COVID-19 incidence and vaccination rates among Canadian dental hygienists

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PRACTICAL IMPLICATIONS OF THIS RESEARCH

- This project is the first of its kind to establish a prospective cohort of dental hygienists in Canada and to report the extent of the impact of COVID-19 on Canadian dental hygienists.
- The incidence of COVID-19 among dental hygienists practising in the community in Canada is reported to be lower than in the general population.

ABSTRACT

Background: Oral health care settings potentially carry a high risk of cross-infection due to close contact and aerosol-generating procedures. There is limited evidence of the impact of COVID-19 among dental hygienists. This longitudinal study aimed to 1) estimate COVID-19 incidence rates among Canadian dental hygienists over a 1-year period; and 2) estimate vaccination rates among Canadian dental hygienists. **Methods:** A prospective cohort study design was used to collect self-reported COVID-19 status from 876 registered dental hygienists across Canada via an online baseline survey and then 6 follow-up questionnaires delivered between December 2020 and January 2022. Bayesian Poisson and binomial models were used to estimate the incidence rate and cumulative incidence of self-reported COVID-19. **Results:** The estimated cumulative incidence of COVID-19 in dental hygienists in Canada from December 2020 to January 2022 was 2.39% (95% CrI, 1.49%–3.50%), while the estimated cumulative incidence of COVID-19 in corresponding Canadian provinces was 5.12% (95% CrI, 5.12%–5.13%) during the same period. At last follow-up, 89.4% of participants self-reported that they had received at least 1 dose of a COVID-19 vaccine. **Conclusion:** The low infection rate observed among Canadian dental hygienists between December 2020 and January 2022 is reassuring to the dental hygiene and general community.

RÉSUMÉ

Contexte : Les milieux de soins buccodentaires présentent potentiellement un risque élevé d'infections croisées en raison des contacts étroits et des procédures qui produisent des aérosols. Il y a peu de preuves de l'effet de la COVID-19 chez les hygiénistes dentaires. La présente étude longitudinale visait à 1) estimer les taux d'incidence de la COVID-19 chez les hygiénistes dentaires canadiens sur une période d'un an; et 2) estimer les taux de vaccination chez les hygiénistes dentaires canadiens. **Méthodologie :** Une méthodologie prospective des cohortes a été utilisée pour recueillir le statut de COVID-19 autodéclaré de 876 hygiénistes dentaires autorisés au Canada par l'intermédiaire d'une enquête initiale en ligne, puis de 6 questionnaires de suivi, distribués entre décembre 2020 et janvier 2022. Des modèles bayésiens de Poisson et binomiaux ont été utilisés pour estimer le taux d'incidence et l'incidence cumulative de la COVID-19 autodéclarée. **Résultats :** L'incidence cumulative estimée de la COVID-19 chez les hygiénistes dentaires au Canada entre décembre 2020 et janvier 2022 était de 2,39 % (intervalle de crédibilité à 95 %, 1,49 % – 3,50 %), alors que l'incidence cumulative estimée de la COVID-19 dans les provinces canadiennes correspondantes était de 5,12 % (intervalle de crédibilité à 95 %, 5,12 % – 5,13 %) au cours de la même période. Lors du dernier suivi, 89,4 % des participants ont déclaré avoir reçu au moins une dose du vaccin contre la COVID-19. **Conclusion :** Le faible taux d'infection constaté chez les hygiénistes dentaires canadiens entre décembre 2020 et janvier 2022 est rassurant pour la communauté d'hygiène dentaire et la communauté générale.

Keywords: Canada; COVID-19; dental hygienist; incidence; personal protective equipment; prevalence; relative risk
CDHA Research Agenda category: risk assessment and management

INTRODUCTION

In December 2019, the world became aware of the coronavirus (COVID-19) outbreak occurring in Wuhan, China.[1] On January 30, 2020, the World Health Organization (WHO) made a formal declaration of a public health emergency of international concern; WHO declared a global pandemic on March 11, 2020.[2,3] By March 2020, all provinces and territories in Canada had declared a state of emergency,[4] and oral health services in many provinces were mandated to cease operations by public health authorities, with the exception of emergency care. This forced shutdown resulted in dental hygienists being furloughed from their positions. At the time, emerging evidence was showing an increased incidence of COVID-19 among several groups of health care providers (HCPs).[5,6]

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However, dental hygienists, a high-risk group of HCPs, were excluded from these studies. Oral health care settings potentially carry a high risk of cross-infection between care providers and clients due to their close contact and aerosol-generating procedures (AGP).[7–10] Instruments used for dental hygiene care (e.g., ultrasonic handpieces) aerosolize saliva and blood that can potentially remain suspended in the air for several hours.[7,9,10]

There is very little evidence of the impact of COVID-19 in terms of infection rates or infection control procedures among dental hygienists in Canada or elsewhere in the world. The incidence of COVID-19 among dentists practising in the community in Canada has recently been reported.[11] Globally, there has been an increase in the number of studies that have presented the incidence or prevalence of COVID-19 among oral health professionals.[12–32] Dental hygienists are essential to oral health care delivery in Canada. To assess the overall impact of the COVID-19 pandemic on the Canadian oral health care system, dental hygiene-specific evidence, in addition to that from dentists, is necessary. Thus, the objectives of this study were to 1) estimate the incidence rate, the cumulative incidence, and the estimated risk of COVID-19, based on self-reported data, among dental hygienists in Canada between December 2020 and January 2022; and 2) estimate COVID-19 vaccination rates among Canadian dental hygienists during the same period.

METHODS

Study design and recruitment

The study used a prospective cohort design. Eligibility criteria were as follows: being registered and licensed to practise dental hygiene in Canada during the study period and no previous diagnosis of COVID-19. Potential participants were identified from the rosters of provincial dental hygiene licensing bodies in British Columbia, Alberta, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, and Newfoundland & Labrador. Dental hygienists were invited to participate in the online survey through an email message sent by their respective regulatory bodies on December 9, 2020. Regular reminder emails were sent until the required sample size was reached. After completing a baseline survey, participants were checked for eligibility. Those who indicated that they had tested COVID-19 positive at baseline and those who retired before December 9, 2020, were excluded. Eligible participants were then invited to participate in follow-up surveys until January 2022.

The sample size for the study was calculated based on estimates of infection rates in May 2020 in Canada and determined to be 385 participants, to be followed for 1 year, to estimate an incidence rate of 4 per 100 person-years with a margin of error of 2 per 100 person-years.[33–35]

Data collection

After providing informed consent, participants were invited to complete an online baseline survey (Supplementary Materials, S1, available at cjdh.ca) conducted through McGill University's "LimeSurvey" platform,[36] a closed, token-based, online research tool that is hosted on a secured McGill server located in Canada, thus complying with the Personal Information International Disclosure Protection Act.

Three domains of information were collected at this stage: 1) demographics and comorbidities; 2) details of clinical activities and dental hygiene care provided to clients in the previous 2 weeks (i.e., number of AGPs performed, N95 use, ventilation in clinics); and 3) self-reported data of COVID-19 positive test results and symptoms related to COVID-19. Questionnaires were adapted from WHO Unity Study protocols for assessment of COVID-19 risk among health care workers[37] and were available in both official languages. Questions were developed and vetted by the research team and were pilot tested on a subset of participants prior to recruitment and implementation of the survey.

After completing the baseline survey, participants were checked for eligibility. Participants who self-identified as COVID-19 negative at baseline were invited to participate in the longitudinal phase of the study, which consisted of 6 follow-up surveys that were spaced an average of 59 days apart, until January 9, 2022. These follow-up questionnaires (Supplementary Materials, S1, available at cjdh.ca) collected data on self-reported COVID-19 vaccination; COVID-19 tests and symptoms; clinical activities and dental hygiene care provided to clients since the last survey; and overall impact of COVID-19. This study reports on self-reported diagnosis of COVID-19 and COVID-19 vaccination. End of follow-up for a participant was defined as the earliest event among the following: 1) self-reported diagnosis of COVID-19; 2) death; 3) self-reported retirement from dental hygiene practice; or 4) completion of the study 12 months after the baseline survey.

Study protocol and ethics approval was obtained from the ethics review boards at McGill University (A06-M49-20A [20-06-018]) and Dalhousie University (REB# 2021-5716). This study complies with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

Statistical analysis

Descriptive statistics were used to explore patterns in the data and to illustrate the longitudinal change in vaccination rates during the study period. To properly account for the uncertainty due to interval-censored data, a Bayesian approach was used to estimate the prevalence at baseline, incidence rate, and cumulative incidence of COVID-19. The approach takes into account the uncertainty in the follow-up time due to the fact that only date of testing is measured instead of the true date of infection.[38] The latter is often unknown, but given that most infections produce a negative test result after 2 weeks, the true infection date can be assumed to be no more than 14 days prior to the test date. The study model integrates this uncertainty by randomly imputing a value

for the follow-up duration from the interval between the date of positive test and 14 days prior to it. For estimating baseline prevalence and cumulative incidence, a Bayesian binomial model was used. A Bayesian Poisson model was used to estimate the incidence rate. Non-informative priors [Gamma (0.0001, 0.0001) & Beta (1,1)] were used for the rate and risk parameters. The model was fit in JAGS[39] using 4 parallel MCMC chains with 25,000 burn-in and 25,000 samples each (Supplementary Materials, S2, available at cjdh.ca). The convergence of MCMC chains was assessed using trace plots and Gelman and Rubin's Rhat value.[40,41] Mean and 95% credible intervals (95% CrI) are reported for each parameter.

RESULTS

Invitations to participate were sent to 30,444 registered dental hygienists via dental hygiene regulatory bodies. Of the 1530 participants who registered on the survey portal, 958 consented to participate in the project. After excluding participants who did not complete baseline visits (n = 65), retired participants (n = 9) and COVID-19 positive participants (n = 8), 876 participants were invited to participate in the longitudinal follow-up surveys.

A summary of the sociodemographic responses of the participants is detailed in Table 1. The median age of participants was 42 years (25th and 75th percentiles were 33 and 52 years, respectively). The majority of participants identified as female (97.8%) and Caucasian (86.1%), with 92.7% reporting their primary practice type as clinical dental hygiene working alongside a dentist in private or public sectors. The majority of participants indicated that their primary practice was in British Columbia, Alberta or Ontario (26.3%, 25.3%, and 24.0%, respectively), followed by Quebec (9.6%) and Manitoba (9.2%). Most participants (86.4%) served in an urban setting, and most practised in only one office (78.3%).

Data were collected from December 9, 2020, to January 9, 2022, with a median follow-up time of 319 days (25th and 75th percentiles were 208 and 355 days, respectively); 450 participants (51.4%) were lost to follow-up during the study period.

COVID-19 among dental hygienists across Canada

Eight participants reported COVID-19 infection history at baseline. The estimated prevalence of COVID-19 in dental hygienists in Canada was 0.93% (95% CrI, 0.43%–1.64%) from November 2019 to December 2020.

Twenty participants reported COVID-19 infection during the follow-up period of the study. The estimated cumulative incidence of COVID-19 in dental hygienists in Canada from December 2020 to January 2022 was 2.39% (95% CrI, 1.49%–3.50%). The incidence rate of COVID-19 in dental hygienists in Canada was 8.74 (95% CrI, 5.34 to 13.00) cases per 100,000 person-days at risk. The cumulative incidence of COVID-19 in the provinces where participants practised between December 2020

Table 1. Descriptive characteristics of respondents at baseline

	Total N = 876 (%)
Age (years) median (25th, 75th percentiles)	42 (33, 52)
Sex	
Female	857 (97.8)
Male	19 (2.2)
Ethnicity	
White (Caucasian)	754 (86.1)
Asian	79 (9.0)
Arab	6 (0.7)
Black	6 (0.7)
Indigenous/Aboriginal	6 (0.7)
Latin American	6 (0.7)
Mixed	11 (1.3)
Other	98 (0.9)
Province	
Alberta	222 (25.3)
British Columbia	230 (26.3)
Manitoba	81 (9.2)
Ontario	210 (24.0)
Quebec	84 (9.6)
New Brunswick	12 (1.4)
Nova Scotia	26 (3.0)
Newfoundland and Labrador	11 (1.3)
Type of community served	
Urban	757 (86.4)
Rural	115 (13.1)
Remote	4 (0.5)
Number of practices	
1	686 (78.3)
2	150 (17.1)
3	30 (3.4)
≥4	10 (1.1)
Practice setting	
Clinical dental hygiene[a]	812 (92.7)
Independent dental hygiene[b]	25 (2.9)
Other	39 (4.5)

[a]Defined as working alongside a dentist in private or public sectors
[b]Defined as working independently or along with other dental hygienists, but not with a dentist, in private or public sectors.

Table 2. Participant COVID-19 vaccination status by follow-up visit

	Baseline	Follow-up 1 n (%)	Follow-up 2 n (%)	Follow-up 3 n (%)	Follow-up 4 n (%)	Follow-up 5 n (%)	Follow-up 6 n (%)
Not vaccinated	n/a	746 (99.2)	53 (8.3)	43 (7.3)	41 (6.9)	27 (5.8)	20 (4.7)
Vaccinated	n/a	4 (0.5)	586 (91.3)	537 (91.2)	538 (90.4)	420 (90.3)	381 (89.4)
No response	n/a	2 (0.3)	3 (0.5)	9 (1.5)	16 (2.7)	18 (3.9)	25 (5.9)

and January 2022 was 5.12% (95% CrI, 5.12%–5.13%). Furthermore, the cumulative count of cases of COVID-19 reported among the study population followed the status of the epidemic in the corresponding provinces (Figure 1).

Vaccination rates among Canadian dental hygienists

At the time of the baseline survey (December 9, 2020), COVID-19 vaccines were not yet available to dental hygienists in Canada. In the first follow-up period (January 13, 2021, to February 21, 2021) only 0.5% of respondents indicated that they had received at least 1 dose of COVID-19 vaccine (Table 2). The proportion of participants who received at least 1 dose of COVID-19 vaccine increased sharply between follow-up 1 and 2. At follow-up 2, 91.3% of respondents indicated that they had received a COVID-19 vaccine. The proportion of vaccinated participants leveled off in subsequent months. At last follow-up, 89.4% of participants self-reported that they had been vaccinated. The proportion of unvaccinated respondents decreased with each follow-up, with 4.7% indicating vaccine hesitancy at the end of the study (January 9, 2022) (Figure 2a). Figure 2b illustrates the vaccination rate of participants and corresponding 95% CI over the study period. There was no statistically significant relationship between COVID-19 vaccine acceptance and age, sex, ethnicity, province of practice or type of community served (urban/rural) (c^2 or Fisher Exact test, p values > 0.05). Figure 3 shows the number of doses taken by participants over time. By the end of the study follow-up (January 9, 2022), 69% of participants had indicated that they had received 2 doses, and 19.7% of participants had indicated that they had received 3 doses.

DISCUSSION

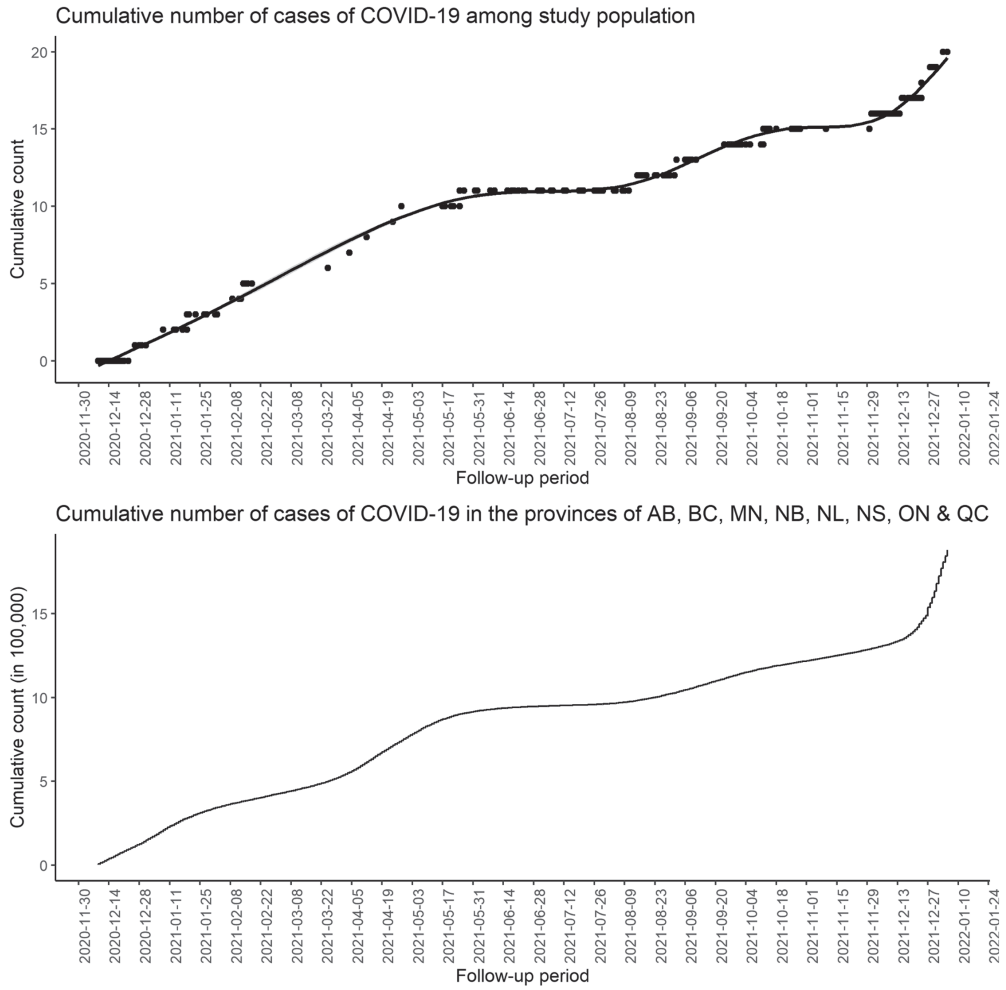
Although health care professionals in general have been characterized as at risk of COVID-19 infection,[6,7,42,43] and oral health care professionals have been identified as a high-risk group for exposure to the SARS-CoV-2 virus,[44–49] this study showed that Canadian dental hygienists had a lower-than-expected risk compared to the general population during the study period. Due to the dynamic nature of infection rates and the fact that dental hygienists may have been included in the data on the general population, these comparisons must be interpreted with caution.

The study findings are in line with a US study of dental hygienists, which found that, despite initial concerns, dental hygienists had a lower COVID-19 cumulative prevalence (8.8%) than the general US population (11.7%) over the same period.[22] Similarly, incidence proportion of COVID-19 among dentists practising in the community in Canada has been shown to be lower than the Canadian population during the same period.[11] It is important to note that the incidence rate calculated in the present study (8.74 cases per 100,000 person-days risk [95% CI, 5.34–13.0]) cannot be compared directly to the incidence rate reported in the study of Canadian dentists (5.10 cases per 100,000 person-days risk [95% CI, 1.86–9.91]), because these data were collected at different time periods. In addition to overlapping 95% CrI, data in the present study were collected from December 9, 2020, to January 9, 2022, when rates across the country were higher than when data were collected from the Canadian dentists in the community study (July 29, 2020, to February 12, 2021).

In addition, the findings of the present study align with numerous global studies that found that oral health care professionals were not at higher risk of COVID-19 than the general population.[18,19,21,23,25,26,30,31] However, the findings do contrast with 3 studies that reported the proportion of oral health care workers infected with COVID-19 as higher than in the general population.[12,32,50] It has been proposed that this could be attributed to regional differences[50] and variations in the use of enhanced personal protective equipment (PPE).[12,32] In addition to the use of PPE to prevent infection, seemingly lower infection rates in the current study sample compared to the general population may have been influenced by several factors, such as pre-procedural screening of clients, adherence to rigorous infection prevention and control protocols, public health measures such as masking and social distancing, and increased awareness and precautionary behaviour of dental hygienists, in general, outside their workplace.

Uptake of vaccination is a conceivable explanation for low infection rates. By the end of the second follow-up period (June 13, 2021), 91.3% of respondents had indicated that they had received at least 1 dose of a COVID-19 vaccine. Although vaccine acceptance was high among the study participants, by the end of the study, 4.7% of respondents indicated their COVID-19 vaccination status as "not vaccinated". Vaccine hesitancy remains an ongoing concern. As regulated primary health care professionals, dental hygienists have a responsibility to promote and protect the health of Canadians by supporting the country's

Figure 1. Cumulative case counts of COVID-19 reported in the general Canadian population in Alberta (AB), British Columbia (BC), Manitoba (MB, New Brunswick (NB), Newfoundland & Labrador (NL), Nova Scotia (NS), Ontario (ON), and Quebec (QC) and among study participants between December 2020 and January 2022 show similar patterns



national public health agency in encouraging everyone to end the pandemic by means of achieving herd immunity.[51]

There are approximately 33,400 registered dental hygienists in Canada.[52] It is important to recognize that, although invitations were sent to the majority of dental hygienists across Canada, only a small proportion responded. The sample, while including participants from multiple provinces, is a convenience sample of dental hygienists who voluntarily responded to the invitation to participate. This study analysed self-reported data, making its findings vulnerable to bias. Findings should be interpreted with caution as a result. In addition, a low response rate and loss to follow-up limit the generalizability of the results. However, the distribution of demographic characteristics within the sample, including age, sex, ethnicity, number of practice settings, and type of practice setting, was comparable to national data collected on dental hygienists via the Canadian Dental Hygienists Association's 2021 Job Market and Employment Survey.[53]

Since data collection for this study ended, the Omicron variant, which has been shown to spread more easily than earlier variants of the SARS-CoV-2 virus, has emerged and has resulted in much higher infection rates among the population. Further studies are necessary to evaluate the risk of COVID-19 with different aims from the present study, as well as the COVID-19-related risks in light of the different infection dynamics of the newest COVID-19 variants.

CONCLUSION

At the beginning of the pandemic, COVID-19 had an enormous emotional and economic impact on dental hygienists mainly due to a large knowledge gap on COVID-19 transmission and infection risks.[54] Months after the beginning of the pandemic, scientific evidence began to reveal the actual transmission risks among oral health care personnel, but less specifically among dental hygienists. By reporting infection rates in Canadian

Figure 2a. Proportion of vaccinated participants by follow-up visit

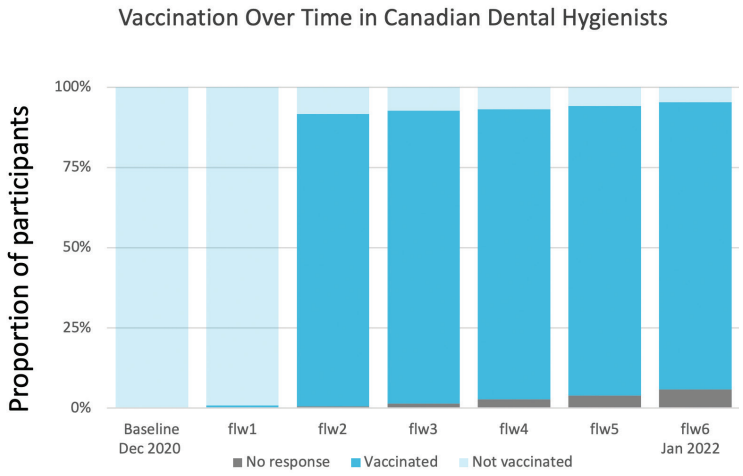


Figure 2b. Rate of vaccination of participants over the study duration. The blue shaded area represents the 95% CI and the "+" symbols represent censoring.

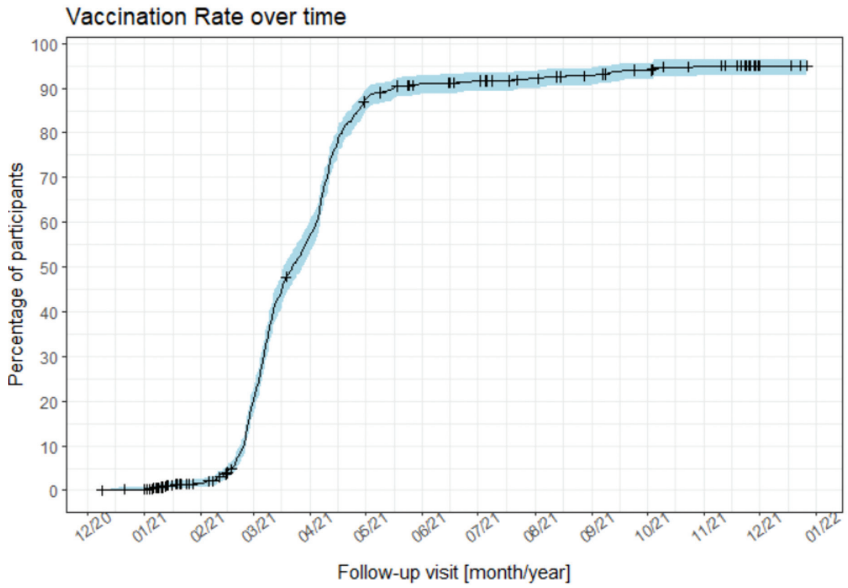
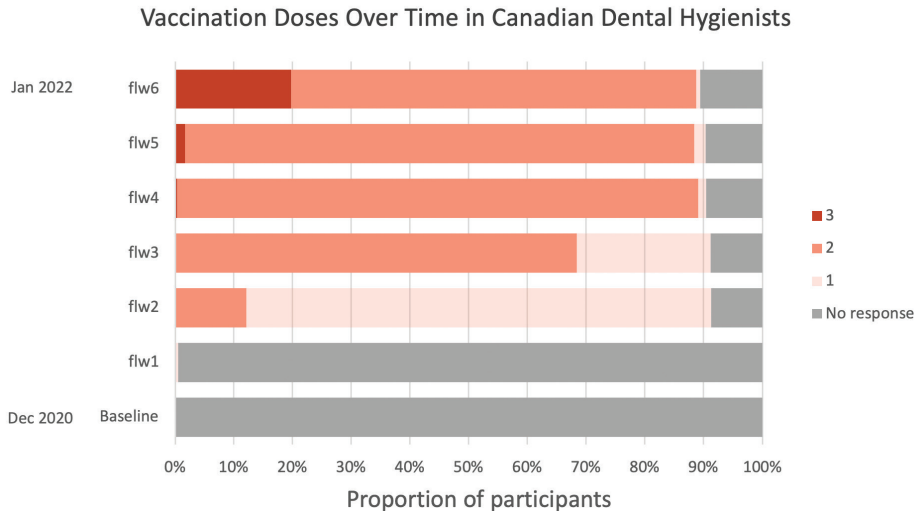


Figure 3. Number of vaccination doses taken by participants over time



dental hygienists, the current study assists in bridging this knowledge gap in the dental hygiene community. The findings suggest that dental hygienists do not have a higher incidence rate of COVID-19 than the general population. The low infection rate is a cumulative effect of all the different protective measures that have been employed, including the use of protective PPE, pre-procedural screening of clients, social distancing, and other public health measures. This study is a proof of principle that dental hygiene care is safe for clients and oral health care professionals when public health guidelines are followed.

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CONFLICTS OF INTEREST

The authors declare no known conflicts of interest.

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