 (60)	32 (40)	1.89	< 0.05	1.05–3.41
	No identifiable contact	272 (69)	122 (31)	1		
	External case	21 (63.6)	12 (36.4)	1.17	0.507	0.73–1.89
	Occupational suspicion	117 (65)	65 (35)	1.13	0.332	0.88–1.45
COVID-19 confirmed in the past	Family	115 (55.8)	91 (44.2)	1.43	< 0.05	1.15–1.77
	No	441 (61.5)	276 (38.5)	1		
	Yes	84 (87.5)	12 (12.5)	0.32	< 0.05	0.19–0.56
Vaccine	Coronavac	306 (61.3)	193 (38.7)	1		
	ChAdOx1 nCov-19	219 (69.7)	95 (30.3)	0.78	< 0.05	0.64–0.96

\* Without patient assistance: jobs that do not require contact with patients (Baptista et al., 2021).

\*\* Non-COVID care: assistance to patients without a diagnosis of COVID-19.

\*\*\* COVID-19 care: assistance to patients diagnosed with COVID-19.

\*\*\*\* Other health professionals with higher education.

of COVID-19 performed an RT-PCR (reverse transcriptase reaction followed by a polymerase chain reaction) test for SARS-CoV-2, and had received at least one dose of the SARS-CoV-2 vaccine in the first 9 weeks of the vaccination roll-out.

The variables evaluated were: sex, age, work area, role, source of infection, previous diagnosis of COVID-19, date of vaccine administration, type of vaccine (ChAdOx1 nCoV-19 or CoronaVac), date and result of the RT-PCR assay for SARS-CoV-2, number of professionals diagnosed with COVID-19 after vaccination, need for hospitalization, and admission to the intensive care unit (ICU).

A prevalence ratio (PR) measure with 95% CI, estimated by Poisson regression analysis with robust variance adjustment, was used to verify the factors and the strengths of the associations with the PCR test result in the general sample, stratified by type of vaccine, while Fisher's exact test was used to assess the association of the vaccine with hospitalization and ICU outcomes among the COVID-19 patients. Analyses were performed using the SPSS software version 25, and the level of significance was set at 5%.

The study was approved by the institutional Research Ethics Committee (No. 3080132400005327), and financial support was provided by the Research Incentive Fund (FIPE) of Hospital de Clínicas de Porto Alegre.

## Results

The 20–40 and 41–60 years age groups were represented similarly in our sample, accounting for 48% and 48.6%, respectively, of the total HCWs evaluated. 81.7% of the 813 evaluated HCWs were females, and 35.4% (288) of those who underwent RT-PCR for SARS-CoV-2 showed a detectable result (Table 1).

The ChAdOx1 nCoV-19 vaccine decreased the prevalence of infection by 22% (PR: 0.78, 95% CI: 0.64–0.96). Regardless of the type of vaccine, after the first dose, the prevalence of infection decreased by 7% each week (PR: 0.93, 95% CI: 0.89–0.97). A previous diagnosis of COVID-19 reduced the prevalence of new infections by 68% (PR: 0.32, 95% CI: 0.19–0.56).

Among the 314 suspected cases who had received the ChAdOx1 nCoV-19 vaccine, a positive diagnosis for COVID-19 was observed in 30.3%. An important finding was that a previous diagnosis of COVID-19 at least 45 days earlier reduced the prevalence by 71%

(PR: 0.29, 95% CI: 0.11–0.75) among these HCWs. When only HCWs who had received one dose of ChAdOx1 nCoV-19 were considered, prevalence was reduced by 10% each week after vaccination (PR: 0.90, 95% CI: 0.84–0.96) (Table 2).

Among the 399 suspected cases who had received the CoronaVac vaccine, a positive diagnosis for COVID-19 was observed in 38.7%. Physicians showed a 2.25-fold increased prevalence for a positive diagnosis of COVID-19 compared with other HCWs with a higher education (PR: 2.25, 95% CI: 1.08–4.69). A previous diagnosis of COVID-19 reduced prevalence by 65% (PR: 0.35, 95% CI: 0.18–0.67) (Table 2).

A hospitalization outcome was observed in 14 of the 288 COVID-19 patients. However, no cases with positive RT-PCR died after the administration of both vaccines during the period under study.

## Discussion

Our data suggest that, after the first dose, the prevalence of infection decreased every week, regardless of the type of vaccine. Within our population, ChAdOx1 nCoV-19 seemed to provide better protection in relation to COVID-19, and further studies are needed to identify the cause of this difference.

The higher prevalence among physicians, identified in our population, may be associated with the prevalence of double working hours, with different levels of exposure and protection against COVID-19.

The different levels of protection against COVID-19, such as the use of personal protective equipment, may be associated with a lower prevalence of positive cases in the occupational environment when compared with other environments. However, more studies are needed in this area.

The presence of a previous diagnosis of COVID-19 was a protective factor against new SARS-CoV-2 infections. In agreement with our data, studies carried out in Denmark and Qatar indicated that the presence of a previous diagnosis of COVID-19 infection can provide protection against a new infection of up to 78.8% and 95%, respectively (Hansen et al., 2021; Abu-Raddad et al., 2021).

Our data are also in agreement with those of a study conducted in Israel in evidencing a decline in cases of COVID-19 and in se-

**Table 2**

Factors associated with the diagnosis of COVID-19 – vaccinated with CoronaVac and ChAdOx1 nCov-19

Characteristics		RT-PCR result		ChAdOx1 nCov-19			RT-PCR result		CoronaVac		
		Negative	Positive	PR	p-value	95% CI	Negative	Positive	PR	p-value	95% CI
		N (%)	N (%)				N (%)	N (%)			
		219 (70)	95 (30)				306 (61)	193 (39)			
Work area	Without patient assistance*	33 (66)	39 (36.4)	1			35 (61.4)	22 (38.6)	1		
	Non-COVID patient assistance**	23 (63.9)	13 (36.1)	0.84	0.430	(0.54–1.9)	153 (60.2)	70 (37.2)	0.96	0.871	0.72–1.48
	COVID patient assistance***	163 (71.5)	65 (28.5)	1.06	0.839	(0.59–1.3)	118 (62.8)	101 (39.8)	1.03	0.852	0.66–1.41
Role	Other health professional****	20 (80)	5 (20)	1			21 (77.8)	6 (22.2)	1		
	Physician	15 (51.6)	15 (48.4)	2.42	< 0.05	(1.02–5.74)	45 (50)	45 (50)	2.25	< 0.05	1.08–4.69
	Nurse	101 (73.2)	37 (26.8)	1.34	0.489	(0.58–3.08)	160 (62.7)	95 (37.3)	1.68	0.162	0.81–3.46
Origin of contact	Care support	61 (71.8)	24 (28.2)	1.41	0.429	(0.60–3.32)	53 (64.6)	29 (35.4)	1.59	0.233	0.74–3.42
	Administration	21 (60)	14 (40)	2.00	0.124	(0.83–4.84)	27 (60)	18 (40)	1.8	0.145	0.82–3.97
	No identifiable contact	123 (45)	41 (25)	1			149 (64.8)	81 (35.2)	1		
COVID-19 confirmed in the past	External case	7 (70)	3 (30)	1.2	0.716	(0.45–3.21)	14 (60.9)	9 (39.1)	1.11	0.702	0.65–1.9
	Occupational suspicion	40 (74.01)	14 (25.9)	1.04	0.892	(0.61–1.75)	77 (61.1)	49 (38.9)	1.10	0.488	0.83–1.46
	Family	49 (57)	37 (43)	1.72	< 0.05	(1.2–2.47)	66 (55)	54 (45)	1.28	0.069	0.98–1.66
	No	182 (66.7)	91 (33.3)	1			259 (58.3)	185 (41.7)	1		
	Yes	37 (90.02)	4 (9.8)	0.29	< 0.05	(0.11–0.75)	47 (85.5)	8 (14.5)	0.35	< 0.05	0.18–0.67

\* Without patient assistance: jobs that do not require contact with patients.

\*\* Non-COVID patient assistance: assistance to patients without a diagnosis of COVID-19.

\*\*\* COVID patient assistance: assistance to patients diagnosed with COVID-19.

\*\*\*\* Other health professionals with higher education.

vere forms of the disease following the start of vaccine rollout (Rossman et al., 2021).

## Conclusion

Our data suggest that the vaccines used by the institution reduced the number of COVID-19 cases among HCWs, and protected against severe forms of the disease.

Analysis of the cases with SARS-CoV-2-positive RT-PCR showed that there was a possibility of infection after the administration of a COVID-19 vaccine. Further studies are needed to confirm this in the medium and long term, taking into account the types of virus in circulation in the country, and also the types of vaccine administered.

## Declaration of Competing Interest

The researchers declare that they have no conflicts of interest.

## References

- Abu-Raddad LJ, Chemaitelly H, Coyle P, Malek JA, Ahmed AA, Mohamoud YA, et al. SARS-CoV-2 antibody-positivity protects against reinfection for at least seven months with 95% efficacy. *EClinicalMedicine* 2021;35.

- Baptista MC, Burton WN, Pawlowski B, Pransky G. A physician's guide for workers' return to work during COVID-19 pandemic. *J Occup Environ Med* 2021;63(3):199–220.
- Benenson S, Oster Y, Cohen MJ, Nir-Paz R. BNT162b2 mRNA COVID-19 vaccine effectiveness among health care workers. *N Engl J Med* 2021;384(18):1775–7.
- Bradley T, Grundberg E, Selvarangan R, LeMaster C, Fraley E, Banerjee D, et al. Antibody responses after a single dose of SARS-CoV-2 mRNA vaccine [published online March 23, 2021]. *N Engl J Med* 2021. doi:10.1056/NEJMc2102051.
- Daniel W, Nivet M, Warner J, Podolsky DK. Early evidence of the effect of SARS-CoV-2 vaccine at one medical center [published online, March 23, 2021]. *N Engl J Med* 2021. doi:10.1056/NEJMc2102153.
- Hansen CH, Michlmayr D, Gubbels SM, Mølbak K, Ethelberg S. Assessment of protection against reinfection with SARS-CoV-2 among 4 million PCR-tested individuals in Denmark in 2020: a population-level observational study. *Lancet* 2021;397(10280):1204–12.
- Keehner J, Horton LE, Pfeffer MA, Longhurst CA, Schooley RT, Currier JS, Abeles SR, Torriani FJ. SARS-CoV-2 infection after vaccination in health care workers in California. *N Engl J Med* 2021;384(18):1774–5.
- Rossman H, Shilo S, Meir T, Gorfine M, Shalit U, Segal E. COVID-19 dynamics after a national immunization program in Israel [published online, April 19, 2021]. *Nat Med* 2021. doi:10.1038/s41591-021-01337-2.
- Wang P, Casner RG, Nair MS, Wang M, Yu J, Cerutti G, et al. Increased resistance of SARS-CoV-2 variant P.1 to antibody neutralization. *Cell Host Microbe* 2021 S1931–3128(21)00183–89.