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Severe acute respiratory syndrome coronavirus 2 infection in asymptomatic pediatric dental patients

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ABSTRACT

Background. Children with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are typically asymptomatic but contagious. The authors investigated the positivity rate of asymptomatic SARS-CoV-2 infection in pediatric dental patients.

Methods. The authors reviewed consecutive charts of children younger than 18 years scheduled for elective dental procedures from April 1, 2020, through August 1, 2020. All patients were screened for signs and symptoms of SARS-CoV-2 infection. Asymptomatic patients scheduled for dental procedures underwent polymerase chain reaction (PCR) testing for SARS-CoV-2. Socio-demographic characteristics were abstracted, and positivity rates were calculated. Variables for patients who were SARS-CoV-2 positive and SARS-CoV-2 negative were compared using Fisher exact and Mann-Whitney *U* tests.

Results. The sample size was 921. The median age was 6 years, and 50.9% were boys. The overall SARS-CoV-2 positivity rate was 2.3%. Age, insurance status, medical history, and dental diagnosis were comparable in patients who were SARS-CoV-2 positive and SARS-CoV-2 negative. Positivity rates were statistically higher for Hispanic or Latinx patients than other groups ($P = .038$).

Conclusions. Although the yield of testing was low, the systematic evaluation of asymptomatic pediatric dental cases via PCR resulted in the identification of SARS-CoV-2 carriers who could have been infectious. In this study, Hispanics or Latinx had a higher positivity rate than other demographic groups.

Practical Implications. PCR testing for SARS-CoV-2 of asymptomatic patients in pediatric dentistry adds value to the use of screening questionnaires for the identification of infected people who could be contagious.

Key Words. Pediatric dentistry; COVID-19; severe acute respiratory syndrome coronavirus 2; polymerase chain reaction testing.

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The COVID-19 pandemic continues to spread, with almost 54 million confirmed cases worldwide and more than 11 million people infected in the United States as of November 20, 2020.¹ At the same time, Chicago, Illinois, one of the hotspots in the United States, had approximately 573,000 reported cases.² COVID-19 is a disease caused by the zoonotic pathogen severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This disease manifests with nonspecific flulike symptoms, and its most common clinical complication is acute respiratory distress syndrome, which is the leading cause of death.³

Because severe illness due to SARS-CoV-2 in children is rare, screening efforts largely have targeted adult populations.^{4,5} Thus, the epidemiology of SARS-CoV-2 infection in children is not well known and is rapidly evolving. Children comprise approximately 20% of the US population.⁶ However, on the basis of data from the Centers for Disease Control and Prevention (CDC), SARS-CoV-2 cases occur in only 1.7% of people younger than 4 years and 7.7% of those aged 5 through 17 years.⁷ Patients who require medical care may have comorbid conditions that can predispose them to SARS-CoV-2 infection.⁸ Rates from 0.6% through 13.7% were reported in asymptomatic

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cohorts.⁹⁻¹³ Most of these studies included adults only. Three studies that tested asymptomatic surgical and oncological pediatric patients via polymerase chain reaction (PCR) reported positivity rates for SARS-CoV-2 from 0.6% through 2.5%.⁹⁻¹¹ In addition, a study including 33,041 asymptomatic children tested in different US hospitals reported a pooled prevalence of 0.7%.¹⁴ Although children typically have a benign course compared with adults or remain asymptomatic, they have the potential to carry substantial viral loads and be a source of infection.¹⁵

SARS-CoV-2 is present in high concentrations in the oral cavity and the pharynx.¹⁶ In addition, dental procedures can generate aerosols that increase the risk of contagion.¹⁷ Thus, oral health care providers are at high risk of getting infected if they encounter a positive SARS-CoV-2 patient. In the COVID-19 pandemic, the CDC and the American Dental Association have released interim guidelines for infection control in dental practices.^{16,18} These include screening every patient for signs and symptoms of COVID-19, the use of universal personal protection equipment, and source control strategies such as the use of face masks at all times, frequent hand hygiene, standard sequence of donning and doffing PPE, and implementation of technical approaches to reduce disease transmission. The CDC suggested SARS-CoV-2 testing for asymptomatic dental patients undergoing oral health care as a way to identify carriers and reduce the risk of experiencing exposure in dental facilities.¹⁶ This new strategy, however, has not been universally adopted.

The identification of patients with SARS-CoV-2 is important in guiding the implementation of infection control strategies and mitigating the risk of developing infection in oral health care providers. Despite these benefits, the epidemiology of SARS-CoV-2 infections in asymptomatic children requiring dental procedures has not been investigated, to our knowledge. In this article, we report the positivity rate of SARS-CoV-2 infection in asymptomatic children attending a high-volume pediatric dental practice in Chicago, Illinois.

METHODS

We conducted this retrospective study in a high-volume pediatric dental clinic associated with the University of Illinois at Chicago in Chicago, Illinois. The study was reviewed and approved by the local institutional review board. Owing to the nature of the study, the institutional review board waived the need for consent. The cohort analyzed was children younger than 18 years who were scheduled for comprehensive oral health care under general anesthesia or routine oral health care that required aerosol-generating procedures. Data collection of consecutive cases began on May 1, 2020, and ended on August 1, 2020. As part of our standard practice, all patients underwent preoperative telephone screening for signs and symptoms of COVID-19 or exposure to either proven or suspected cases of SARS-CoV-2 infection, as recommended by the CDC.¹⁹ The box depicts a copy of the screening questionnaire. Patients who confirmed having signs and symptoms of COVID-19 or exposure to either proven or suspected cases of SARS-CoV-2 during the preoperative screening were referred to their primary care physician for further evaluation and were not part of this study. SARS-CoV-2 testing was performed in all patients who answered no to all the screening questions. Nasopharyngeal swabs were obtained by clinic personnel who received education on specimen collection and handling as recommended by the CDC.²⁰ Samples were analyzed for SARS-CoV-2 RNA via reverse transcription PCR at Simple Laboratories in Chicago, Illinois (limit of detection of 10 RNA copies per microliter; specificity, > 99%).²¹ Parents or legal guardian of children with positive PCR testing were informed of the results and referred for pediatric evaluation.

We extracted demographics (age, sex, and race or ethnicity), insurance type, dental diagnosis, and medical history from the electronic dental record. In addition, for the Hispanic or Latinx patients, we extracted language of preference of the parent or caregiver as a measure of acculturation.²² Results are presented as median and interquartile ranges (IQR), total number, percentage, and relative risk (RR) with 95% confidence interval (CI). We analyzed age distribution using the Kolmogorov-Smirnov test. We calculated positivity rates as the number of positive SARS-CoV-2 cases divided by the total number of cases tested for each group. We compared the characteristics of patients who were SARS-CoV-2 positive and SARS-CoV-2 negative using Fisher exact test for categorical variables and Mann-Whitney *U* test for continuous variables. All tests of significance were 2-tailed, with a threshold for significance of *P* value less than .05. We performed statistical analyses using SPSS Version 27 (SPSS).

In an exploratory analysis, we investigated the effect of sex on positivity rate. To this end, we pooled data from independent studies that reported positivity rates in asymptomatic

ABBREVIATION KEY

- CDC:** Centers for Disease Control and Prevention.
- PCR:** Polymerase chain reaction.
- SARS-** Severe acute
- CoV-2:** respiratory syndrome coronavirus 2.

Box. Screening questionnaire.

Within the last 2 weeks, have you (or your child) experienced any of the following signs or symptoms?

- Fever
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

Within the last 2 weeks, have you (or your child) been exposed to a person who is known to have COVID-19 or SARS-CoV-2?

Within the last 2 weeks, have you (or your child) been exposed to a person who is under investigation for COVID-19 or SARS-CoV-2?

Within the last 2 weeks, have you (or your child) been asked to self-isolate or quarantine?

Within the last 2 weeks, have you (or your child) been exposed to a person that was placed in quarantine?

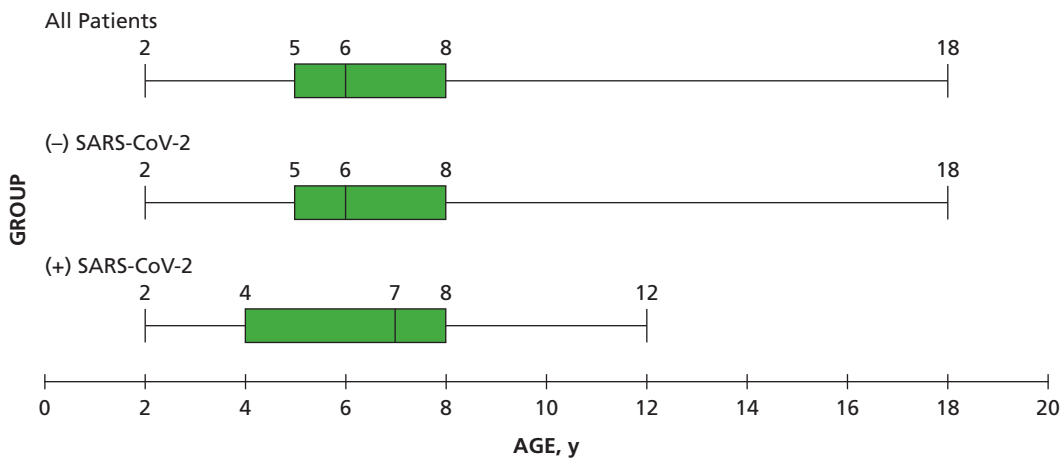


Figure 1. Age distribution for all, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) positive and SARS-CoV-2 negative patients.

pediatric cohorts.^{9,10} We performed the meta-analysis using RevMan Version 5.4 (Cochrane Collaboration). We pooled outcome data using the Mantel-Haenszel test, producing RR along with their 95% CI. We used random-effect models, given the initial sampling frame for the included studies. We assessed statistical heterogeneity among studies using the I^2 statistic, with results below 50% indicative of high heterogeneity. The statistical analysis was performed by 2 of the authors (G.T., F.D.T.). None of the authors had a direct role in data collection, the administration of the screening questionnaires, or the performance of the reverse transcript PCR.

RESULTS

A total of 921 pediatric patients were included in the study. The median (IQR) age of our cohort was 6 (5-8) years (range, 2-18 years) (Figure 1). The table depicts the characteristics of the study cohort. There was a comparable representation of males and females. Our cohort largely comprised Hispanic or Latinx

Table. Clinical and demographic characteristics.

VARIABLE	ALL (n = 921)	SARS-CoV-2* NEGATIVE (n = 900)	SARS-CoV-2 POSITIVE (n = 21)	P VALUE
Age, y (Interquartile Range)	6 (5-8)	6 (5-8)	7 (4-8)	.391
Male Sex, No. (%)	471 (51.2)	458 (50.9)	13 (61.9)	.380
Race or Ethnicity, No. (%)				
Asian	51 (5.5)	51 (5.7)	0 (0.0)	.624
White	148 (16.1)	146 (16.2)	2 (9.5)	.556
Black	73 (7.9)	73 (8.1)	0 (0.0)	.401
Hispanic or Latinx	583 (63.3)	565 (62.8)	18 (85.7)	.038
Other	61 (6.6)	60 (6.7)	1 (4.8)	> .999
Unknown	5 (0.6)	5 (0.6)	0 (0.0)	> .999
Insurance, No. (%)				
Public Aid	859 (93.2)	839 (93.2)	20 (95)	> .999
Private	55 (6.0)	54 (6.0)	1 (5)	> .999
Self-pay	7 (0.8)	7 (0.8)	0 (0)	> .999
Medical History, No. (%)				
Allergies	12 (1.3)	12 (1.3)	0 (0)	> .999
Anemia	5 (0.5)	6 (0.7)	0 (0)	> .999
Asthma	20 (2.2)	19 (2.1)	1 (7)	.373
Psychiatric/Neurologic [†]	9 (1.0)	9 (1.0)	0 (0)	> .999
Heart murmur	6 (0.7)	5 (0.6)	1 (7)	.130
Other	2 (0.2)	2 (0.2)	0 (0)	> .999
Dental Diagnosis, No. (%)				
Caries	825 (89.6)	807 (89.7)	20 (95.0)	.258
Caries with abscess	77 (8.3)	74 (8.2)	1 (5.0)	.410
Orthodontics (debonding)	19 (2.1)	19 (2.1)	0 (0)	> .999
Language of Preference, No. (%)[‡]				
English	335 (58.1)	327 (57.9)	8 (44.4)	.334
Not documented	4 (0.7)	4 (0.7)	0 (0.0)	> .999

* SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2. † Includes autism spectrum disorder, mood disorders, learning disabilities, and cerebral palsy. ‡ Calculated for Hispanics or Latinx only.

children, who accounted for 63% of the participants. Approximately 93% were covered by medical assistance programs from the Illinois Department of Healthcare and Family Services (Public Aid).

The overall SARS-CoV-2 positivity rate was 2.3% (21 of 921). **Figure 1** shows the distribution of ages for the SARS-CoV-2 positive and negative groups. The median (IQR) age was 6 (5-8) years for patients who were SARS-CoV-2 negative (range, 2-17 years) and 7 (4-8) years for patients who were SARS-CoV-2 positive (range, 2-12 years). Age in both groups, however, was not statistically different. Age was also analyzed as a continuous variable. Under these circumstances, the association of age with SARS-CoV-2 remained not statistically significant (data not shown). Insurance status, medical history, and dental diagnosis were comparable in both groups. Positivity rates were statistically higher for the Hispanic or Latinx group than other groups ($P = .038$); frequency values were 3.1% in Hispanics or Latinx, 1.4% in whites, and 0% in blacks and Asians. The RR of Hispanics or Latinx having a positive SARS-CoV-2 test was 3.5 (95% CI, 1.04 to 11.7; $P = .040$). No statistically significant differences were observed in the language of preference for Hispanics or Latinx with positive and negative SARS-CoV-2 tests.

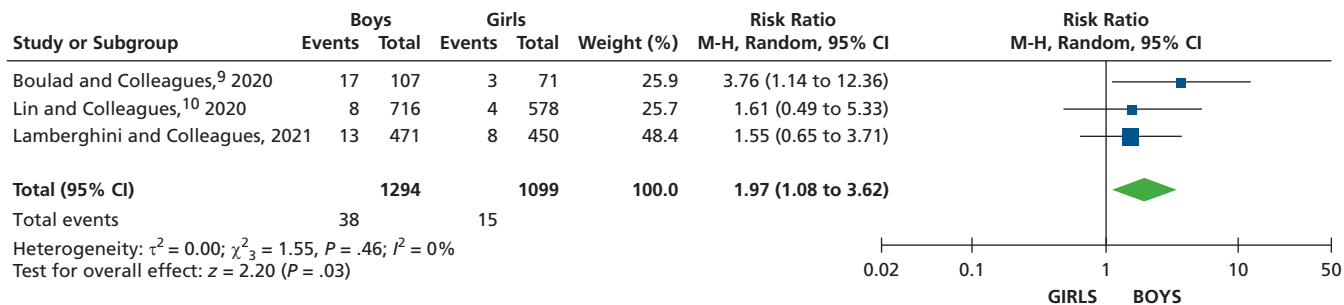


Figure 2. Forest plot of pooled relative risk for the effect of sex on severe acute respiratory syndrome coronavirus 2 test positivity for asymptomatic patients. Size of each square is relative to its random-effects model weight, and the corresponding 95% confidence interval (CI) is represented by the horizontal lines. The width of the diamond represents the 95% CI of the pooled relative risk from all studies. M-H: Mantel-Haenszel (random-effects model).

The sex distribution among the SARS-CoV-2 positive children exhibited an almost double frequency of boys ($n = 13$) compared with girls ($n = 8$); however, this difference did not reach statistical significance (RR, 1.55; 95% CI, 0.65 to 3.71; $P = .32$). In pooled data analysis using information from other studies reporting the rate of positivity in asymptomatic patients ($n = 2,393$), boys had a 1.97 times increased risk (95% CI, 1.08 to 3.62) of being positive for SARS-CoV-2 compared with girls, with an I^2 of 0% (Figure 2).

DISCUSSION

In this study, we observed a low positivity rate of SARS-CoV-2 among asymptomatic pediatric dental patients. In addition, Hispanics or Latinx had a higher relative positivity risk than other sociodemographic groups. The true burden of asymptomatic pediatric cases is still unknown, and several factors contribute to this problem, such as the age limits at certain testing centers and the discomfort associated with the swab.^{23,24} The rate of positivity of 2.3% observed in our cohort was higher than the 0.6% through 0.9% described in oncological pediatric patients^{9,11} and closer to the 2.2% reported in surgical pediatric patients.¹⁰ In comparison, our estimates were higher than the pooled prevalence of 0.65% reported by Sola and colleagues.¹⁴ In that study, the prevalence of SARS-CoV-2 varied by region and ranged from 0% through 2.2%. Together, these findings suggest that the SARS-CoV-2 positivity rate is heterogeneously distributed in the general population. In our study, we had a higher representation of Hispanics or Latinx. Data from the Illinois Department of Public Health showed that the positivity rate for SARS-CoV-2 infection was higher in Hispanics or Latinx than in other demographic groups.²⁵ Our findings are in agreement with these estimates and support the notion that the implementation of SARS-CoV-2 testing may be particularly useful in pediatric dental clinics that provide care to sociodemographic groups with elevated prevalence of the disease based on local registries. In addition, our findings confirm that the implementation of questionnaires, although useful to identify high-risk patients, does not eliminate completely the risk of SARS-CoV-2 spreading in dental offices.

Studies conducted in adult cohorts have shown consistently that men are more likely than women to experience severe COVID-19 disease.^{26,27} It has been suggested that sex-specific differences in immunity may predispose males to develop a more robust inflammatory response against SARS-CoV-2, leading to systemic complications and death.²⁸ However, a report shows that males and females have comparable prevalences.⁷ In our study, we observed that boys have a trend toward higher positivity rate of infection than girls. This difference did not reach statistical significance but remained steady through the entire data collection period, suggesting that our study could have been underpowered to address this question. Using pooled data from other 2 studies that reported rate of positivity in pediatric cohorts, we confirmed that males have an approximately 2-fold increase in the risk of being positive for SARS-CoV-2 than females.^{9,10} From the pathogenic standpoint, it has been suggested that sex-specific factors may upregulate the expression of angiotensin-converting enzyme 2 in epithelial cells, which is the binding site for SARS-CoV-2 in human cells.²⁸ However, because of the low sample size, the results of our pooled analysis should be interpreted with caution.

Our study had several limitations. First, the positivity rates in different demographic subgroups were likely to mirror the distribution of prevalences in the local community. Thus, our data do

not prove necessarily that Hispanics or Latinx have an intrinsic susceptibility to the disease. It is likely that different socioeconomic factors may play a role in the increased positivity rate observed in this subpopulation. To this end, we did not have access to key information, such as the ability of parents or caregivers to exercise social distancing, access by parents or caregivers to remote work, household income, and dwelling conditions, which are likely to influence disease exposure. Second, our sample was skewed to include a higher proportion of Hispanics or Latinx and lower proportions of Asians and blacks. For our findings to be generalizable to the entire population, they should be replicated in a larger sample with a census representation of each race and ethnicity. Third, positivity rates are influenced by the quality of the sample collection and handling. Pediatric patients may not cooperate with nasal swabbing, and this represents an additional challenge. In our practice, nasopharyngeal samples were obtained by trained personnel who received targeted education as recommended by the CDC.²⁰ It is likely that the saliva testing will be better accepted by children and easier to implement in pediatric clinical practices. Fourth, the low number of positive cases, manifested by the large 95% CIs, limits our ability to identify predictors of SARS-CoV-2 infection. However, our report is the second largest study looking at the positivity rate in a pediatric cohort and the first conducted in a private environment. The main strength of our study is its novelty, as it is the first report, to our knowledge, on positivity rate for SARS-CoV-2 in dentistry.

In our study, we observed that PCR testing for SARS-CoV-2 of asymptomatic patients adds value to the use of screening questionnaires for the identification of infected patients who could be contagious. Failure to identify these patients may perpetuate the spread of the infection and have negative ramifications in the dental workforce. The positivity rate described in our article is relatively low but within the range described in pediatric cohorts with medical conditions at large academic centers.^{9-11,14} The incidence of COVID-19 that would justify the use of PCR screening in a dental practice has not been established. It has been proposed that mass testing with the goal of identifying asymptomatic carriers may be a necessary and effective strategy to limit the spread of the disease.²⁹ Practical aspects should be considered before implementing such an approach. The use of rapid COVID-19 antigen platforms in the dental office is a provocative idea, and several models have been developed.³⁰ However, the cost of the diagnostic equipment and test kits can add rapidly to the increasing costs associated with the pandemic.³¹ As an alternative, clinics can use decentralized diagnostic laboratories. On the basis of our own experience, however, these laboratories may favor providing services to large clinics to the detriment of low-volume offices. In addition, practices should adopt a flexible and streamlined scheduling process that allows bringing the patient back for treatment shortly after the testing. There is also the issue of patients or their parents not being amenable to nasopharyngeal swabbing. On the basis of our experience, it is important that clinics revisit their established workflows and confirm the feasibility of SARS-CoV-2 testing. This requires identifying the suitable diagnostic test and allocating additional resources for phone screening, nasopharyngeal swabbing, and dynamic scheduling.

CONCLUSIONS

Dental practices resuming care should consider adding SARS-CoV-2 testing to the use of screening tools, personal protective equipment, and source control strategies before using aerosol-generating procedures. This may be particularly important to reduce exposure in areas of elevated regional prevalence of SARS-CoV-2. ■

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