Original Research
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SARS-CoV-2 infection among Brazilian dentists: a seroprevalence study

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Abstract: This cross-sectional study aimed to determine the seroprevalence of SARS-CoV-2 infection among Brazilian dentists and its associated factors. Stratified random sampling of dentists from 33 administrative regions of the Federal District (Brazil) was performed. The presence of antibodies was verified by the OnSite COVID-19 IgG/IgM Rapid Test. Participants answered a survey about sociodemographic characteristics, exposure to COVID-19, and professional practice. A chi-square test was performed between serostatus and exposure variables. Mann-Whitney tests were carried out for quantitative variables. Odds ratio (OR) and 95% confidence intervals (95%CI) were calculated. A series of binomial logistic regression models was performed. The seroprevalence of SARS-CoV-2 infection among 324 selected dentists was 19.1%. There was a statistically significant association between seropositivity and previous confirmed diagnosis of COVID-19, loss of taste or smell, diagnosis of COVID-19 in a household member, and treatment of a patient with fever. Dentists with a previous confirmed diagnosis of COVID-19 had 29.5 [12.7–68.4] higher odds to exhibit positive serology test results. Dentists with confirmed diagnosis of COVID-19 in a household member had 2.5 [1.1–5.3] times higher odds to exhibit positive serology test results. Professionals with loss of taste or smell in the last 15 days had 5.24 [1.1–24.1] times higher odds to exhibit positive serology test results, and, for those who had treated patients with fever, there were 2.99 [1.03–8.7] times higher odds to exhibit negative serology test results. There was a similar prevalence rate of infection among dentists and in the general population. Nevertheless, this finding applies to the epidemiological situation in 2020, before the development of vaccines and the emergence of SARS-CoV-2 Delta variant.

Keywords: SARS-CoV-2; COVID-19; COVID-19 Serological Testing; Cross-Sectional Studies.

Declaration of Interests: The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

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Introduction

On March 11, 2020, the World Health Organization (WHO) updated the status of the coronavirus outbreak from a 'public health emergency of international concern' to a pandemic.[1] The SARS-CoV-2 virus is responsible for the coronavirus disease 2019 (COVID-19) and integrates a large family of viruses that contains a single RNA and attacks human cells by binding to angiotensin-converting enzyme receptors (ACE2), localized in the epithelium of the oral and nasal mucosae.[2]

Transmission of COVID-19 occurs through the contact of the oral, nasal, and ocular mucosae with droplets generated by sneezing, coughing, and speaking. Also, direct and indirect contact with the saliva *per se* may occur.[3,4] The aerosol generated during health procedures, especially dental interventions, may be an important source of transmission of several viruses, including SARS-CoV-2.[5] In fact, the COVID-19 pandemic has stirred up a global heated discussion about occupational hazards in dental practice. For instance, reinforcing biosafety measures, improving physical barriers, reducing aerosol production, monitoring patients' signs and symptoms associated with COVID-19, and testing patients and dental staff are now routine dental practice standards.[4]

There are two types of tests to identify the virus or specific antibodies.[6] The reverse transcription polymerase chain reaction (RT-PCR) technique identifies the virus by recognizing the presence of the viral RNA in the material collected from swabs of the nasal and oropharyngeal mucosae. RT-PCR is an expensive method that takes hours or even days to return the results; it also requires professionals with specialized knowledge to collect the sample and who are exposed to a high risk of infection.[6,7,8] Detection by RT-PCR is only possible from the third to the sixth day after contact with an infected individual.[6]

On the other hand, the antibody method uses a blood or saliva sample to determine the presence of IgM (2019-nCoV IgM) and IgG (2019-nCoV IgG).[6,8] Antibody testing is particularly applicable in epidemiological surveys and few reports have investigated antibodies against SARS-CoV-2 detection in saliva.[7,8] In general, most infected people have seroconversion between the seventh and eleventh day after exposure to the virus. However, the literature shows seroconversion also before this time window.[6] The 2019-nCoV IgM can be detected from three to five days after exposure to the virus; and while 2019-nCoV IgM level decreases, the 2019-nCoV IgG rapidly increases. For instance, the 2019-nCoV IgG titer may rise fourfold or higher during the recovery period when compared to the acute phase.[6]

Despite global evidence about occupational hazards regarding the transmission of COVID-19 among health professionals, there is still little information in the literature about the prevalence of SARS-CoV-2 seroconversion among dentists. This study hypothesized that 5% of dentists were positive for SARS-CoV-2, based on the prevalence observed for the general population in the Federal District in March 2020. Therefore, this study aimed to determine the seroprevalence of SARS-CoV-2 infection among dentists from the Federal District, Brazil.

Methodology

This cross-sectional study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines[9] and was performed in the Federal District - Brazil, from October to November 2020. The study was approved by the Human Research Ethics Committee of the School of Health Sciences at the University of Brasília (process no. 4.114.776; CAAE 33386820.2.0000.0030), and an informed consent was obtained from all participants.

Professionally active dentists registered with the Regional Council of Dentistry of the Federal District were randomly selected by a stratified sample from among 33 administrative regions. The Federal District (DF) is located in the Mid-West region of Brazil and it has 33 administrative regions, and an estimated population of 3,055,149 inhabitants. The capital of Brazil, Brasília, is located in the DF. There are 7,900 dentists registered with the Regional Council of Dentistry of the Federal District, and they were selected by a stratified random sample of each administrative region. A list with all dentists was organized according to the professional registration number of each dentist. Each dentist was then assigned a number (0 to 1) generated by the random function in Excel. The percentage of dentists in each administrative region was calculated using the information on address. These data were used for calculating the sample size of the final sample for each administrative region. The dentists were sorted in increasing order by administrative region using a randomly chosen number. After being sorted in increasing order, the dentists at the top of the list obtained for each administrative region were included in the sample, considering the number defined by the sample size calculation.

Sample size was calculated[10] considering a 5% seroprevalence rate, a 99% confidence interval, a 5% confidence limit, and a 2.3 design effect for stratified samples. The calculated sample comprised 286 out of the 7,900 dentists registered with the Regional Council of Dentistry of the Federal District. A percentage of 10% was added to the calculated sample size to make up for possible losses and, therefore, the final sample consisted of 314 dentists.

The order in which the dentists would be invited to take part in the sample was randomly selected from the list of dentists organized by administrative regions. In case of decline or withdrawal, the next dentist on the list was called up until the final sample size was achieved. This strategy was chosen to reduce selection bias.

Up to three phone calls were made to each participant. If the dentist agreed to participate, an electronic informed consent form and a self-administered questionnaire were sent by e-mail. The antibody identification test was then scheduled at one of the units of the Regional Council of Dentistry of the Federal District. If, for any reason, the participant missed the test, the test could be rescheduled once.

The electronic questionnaire was structured using Google Forms (Google Inc.). It comprised 24 questions, divided into three dimensions: 1. sociodemographic (SD) characteristics, 2. exposure to COVID-19 (EC), and 3. professional practice (PP).

Antibodies were identified by the OnSite COVID-19 IgG/IgM Rapid Test® (CTK, Biotech Inc, Poway, CA, USA), a single-use lateral flow immunoassay with 97.1% sensitivity and 97.8% specificity. The test detected the qualitative presence and differentiation of anti-SARS-CoV-2 IgG and IgM antibodies. A biomedical researcher performed the tests on the selected dentists according to the manufacturer's instructions.

The main outcome was seroprevalence of SARS-CoV-2, dichotomized into serostatus (positive or negative). Individuals presenting IgM, IgG, or IgG and IgM positive results were considered positive for SARS-CoV-2. Exposure, predictors, and potential confounders of serostatus were defined in the three dimensions: 1. SD: sex, age, place of residence, place of work, years of practice, educational level, ways of commuting to work, sector of professional practice, and main income source; 2. EC: self-reported confirmed diagnosis of COVID-19, type of diagnostic test, risk group to which the participant belonged, symptoms related to COVID-19 in the last 15 days, self-reported confirmed diagnosis of COVID-19 of a household member, and household member's symptoms related to COVID-19 in the last 15 days; 3. PP: reduction in working hours during the pandemic, treatment of patients with COVID-19, and treatment of patients with COVID-19 symptoms. Adjusted analyses were performed.

All statistical analyses were performed using Excel (Microsoft 365, Microsoft Corporation - Redmond, Washington, United States) and Statistical Package for Social Sciences 23.0 (International Business Machines Corporation - Armonk, NY, USA). Absolute and relative frequencies were calculated for the categorical variables, and, mean, standard deviation, median, range, and 25th and 75th quartiles were calculated for the quantitative variables.

The chi-square test of independence was performed for serostatus and exposure variables to identify any association and possible confounders and to decide which should be included in the regression model. Additionally, univariate binomial logistic regression was carried out. Associations with a p-value less than or equal to 0.20 were included. Cramer's V test was performed to estimate the strength of associations. Mann-Whitney tests were carried out for the quantitative variables. A series of binomial logistic regression models was performed using the hierarchical method and the forward stepwise method (likelihood ratio) to assess the sensivity of the models. The model was adjusted by performing the univariate regression with each of the variables, and the result was the same as for the chi-square test for independence; multivariate analysis by the stepwise forward method, and the best model was the one including only the two variables: "treatment of patient with fever" and "loss of taste or smell in the last 15 days"; multivariate analysis using the backward stepwise method, and the best model was the one with the same variables of the stepwise forward method. The analysis by administrative region was not performed because there was no difference in distribution across the regions.

The Hosmer-Lemeshow goodness-of-fit test, Casewise listing of residuals, and Nagelkerke's R squared were used to assess the adequacy of models, test for outliers, and explain variation, respectively. The 95%CI for OR was calculated, and no missing data were found when processing the binomial logistic regression models.

Results

In total, 1,169 dentists were contacted by phone and 324 were included in the study (Figure).

Descriptive data and the main characteristics of the sample are shown in Table 1. Among the sampled participants, 217 (67%) were female and the prevalence of seropositivity was 19.1% (n = 62) – 21 (6.5%) were IgG-positive; 12 (3.7%) IgM-positive; and 29 (9.0%) IgG- and IgM-positive. Ages ranged from 21 to 71 years (mean 40.2; SD 10.8) and years of dental practice ranged from 0 to 48 years (mean 15.8; SD 10.9). Most participants (n = 233, 71.9%) were specialists or attended residency in dentistry; 89.5% (n = 290) worked in the private sector and most of them (n=270; 83.3%) had the private sector as their main source of income.

Considering exposure to COVID-19, 48 (14.8%) dentists had a confirmed diagnosis while 77 (23.8%), had someone in their household with a confirmed diagnosis of COVID-19. Conventional PCR was the most widely used diagnostic test (n = 32, 9.9%) and the most frequent risk groups had high blood pressure (n = 23, 7.1%), asthma (n = 17, 5.2%), and smoking habits (n = 17, 5.2%). In the last 15 days, the most widely reported symptoms were headache (n = 54, 16.7%), fatigue (n = 42, 13.0%), and myalgia (n = 25, 7.7%).

About professional practice, 303 (93.5%) dentists mentioned they kept working during the pandemic; 73 (22.5%) did not reduce their working hours, 192

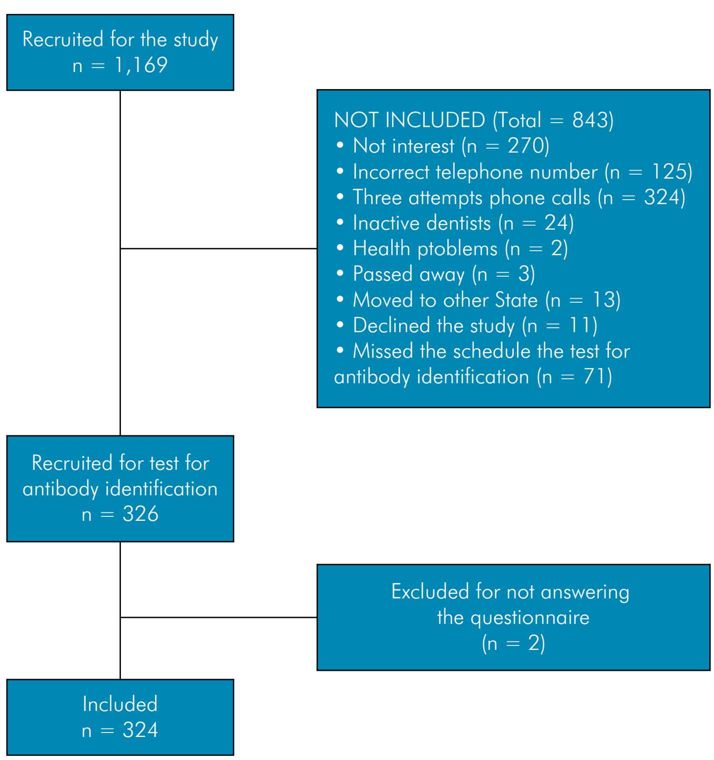

Figure. Flowchart showing the sample selection.

Table 1. Characteristics of study participants. Absolute (n) and relative (%) distribution.

Variable	n	%
Serology test results		
IgG	21	6.5
IgM	12	3.7
IgG/IgM	29	9.0
Negative	262	80.8
Sex		
Female	217	67.0
Male	107	33.0
Age (years)		
< 25	20	6.1
25–30	59	18.2
31–40	88	27.1
41–50	92	28.4
51–60	58	17.9
> 60	7	2.1
Years of practice		
< 5	67	20.6
5–10	64	19.8
11–15	39	11.9
16–20	46	14.3
21–30	78	24.2
> 30	30	9.0
Educational level		
Graduate degree	56	17.3
Specialization or Residency	233	71.9
Master's degree	23	7.1
Doctoral degree	7	2.2
Post-doctoral degree	5	1.5
Ways of commuting to work		
On foot	10	3.1
App transportation	6	1.9
Own transport (car or motorcycle)	291	89.8
Public transportation (bus or subway)	15	4.6
None	2	0.6
Professional practice		
Private sector	290	89.5
Public sector	70	21.6
Main source of income		
Private sector	270	83.3
Public sector	54	16.6
Confirmed diagnosis of COVID-19		
No	276	85.2
Yes	48	14.8
Test used for diagnosis		
I was not diagnosed with COVID-19	276	85.2
Not sure	2	0.6
Conventional PCR	32	9.9

Continue

Continuation

Rapid PCR	5	1.5
Serological test	9	2.8
Risk groups		
Age over 60 years	9	2.8
Asthma	17	5.2
Diabetes	10	3.1
Smokers	17	5.2
High blood pressure	23	7.1
Heart diseases	6	1.9
Symptoms in the last 15 days		
Fatigue	42	13.0
Diarrhea	21	6.5
Headache	54	16.7
Myalgia	25	7.7
Dyspnea	8	2.5
Fever	4	1.2
Loss of taste or smell	7	2.2
Cough	21	6.5
Confirmed diagnosis of COVID-19 in household member		
No	247	76.2
Yes	77	23.8
Household member's symptoms in the last 15 days		
Fatigue	14	4.3
Diarrhea	16	4.9
Headache	38	11.7
Myalgia	11	3.4
Dyspnea	10	3.1
Fever	19	5.9
Loss of taste or smell	3	0.9
Cough	7	2.2
Reduction in working hours during the pandemic		
None	73	22.5
Away from work	21	6.5
Worked fewer hours	192	59.3
Worked on alternate days	38	11.7
Treatment of patient with COVID-19		
No	107	33.0
Yes	217	67.0
Patient's symptoms during treatment		
Fatigue	49	15.1
Diarrhea	22	6.8
Headache	75	23.1
Myalgia	29	9.0
Dyspnea	42	13.0
Fever	51	15.7
Loss of taste or smell	41	12.7
Cough	63	19.4
Patients with no signs or symptoms	188	58.0
Not performing patient care	30	9.3
Total	324	100.0

(59.3%) reduced their working hours partially, 38 (11.7%) worked on alternate days, and only 21 (6.5%) refrained from working. A total of 217 (66.97%) dentists reported having treated patients with presumable diagnosis of COVID-19, and the main symptoms were fatigue (n = 49, 15.1%), headache (n = 75, 23.1%), dyspnea (n = 42, 13.0%), fever (n = 51, 15.7%), loss of taste or smell (n = 41, 12.7%), and cough (n = 63, 19.4%).

Table 2 shows cross tabulation between serostatus and main variables. Most seropositive dentists (n = 62, 19.1%) were female (n = 40; 67%), working in the private sector (n = 53, 85.5%), with a mean age of 39 years (SD = 10).

There was no statistically significant association between serostatus and sex ($\chi^2(1) = 0.02$, $p = 0.89$), age ($U = 7696.5$, $z = -0.64$, $p = 0.52$), place of residence ($\chi^2(25) = 28.59$, $p = 0.28$), place of work ($\chi^2(25) = 27.46$, $p = 0.33$), years of practice ($U = 7872.0$, $z = -0.38$, $p = 0.71$), educational level ($\chi^2(4) = 1.98$, $p = 0.74$), ways of commuting to work ($\chi^2(4) = 3.37$, $p = 0.50$), professional practice in the private sector ($\chi^2(1) = 0.05$, $p = 0.82$), professional practice in the public sector ($\chi^2(1) = 0.04$, $p = 0.84$), main source of income ($\chi^2(1) = 0.26$, $p = 0.61$), risk groups ($\chi^2(1) = 1.94$, $p = 0.16$), symptoms in the last 15 days ($\chi^2(1) = 1.13$, $p = 0.29$), symptoms presented by a household member in the last 15 days ($\chi^2(1) = 2.07$, $p = 0.15$), reduction in working hours ($\chi^2(3) = 3.11$, $p = 0.38$), treatment of patient with COVID-19 ($\chi^2(1) = 0.21$, $p = 0.65$), and treatment of patient with COVID-19 symptoms ($\chi^2(2) = 2.53$, $p = 0.11$).

There was a statistically significant association between serostatus and confirmed diagnosis of COVID-19 ($\chi^2(1) = 131.23$, $p < 0.0005$), loss of taste or smell ($\chi^2(1) = 6.68$, $p = 0.010$), confirmed diagnosis of COVID-19 in a household member ($\chi^2(1) = 36.73$, $p < 0.0005$), and treatment of patient with fever ($\chi^2(1) = 4.99$, $p = 0.03$).

Two binomial logistic regression models were fitted to explain the effect in SARS-CoV-2 serology test results.

Table 3 shows the results of the binomial logistic regression with confirmed diagnosis of COVID-19 and confirmed diagnosis of COVID-19 in a household member. The logistic regression model was statistically significant ($\chi^2(2) = 108.98$, $p < 0.0005$). The model explained 45.8% (Nagelkerke's R^2) of the variance in serology test results and correctly classified 85.5% of the cases. Dentists with a confirmed diagnosis of COVID-19 had 29.52 (95%CI 12.740–68.405, $p < 0.0005$) times higher odds to exhibit positive serology than those without it. Dentists with a confirmed diagnosis of COVID-19 in a household member had 2.46 (95%CI 1.13–5.34, $p = 0.02$) times higher odds to exhibit positive serology than those without it.

Table 4 shows the results of the binomial logistic regression for dentists who presented loss of taste or smell and for those who had treated patients with fever. The logistic regression model was statistically significant ($\chi^2(2) = 10.33$, $p = 0.006$). The model explained 5.0% (Nagelkerke's R^2) of the variance in serology test results and correctly classified 81.2% of the cases. Those with loss of taste or smell in the last 15 days had 5.24 (95%CI 1.14–24.09, $p = 0.03$) times higher odds to exhibit positive serology than those without impairment of their sense of taste or smell. On the other hand, those who had treated patients with fever had 2.99 (95%CI 1.03–8.70, $p = 0.04$) times higher odds to exhibit negative serology.

Discussion

In our study, seroprevalence of SARS-CoV-2 infection was 19.1% among the dentists from the Federal District. We formulated the hypothesis according to the population's prevalence of seropositivity in the initial pandemic period. However, seroprevalence among the dentists was much higher than 5%, but it was similar to that observed for the general population of DF. The results of the present study were similar to those from a serological survey carried out by the State Health Department of the Federal District (SES-DF) for the general population in December 2020. In the SES-DF survey, a probabilistic sample of 1,077 residents was tested with the OnSite COVID-19 IgG/IgM Rapid Test®, and 17% presented positive results. Among the positive individuals, 82% were IgG+, 13% were IgM+, and 5% were both IgG+ and IgM+.[11]

Although there are around 500 studies published about SARS-CoV-2 seroprevalence, information about the frequency of dentists who have antibodies against

Table 2. Cross tabulation between serostatus and main variables.

Variable		SARS-CoV-2 Serostatus		Total	Pearson's chi-square			Cramer's V
		Negative	Positive		Valor	df	p-value*	Valor**
Gender								
Female	N	175	42	217	0.02	1	0.887	0.008
	%	80.60	19.40	100.00				
Male	N	87	20	107				
	%	81.30	18.70	100.00				
Total	N	262	62	324				
	%	80.90	19.10	100.00				
Education level								
Graduate	N	44	12	56	1.975	4	0.74	0.078
	%	78.60	21.40	100.00				
Specialization	N	187	46	233				
	%	80.30	19.70	100.00				
Master	N	21	2	23				
	%	91.30	8.70	100.00				
Doctor	N	6	1	7				
	%	85.70	14.30	100.00				
Post-doctoral	N	4	1	5				
	%	80.00	20.00	100.00				
Total	N	262	62	324				
	%	80.90	19.10	100.00				
Professional practice in private sector								
No	N	28	6	34	0.054	1	0.816	0.013
	%	82.40	17.60	100.00				
Yes	N	234	56	290				
	%	80.70	19.30	100.00				
Total	N	262	62	324				
	%	80.90	19.10	100.00				
Professional practice in public sector								
No	N	206	48	254	0.043	1	0.836	0.012
	%	81.10	18.90	100.00				
Yes	N	56	14	70				
	%	80.00	20.00	100.00				
Total	N	262	62	324				
	%	80.90	19.10	100.00				
Work in a primary health care unit								
No	N	245	55	300	1.685	1	0.194	0.072
	%	81.7	18.3	100.0				
Yes	N	17	7	24				
	%	70.8	29.2	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				

Continue

Continuation

Belongs to the group of asthmatics								
No	N	246	61	307	2.037	1	0.154	0.079
	%	80.1	19.9	100.0				
Yes	N	16	1	17				
	%	94.1	5.9	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Belongs to any risk group								
No	N	203	53	256	1.936	1	0.164	0.077
	%	79.3	20.7	100.0				
Yes	N	59	9	68				
	%	86.8	13.2	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Confirmed diagnosis of COVID-19								
No	N	252	24	276	131.227	1	0.000	0.636
	%	91.3	8.7	100.0				
Yes	N	10	38	48				
	%	20.8	79.2	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Presented fatigue								
No	N	232	50	282	2.776	1	0.096	0.093
	%	82.3	17.7	100.0				
Yes	N	30	12	42				
	%	71.4	28.6	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Presented dyspnea								
No	N	257	59	316	1.788	1	0.181	0.074
	%	81.3	18.7	100.0				
Yes	N	5	3	8				
	%	62.5	37.5	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Presented fever								
No	N	260	60	320	2.493	1	0.114	0.088
	%	81.3	18.8	100.0				
Yes	N	2	2	4				
	%	50.0	50.0	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				

Continue

Continuation

Presented loss of taste or smell								
No	N	259	58	317	6.679	1	0.010	0.144
	%	81.7	18.3	100.0				
Yes	N	3	4	7				
	%	42.9	57.1	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Confirmed diagnosis of COVID-19 in household								
No	N	218	29	247	36.729	1	0.000	0.337
	%	88.3	11.7	100.0				
Yes	N	44	33	77				
	%	57.1	42.9	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Household's symptoms myalgia								
No	N	255	58	313	2.184	1	0.139	0.082
	%	81.5	18.5	100.0				
Yes	N	7	4	11				
	%	63.6	36.4	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Household's symptoms Cough								
No	N	258	59	317	2.602	1	0.107	0.090
	%	81.4	18.6	100.0				
Yes	N	4	3	7				
	%	57.1	42.9	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Household's symptoms in the last 15 days								
No	N	219	47	266	2.066	1	0.151	0.080
	%	82.3	17.7	100.0				
Yes	N	43	15	58				
	%	74.1	25.9	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Treated patient with COVID-19								
No	N	215	58	273	0.210	1	0.647	0.025
	%	78.8	21.2	100.0				
Yes	N	47	4	51				
	%	92.2	7.8	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				

Continue

Continuation

Treated patient with symptoms during the treatment								
No	N	171	47	218	2.530	1	0.112	0.088
	%	78.4	21.6	100.0				
Yes	N	91	15	106				
	%	85.8	14.2	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				
Treated patient with fever								
No	N	215	58	273	4.988	1	0.026	0.124
	%	78.8	21.2	100.0				
Yes	N	47	4	51				
	%	92.2	7.8	100.0				
Total	N	262	62	324				
	%	80.9	19.1	100.0				

*p > 0.05 show statistically significant association between serostatus and variables. **Value of Cramer's V shows magnitude of effect size – Small ≅ 0.1, Medium (Moderate) ≅ 0.3, Large ≥ 0.5.

Table 3. Binomial logistic regression for confirmed diagnosis of COVID-19.

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Confirmed diagnosis of COVID-19	3.385	0.429	62.330	1	0.000	29.521	12.740	68.405
Confirmed diagnosis of COVID-19 in household	0.900	0.396	5.172	1	0.023	2.460	1.132	5.342
Constant	-2.557	0.244	109.589	1	0.000	0.078		

a. Variable(s) inserted in step 1: "Have you ever had a confirmed diagnosis of COVID-19?"; "Has anyone in your household ever had a confirmed diagnosis of COVID-19?". Exp(B) is Odds Ratio.

Table 4. Binomial logistic regression for signs and symptoms.

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95%CI for EXP(B)	
							Lower	Upper
Presented Loss of taste or smell	1.655	0.779	4.517	1	0.034	5.235	1.137	24.089
Patient Presented Fever	-1.096	0.543	4.081	1	0.043	0.334	0.115	0.968
Constant	-1.368	0.152	80.495	1	0.000	0.255		

a. Variable(s) inserted in step 1: "Did you have a loss of taste or smell in the last 15 days?"; "Did you attend a patient with fever?". Exp(B) is Odds Ratio.

COVID-19 is still scarce. To the best of our knowledge, the present study is the first probabilistic sampling investigation conducted among Brazilian dentists. Actually, most of the studies have investigated seroprevalence in dental clinics, hospitals, or dental schools using non-probabilistic samples. Between October and December 2020, the present investigation identified 19.1% positive dentists for IgG and/or IgM antibodies in the Federal District (Brazil).

Brazil is the biggest country in Latin America, with an estimated population of 211,755,692 inhabitants, distributed unevenly into five regions: North, Northeast, Southeast, South, and Midwest.[12] The Federal District (DF) is located in the Midwest region and has an estimated population of 3,055,149 inhabitants. Brasília, the capital of Brazil, is located in DF, which is divided into 33 administrative regions.[13]

Two nationwide serological household surveys conducted in 133 sentinel cities in Brazil randomly tested over 50,000 individuals in 2020. The first survey conducted in May 14–21, 2020, tested 25,025 individuals and the second one (June 4–7, 2020) surveyed 31,165 individuals. The local prevalence ranged from 0% to 25.4% in both surveys, and it was associated with social gradient, household size, and ethnic group, demonstrating high heterogeneity by region. Seroprevalence was higher in most impoverished areas, in households with larger numbers of residents, and in the indigenous population. The prevalence in the Midwest region of Brazil ranged from 0% to 0.4% (95%CI 0.2–0.7) between May and June 2020.[14]

A cross-sectional study undertaken in May 2020 in a Teaching Hospital of São Paulo (Brazil) showed 14% seropositivity for IgG/IgM antibodies in 4,987 oligosymptomatic or asymptomatic healthcare workers (those with positive serology without being previously tested with RT-PCR). Seroprevalence was associated with educational level, use of public transportation to commute to work, and working in the cleaning or security sector, besides the presence of fever, loss of smell, and loss of taste.[15]

Differences in the observed COVID-19 seroprevalence in Brazil can be explained by temporal factors related to the pandemic, given that the duration of antibody responses varies between 5 to 6 months and the studies were performed in distinct periods. Besides, the differences in COVID-19 seroprevalence also reflect social disadvantage and different social distancing measures adopted by state governments.

SARS-CoV-2 seroprevalence varies according to the year and the country because temporal conditions are specific to each location. A study conducted in a Dental Hospital in Buenos Aires (Argentina) between March and September 2020 showed 12% seroprevalence for IgM and/or IgG in dentists, dental assistants, and nonclinical personnel.[16] A study conducted in Russia between May and August 2020 showed 11.5% of 157 oral health workers at three dental clinics were positive for anti-SARS-CoV-2 antibodies. In this Russian study, the prevalence of infection was not associated with sex or occupation (dentist/dental assistant). However, it was significantly higher when an aspirating vacuum pump was used without HEPA filters.[17] Estrich et al.[18] conducted a web-based survey in June 2020 with 2,150 U.S. dentists about COVID-19 associated symptoms, SARS-CoV-2 infection, mental and physical health conditions, and infection control procedures. The prevalence of confirmed or probable COVID-19 infection weighted according to age and location to approximate all U.S. dentists was 0.9% (95%CI 0.5–1.5).

A study conducted in health care systems affiliated with four prevention epicenters in the USA indicated a 4.4% (95%CI, 4.1–4.6) prevalence of SARS-CoV-2 among 24,000 healthcare workers between April and August 2020. The community contact with COVID-19 was associated with seropositivity but not with workplace role, environment, or contact with patients with COVID-19. Prolonged contact with patients and production of aerosols, however, were not assessed in this study.[19]

A systematic review and meta-analysis of 127,480 health workers in 94 studies from North America, Europe, Africa, and Asia between March and June 2020 showed an 8.7% (95%CI 6.7–10.9) overall seroprevalence of SARS-CoV-2 antibodies. All studies, except one, used convenience samples, and most were conducted in hospitals or primary care centers.[20] The factors associated with seropositivity for SARS-CoV-2 being male, having non-white ethnicity; working in a COVID-19 unit; holding a patient-related job; being a COVID-19 frontline worker; working as a healthcare assistant; having reported personal protective equipment shortage; having self-reported belief of previous SARS-CoV-2 infection; having tested positive in a previous PCR test; and having come in contact with a household member with suspected or confirmed diagnosis of COVID-19.[20]

In our study, diagnosis of COVID-19, loss of taste or smell, and confirmed diagnosis of COVID-19 in a household member were positively associated with positive serostatus, whereas having treated patients with fever was negatively associated with the presence of antibodies. The association of seropositive results with previous diagnosis of COVID-19 confirmed the high sensitivity of the rapid test used in the study. Most dentists reduced their working hours during the pandemic but resumed patient care; moreover, SARS-CoV-2 seropositivity was associated with a confirmed diagnosis of COVID-19 in a household member. Thus, these results may suggest a possible

SARS-CoV-2 infection due to contact with a family member or community transmission, instead of nosocomial transmission in a dental practice. About the negative association with fever, two possibilities may explain fever as a protective factor. First, dentists were more rigorous in using personal protective equipment and protective measures when treating patients with fever. Second, and more plausible explanation, dentists did not actually check the patients' body temperature, or they considered the patient exhibited fever before the dental appointment.

Limitations of seroprevalence studies include true prevalence underestimation once previously positive individuals become negative within 5 to 6 months. Another possibility is the absence of detectable antibodies against a recent infection if the test was done less than 10 to 15 days after exposure. Moreover, we observed younger dentists agreed to participate in the study more often than older dentists. These results represent a local reality in Brazil, which is an epicenter of COVID-19 pandemic, so they should not be extrapolated to other countries.

The greatest strength of our study was the rigorous probabilistic sampling design, which reduced the selection bias.

The seroprevalence of SARS-CoV-2 observed among dentists from the Federal District exhibited similar rates when compared with the rates for the overall State and Country population. Therefore, questions should be raised about these similarities. Is the use of personal protection equipment during patient care responsible for preventing dentist contamination? Can the new routine of dental practice standards, such as reinforcing biosafety measures, improving physical barriers, reducing aerosol production, monitoring patients' signs and symptoms associated with COVID-19, and testing patients and dental staff, be accountable for keeping infection rates among dentists stable? Regardless of the answers to these questions, the fact is that dental clinical practice involves several particularities that should be taken into account to prevent SARS-CoV-2 infections among dentists. Besides, taste disorders were identified as the most frequent oral manifestation of COVID-19 (prevalence of 45%, OR 12.68; 95%CI 6.41–25.10), far more common than oral lesions, and this information can help the recognition of COVID-19 symptoms.[21]

The main result of this study was the similar prevalence of infection among dentists and in the general population. The prevalence, however, was higher than initially expected, given that the epidemiological characteristics of COVID-19 are quite dynamic and vary according to time and location. This finding sheds light on hypotheses that require prospective longitudinal studies to analyze the effectiveness of personal protection equipment used routinely at dental offices, as well as the risk factors associated with COVID-19 and populations at risk. Nevertheless, this finding applies to the epidemiological situation in 2020, before the development of vaccines and the emergence of SARS-CoV-2 Delta variant. Further studies are needed to confirm this result in this new scenario.

Conclusions

In conclusion, the total seroprevalence of SARS-CoV-2 infection among dentists from the Federal District in Brazil was 19.1%. The presence of antibodies was positively associated with confirmed diagnosis of COVID-19, loss of taste or smell, confirmed diagnosis of COVID-19 in a household member, but negatively associated with the treatment of patients with fever.

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