ACTA ODONTOLOGICA SCANDINAVICA
2023, VOL. 81, NO. 2, 119–123
https://doi.org/10.1080/00016357.2022.2095023

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Prevalence of ongoing or previous SARS-CoV-2 infection among dental personnel – the Swedish experience

Lars Fredriksson, Andreas Cederlund, My Murray, Leif Jansson and Pia Skott

Folktandvården Stockholm, Public Dental Services, Stockholm County Council, Stockholm, Sweden

ABSTRACT

Objective: To investigate whether personnel in a public dental clinic had a higher frequency of ongoing or previous severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection than hospital healthcare workers or the general public in Stockholm during weeks 23–25 in 2020.

Materials and methods: We carried out an observational cohort study from March to June 2020, including 341 employees randomly selected from Public Dental Service in the County of Stockholm. The primary outcome variable was the prevalence of SARS-CoV-2 RNA and/or antibodies against SARS-CoV-2. Throat samples were analysed for SARS-CoV-2 RNA. Venous blood was collected to detect antibodies against SARS-CoV-2 using the Luminex analysis tool (immunoassay) and ELISA. Logistic regression analysis was used to compare the independent groups and calculate the unadjusted odds ratio.

Results: The mean age of the participants was 50.1 years, and 11.7% were male. The prevalence of SARS-CoV-2 RNA and/or antibodies against SARS-CoV-2 was 12.0% (95% confidence interval 8.8–16.0). Among them, 82.5% reported symptoms and 85.4% were on sick-leave between March and June 2020.

Conclusions: The seroprevalence of SARS-CoV-2 infection was approximately similar to that in healthcare personnel, and approximately equal compared to that in the general population.

ARTICLE HISTORY
Received 20 January 2022
Revised 18 May 2022
Accepted 18 June 2022

KEYWORDS
Coronavirus infections; pandemics; dentistry

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), originating in Wuhan, China, has spread worldwide since January 2020 [1]. Infection primarily affects the lungs, but can also cause complications in other organs, such as the cardiovascular and gastrointestinal systems [1]. By the end of 2020, the total number of registered cases was 81 million [2].

Sweden is a country in northern Europe with 10.2 million inhabitants which adopted a 'light touch' lockdown as a response to the SARS-CoV-2 pandemic [3]. The government of Sweden introduced recommendations instead of regulations, keeping society partially open [3]. Citizens were encouraged to stay home if they felt ill, to wash their hands, work from home, stay at least three feet away from other people, and self-isolate at home if over 70 years old. There was also a ban on gatherings of more than 50 people [4]. Schools up to high schools remained open, as did businesses, public transportation, restaurants, bars and dental clinics, to mention some parts of society. The Swedish approach has been criticized and debated since the beginning of the pandemic [3]. Several scientists have claimed that Sweden has chosen a so-called herd immunity approach, allowing a large uncontrolled outbreak in the low-risk population, while protecting vulnerable citizens. Swedish government officials rejected any of these suggestions [5].

Dental healthcare personnel belong to the profession most exposed to SARS-CoV-2 [6]. Consequently, the spread of SARS-CoV-2 in society has had extensive consequences for routine dental care [6]. Recommendations on preventive measures can be found in the guidelines for dental services [7]. The effectiveness of surgical masks against viral respiratory infections has been investigated as well as clinical procedures to be performed during the COVID-19 era [7].

Folktandvården in the county of Stockholm is a public dental care provider with over 80 clinics and almost 2000 employees, with more than 1.4 million patient visits each year. During the pandemic, Folktandvården Stockholm remained open to the public. However, patients older than 70 years were advised to postpone their appointments to a later date, except for those with acute or severe problems. Patients with any type of symptom related to SARS-CoV-2 infection were asked not to come. Four phases are considered crucial for safe dental activities: patient triage, patient waiting room, dental treatment and management after treatment. All planned treatments were phone-triaged on the same day that the appointment was booked. The purpose of triage was to ensure that only patients without respiratory symptoms could be allowed to visit the clinic. The number of seats in the waiting room had been reduced, allowing a minimum of 1.5 m between the chairs. All potentially contaminated items (newspapers, toys, etc.) were removed, and hand disinfection was promoted. Folktandvården Stockholm also issued adapted guidelines on personal protective

CONTACT Leif Jansson leif.jansson@regionstockholm.se Folktandvården Stockholms län AB, Box 38206, SE-10064 Stockholm, Sweden

equipment (PPE) at the start of the pandemic, including gloves, R2-masks and protective shields.

The aim of this study was to investigate whether personnel working in a public dental clinic had a higher frequency of ongoing or previous SARS-CoV-2 infection than hospital healthcare workers or the general public in Stockholm during weeks 23–25 in 2020.

Methods

Ethical statements

The study was conducted in full accordance with the World Medical Association of Helsinki and approved by the Swedish Ethical Review Authority (dnr 2020-01620 and dnr 2020-02363). This study followed the 'Strengthening the Reporting of Observational Studies in Epidemiology' (STROBE) checklist (www.strobe-statement.org/index.php?id=strobe-home).

Study design

The study was designed as an observational cohort study including employees randomly selected at Folktandvården (Public Dental Service) in the county of Stockholm, a region that covers 6500 km^2 around the capital of Sweden. It belongs to the smaller provinces of Sweden but represents about 20% of the population. The subjects were recruited in random order from a list during weeks 23–25 in 2020. This resulted in a sample size of 341 participants (Figure 1). Employees were invited to participate in the study according to their words and written information. After written approval to participate in the investigation was obtained, the study participants were asked to complete a study protocol including a selected panel of parameters, as described in Table 1. Subjects who were sick, had respiratory symptoms on the day of testing, or had a suspected COVID-19 infection less than five days prior to the day of testing, were excluded.

Study variables

The primary outcome variable was the prevalence of SARS-CoV-2 RNA and/or antibodies against SARS-CoV-2. The secondary variables were age, sex, profession, degree of patient-related working tasks, distance from home to clinic, transportation from home to clinic, self-reported symptoms and sick leave during March–June 2020.

Study period

The participants were recruited between weeks 23 and 25, 2020. All enrolled participants signed a written informed consent form that included permission to extract data on sick leave from the employer's administrative database.

Viral nucleic acid detection

Throat swab samples were collected from the pharynx by experienced and trained staff from oral and maxillofacial clinics using a cellular brush technique according to the user's manual. The samples were then analysed for detection and sequencing of SARS-CoV-2 by quantitative RT-PCR at Karolinska University Laboratory, as described by Fröberg et al. [8].

Serological analyses of antibodies

Five millilitres of venous blood was collected to prepare serum samples for detecting antibodies against SARS-CoV-2 using the analysis tools Luminex (immunoassay) and ELISA. The analyses were performed at the Karolinska University Laboratory. Serological reactivity was measured against three different virus protein variants: (i) spike trimers comprising the glycoprotein ectodomain [9], (ii) spike S1 domain and (iii) nucleocapsid protein, according to the procedure previously described by Neiman et al. [10]. Samples were considered IgG-positive when they showed reactivity against at least two of the three viral antigens. All collected biosamples (serum and cell brush samples from the pharynx) were stored and arranged in Stockholms Medicinska Biobank.

Statistical methods

Descriptive statistics and statistical analyses were performed using a computer statistical package (IBM SPSS 26.0; SPSS Inc., Chicago, IL). Logistic regression analysis was used to compare the independent groups and calculate the unadjusted odds ratio. The confidence intervals for prevalence were calculated using the Clopper–Pearson method. The results were considered statistically significant at $p<.05$.

Results

The characteristics of the participants, according to the investigated variables, are presented in Table 1. The number of missing values differs between 4 and 28 for the eight secondary variables. The mean age was 50.1 years (range 25–67), and 11.7% were male. Forty-three percent of the participants reported daily patient-related work. The majority of participants across all professions were female. Self-reported symptoms of SARS-CoV-2 were reported by 43.4% of the sample, and the sick-leave frequency during March–June 2020 was 48.7%.

The prevalence of ongoing SARS-CoV-2 (RNA detection) was 1.8% (six subjects), and presence of antibodies against SARS-CoV-2 was found in 35 subjects (10.3%). Consequently, the prevalence of SARS-CoV-2 RNA or antibodies against SARS-CoV-2 was 12.0% (95% confidence interval 8.8–16.0). Seven subjects declared that they had been tested seropositive in earlier tests, and antibodies were found for everyone in this group. Among those with detected SARS-CoV-2 RNA or antibodies against SARS-CoV-2, 82.5% reported symptoms, and 85.4% were on sick-leave during March–June 2020 (Table 2). None of the other investigated background variables were significantly correlated with the prevalence of SARS-CoV-2 RNA or the presence of antibodies against SARS-CoV-2 (Table 2).

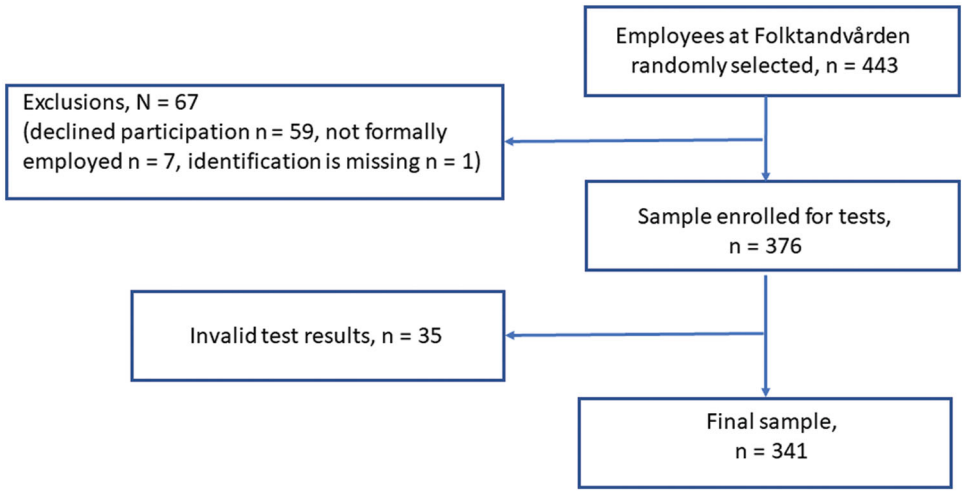

Figure 1. Flow chart.

Table 1. Characteristics of the participants according to investigated variables.

Characteristic	*N*	Description
Age (mean (SD))	332	50.1 (10.3)
Female/male (*N* (%)/*N* (%))	341	301 (88.3)/40 (11.7)
Profession	337	
Administration (*N* (%))		140 (41.5)
Clinic (*N* (%))		197 (58.5)
Category of profession	328	
Receptionist (*N* (%))		52 (15.9)
Dental assistant (*N* (%))		111 (33.8)
Dental hygienist (*N* (%))		41 (12.5)
Dentist (*N* (%))		48 (14.8)
Dental technician (*N* (%))		6 (1.8)
Management (*N* (%))		70 (21.3)
Patient related work	333	
Daily (*N* (%))		142 (42.6)
Sporadically (*N* (%))		86 (25.8)
Never (*N* (%))		105 (31.5)
Distance (km) from home to clinic (mean (SD))	313	11.4 (11.2)
Transportation from home to work	333	
Car (*N* (%))		111 (33.3)
Public transports (*N* (%))		118 (35.4)
Walk/bicycle (*N* (%))		104 (31.2)
Self-reported symptoms of SARS-CoV-2 (*N* (%))	334	145 (43.4)
Sick-leave during March–June 2020 (*N* (%))	337	164 (48.7)

SD: standard deviation.

Discussion

This observational cohort study, which included employees randomly selected from Public Dental Service in the county of Stockholm, found that the prevalence of SARS-CoV-2 RNA and/or antibody positive subjects was 12.0% (95% confidence interval 8.8–16.0). More than 80% of the employees with SARS-CoV-2 RNA or presence of antibodies against SARS-CoV-2 reported presence of COVID-19 symptoms and had been on sick leave during March–June 2020.

The study population consisted of 341 subjects (about 17% of the total number of employees in Public Dental Service in the county of Stockholm) and may be considered as a small sample. This resulted in large confidence intervals. Consequently, comparisons between subgroups according to the prevalence of serology-positive subjects are made more difficult, and this is even more true for multiple logistic regression analyses including several predictors. In addition, the relative frequencies of missing values varied between 1.2% and 8.2% for eight secondary variables, which resulted in a reduced number of cases for analyses.

The serology test used in this project had previously been quality assured and showed 99.4% sensitivity and 99.1% specificity [11]. These values indicate a higher precision than most commercial tests available. Many studies that have examined the prevalence of SARS-CoV-2 among healthcare professionals consist of questionnaires; therefore, the data were self-reported and less reliable than serological tests. To the best of our knowledge, no studies on the seroprevalence of SARS-CoV-2 among dental staff in Sweden have been published to date.

The population-based estimate of seroprevalence in Stockholm was 7.3% between April and May 2020 (www.folkhalsomyndigheten.se/smittskyddberedskap/utbrott/aktuella-utbrott/covid-19), and 11.7% in June 2020. Consequently, SARS-CoV-2 infection appears to have been approximately equal among dental staff compared to the general population during the study period. Stockholm's inner city and suburbs have inhabitants of varying socioeconomic backgrounds. In a study from Stockholm, including a sample of 213 tested subjects in June 2020, the prevalence of SARS-CoV-2 antibodies varied between 4.1% in a middle-class area and 30% in a segregated residential area with low incomes, indicating a cluster transmission [12].

In a recent study from Karolinska University Hospital in Stockholm, 12,928 employees participated in a SARS-CoV-2 screening study that was conducted between 23 April 2020 and 24 June 2020 [11]. The overall prevalence of serology positive subjects was found to be 11.4% (95% confidence interval 10.2–12.6) for males and 11.5% (95% confidence interval 10.9–12.1) for females. The prevalence of SARS-CoV-2 RNA or presence of antibodies during the first three weeks in June 2020 for employees in the present study was 12.0% (95% confidence interval 8.8–16.0), indicating approximately similar seroprevalences in Public Dental Service and a University Hospital in the same city. However, it is important to emphasize that the proportion of infected individuals varies between wards. Distinct clustering transmission of SARS-CoV-2 has been found among healthcare personnel from different wards [11]. These differences between units

Table 2. Prevalence of SARS-CoV-2 or antibodies against SARS-CoV-2 according to investigated variables.

Characteristic	*n* positive/*N*	Prevalence % (95% confidence interval)	Unadjusted odds ratio (95% confidence interval)	*p* Value
Age				NS
≤50 years	19/147	12.9 (8.0–19.4)	1.0	
>50 years	22/185	11.9 (7.6–17.4)	0.9 (0.5–1.8)	
Sex				NS
Female	39/301	13.0 (9.4–17.3)	1.0	
Male	2/40	5.0 (0.6–16.9)	0.3 (0.1–1.5)	
Profession				NS
Administration	18/140	12.9 (7.8–19.6)	1.0	
Clinic	23/197	11.7 (7.5–17.0)	0.9 (0.5–1.7)	
Patient related work				NS
Daily	17/142	12.0 (7.1–18.5)	1.0	
Sporadically	9/86	10.5 (4.9–18.9)	0.9 (0.4–2.0)	
Never	14/105	13.3 (7.5–21.4)	1.1 (0.5–2.4)	
Distance from home to clinic				NS
<10 km	23/152	13.1 (8.5–19.1)	1.0	
>10 km	16/122	11.6 (6.8–18.1)	0.9 (0.4–1.7)	
Transportation from home to work				NS
Car	10/111	9.0 (4.4–15.9)	1.0	
Public transport	16/105	15.2 (9.0–23.6)	1.8 (0.8–4.2)	
Walk/bicycle	11/100	11.0 (5.6–18.8)	1.2 (0.5–3.1)	
Self-reported symptoms				<.001
No	7/189	3.7 (1.5–7.5)	1.0	
Yes	33/145	22.8 (16.2–30.5)	7.7 (3.3–17.9)	
Sick-leave during March–June 2020				<.001
No	6/173	3.5 (1.3–7.4)	1.0	
Yes	35/164	21.3 (15.3–28.4)	7.6 (3.1–18.5)	

NS: not significant.

could be explained by the fact that preventive measures have a significant effect on reducing the risk of SARS-CoV-2 infection [11]. A study including healthcare workers at the Department of Infectious Diseases located in Västmanland, Sweden, with strict infection control guidelines, followed the rate of seroconversion over approximately three months by measuring the prevalence of SARS-CoV-2 antibodies [13]. The seroprevalence of antibodies increased from 15% to 19% among 131 participants over the three months. In this high-exposure environment, the transmission rate was low, indicating that guidelines focussing on infection control are of great importance [13]. In a large acute-care hospital in Sweden, the seroprevalence was 19.1% between April and May 2020 among 2149 employees [14]. This prevalence was higher than that reported by the region during the study period. In addition, seroprevalence was significantly higher in those with patient contact and SARS-CoV-2 patient contact [14].

More than 600 articles on SARS-CoV-2 have been published in dental journals between 2019 and 2020 [2]. A large proportion of these articles focussed on topics such as clinical routines to minimize the spread of infection during the outbreak, clinical symptoms of SARS-CoV-2 in the oral cavity, and the effects of the pandemic on dental education. A questionnaire study including academic experts in oral surgery with the aim of compiling their recommendations for reducing the spread of infection concluded that adequate personal equipment is crucial, as well as avoiding aerosol-generating procedures [15]. Dental staff come into daily contact with patients who may be SARS-CoV-2 positive asymptomatic patients. A study from Scotland on the prevalence of asymptomatic SARS-CoV-2 infection in dental patients during August–October 2020 reported that 0.5% (confidence interval 0.5–0.8%) carried the coronavirus. This result highlights the importance of infection prevention in dental clinics.

However, studies on the prevalence of COVID-19 among dental professionals using serological tests are limited. A retrospective cohort study involving 157 employees at three dental clinics in Russia found that the estimated prevalence of COVID-19 was 11.5% during a follow-up from May to August 2020 [16]. They also reported that the seroprevalence differed significantly between dental clinics. Consequently, seroprevalence was consistent with the results of this study, and a cluster effect was also observed. In a large-scale longitudinal seroepidemiological study from the United Kingdom including 1507 dental care professionals, seroprevalence was measured at baseline (July 2020) and six months later [17]. The seroprevalence of antibodies against SARS-CoV-2 spike glycoprotein was 16.3% compared to 6-7% in the regional population. The presence of antibodies could be detected in over 70% of the participants six months later. Thus, increased protection against SARS-CoV-2 infection is expected for this group.

In conclusion, the seroprevalence of SARS-CoV-2 infection in the dental staff of the Public Dental Service was approximately similar to that in a university hospital in the same region, and approximately equal compared to that the general population during the same time period.

Acknowledgements

We would like to express our deepest gratitude to Professor Joakim Diller and the volunteers who participated in this study.

Disclosure statement

The authors report no conflicts of interest and are responsible for the content and writing of this manuscript.

Funding

Support was obtained from the Karolinska University Hospital and from Folktandvården Stockholm AB.

Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

References

[1] Ciotti M, Ciccozzi M, Terrinoni A, et al. The COVID-19 pandemic. Crit Rev Clin Lab Sci. 2020;57(6):365–388.
[2] Soltani P, Baghaei K, Tafti KT, et al. Science mapping analysis of COVID-19 articles published in dental journals. Int J Environ Res Public Health. 2021;18(4):2110.
[3] Pashakhanlou AH. Sweden's coronavirus strategy: the public health agency and the sites of controversy. World Med Health Policy. 2021;1–21.
[4] Kavaliunas A, Ocaya P, Mumper J, et al. Swedish policy analysis for Covid-19. Health Policy Technol. 2020;9(4):598–612.
[5] Orlowski EJW, Goldsmith DJA. Four months into the COVID-19 pandemic, Sweden's prized herd immunity is nowhere in sight. J R Soc Med. 2020;113(8):292–298.
[6] Villani FA, Aiuto R, Paglia L, et al. COVID-19 and dentistry: prevention in dental practice, a literature review. Int J Environ Res Public Health. 2020;17(12):4609.
[7] Banakar M, Lankarani KB, Jafarpour D, et al. COVID-19 transmission risk and protective protocols in dentistry: a systematic review. BMC Oral Health. 2020;20(1):275.
[8] Fröberg M, Hassan SS, Pimenoff VN, et al. Risk for SARS-CoV-2 infection in healthcare workers outside hospitals: a real-life immunovirological study during the first wave of the COVID-19 epidemic. PLOS One. 2021;16(9):e0257854.
[9] Wrapp D, Wang N, Corbett KS, et al. Cryo-EM structure of the 2019-nCoV spike in the prefusion conformation. Science. 2020;367(6483):1260–1263.
[10] Neiman M, Hellström C, Just D, et al. Individual and stable autoantibody repertoires in healthy individuals. Autoimmunity. 2019;52(1):1–11.
[11] Elfström KM, Blomqvist J, Nilsson P, et al. Differences in risk for SARS-CoV-2 infection among healthcare workers. Prev Med Rep. 2021;24:101518.
[12] Lundkvist Å, Hanson S, Olsen B. Pronounced difference in Covid-19 antibody prevalence indicates cluster transmission in Stockholm, Sweden. Infect Ecol Epidemiol. 2020;10(1):1806505.
[13] Rashid-Abdi M, Krifors A, Sälléber A, et al. Low rate of COVID-19 seroconversion in healthcare workers at a Department of Infectious Diseases in Sweden during the later phase of the first wave; a prospective longitudinal seroepidemiological study. Infect Dis. 2021;53(3):169–175.
[14] Rudberg AS, Havervall S, Månberg A, et al. SARS-CoV-2 exposure, symptoms and seroprevalence in healthcare workers in Sweden. Nat Commun. 2020;11(1):5064.
[15] Becker K, Brunello G, Gurzawska-Comis K, et al. Dental care during COVID-19 pandemic: survey of experts' opinion. Clin Oral Implants Res. 2020;31(12):1253–1260.
[16] Sarapultseva M, Hu D, Sarapultsev A. SARS-CoV-2 seropositivity among dental staff and the role of aspirating systems. JDR Clin Transl Res. 2021;6(2):132–138.
[17] Shields AM, Faustini SE, Kristunas CA, et al. COVID-19: seroprevalence and vaccine responses in UK dental care professionals. J Dent Res. 2021;100(11):1220–1227.