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Effects of the COVID-19 pandemic on children's oral health and oral health care use

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ABSTRACT

Background. The COVID-19 pandemic led to early restrictions on access to oral health care and social distancing requirements. The authors examined the early effects of the COVID-19 pandemic on children's oral health and access to oral health care in the United States.

Methods. Using nationally representative data from the National Survey of Children's Health, the authors compared several measures of children's oral health and oral health care use early during the pandemic in 2020 with 1 year earlier. Logistic (multinomial or binary) regression models were estimated, adjusting for several child and household covariates and state fixed effects. Similar comparisons were estimated for 2019 relative to 2018 to evaluate prepandemic trends.

Results. Children in 2020 were 16% (relative risk ratio, 0.84; 95% CI, 0.75 to 0.93) less likely to have excellent dental health as perceived by parents and 75% (relative risk ratio, 1.75; 95% CI, 1.14 to 2.67) more likely to have poor dental health than in 2019. In addition, children in 2020 had higher risk of bleeding gingivae (odds ratio, 1.46; 95% CI, 1.16 to 1.85). The likelihood of having a dental visit in the past 12 months was 27% (odds ratio, 0.73; 95% CI, 0.65 to 0.82) lower in 2020, including lower likelihood for preventive visits. The differences between 2020 and 2019 were observed across demographic and socioeconomic subgroups. There were no such differences between 2019 and 2018.

Conclusions. There was a widespread decline in children's oral health status and access to oral health care early during the COVID-19 pandemic.

Practical Implications. Prompt policies and oral health campaigns are needed to counter the pandemic effects and increase timely access to dental services.

Key Words. Severe acute respiratory syndrome coronavirus 2; child dental health; access to oral health care; health policy.

Supplemental material is available online.

T he COVID-19 pandemic has posed considerable challenges to children's health.[1-3] Several COVID-19 mitigation policies were declared in the United States beginning in March and April 2020, including lockdowns and closures of schools and businesses.[4] One consequence of these closures and social distancing measures was disrupting children's access to health care services.[5,6] Children's oral health status was likely one of the more adversely affected domains of children's health due to early imposed restrictions on access to dental services.[7-9] However, there is little empirical evidence on the magnitude of changes in children's oral health status and use of dental services during the COVID-19 pandemic. Our aim was to provide evidence on this matter.

In March 2020, the Centers for Diseases Control and Prevention and the American Dental Association recommended that dental offices postpone elective procedures and provide emergency care only[10,11] due to concerns about COVID-19 exposure during treatment.[12-14] Most states also imposed their own restrictions on services at dental offices in the first few months of the pandemic.[15] These restrictions, along with social distancing measures, likely resulted in many parents having to postpone oral health care for their children during the pandemic, particularly for preventive care and nonemergency treatments. Although most dental clinics have reopened since

June 2020, more than 60% reported lower patient volume than usual or closed by the end of 2020, and nearly 40% reported lower volume or closed by October 2021.[16]

The rise in unemployment early in the pandemic might have also reduced access to oral health care due to loss of income and employer-sponsored insurance coverage for 6.9 million dependents by June 2020.[17] Children were more likely to experience unmet oral health care than medical care during the pandemic, especially in families with pandemic-related job or income losses.[9] Among privately insured children, the use of oral health care also rebounded at a slower rate than among insured adults after the reopening.[18] Limited access to, and delayed, oral health care are critical risk factors for worsened children's oral health.[19-22]

School closures during the pandemic likely also had adverse effects on children's oral health. In 2020, most schools closed or changed to remote instruction. School closures disrupted children's access to the school-based oral health care programs offered in some schools. In 2021, there were nearly 2,000 school-based health centers, approximately 16% of which provide onsite dental services to thousands of students annually.[23] Moreover, school closures have disrupted children's access to school-based breakfast and lunch meals. For some children, at-home meals might be less nutritious with more added sugar, a major risk factor for caries in children.[24,25] Meanwhile, the social restrictions and increased time at home might have also changed children's lifestyles and health behaviors. Some studies reported that during the pandemic children had decreased frequency of toothbrushing,[26] poor oral hygiene,[27] and increased consumption of sugar-sweetened beverages and snacks,[26,28-30] which might increase risk of caries and periodontal disease.

We examined the early effects of the COVID-19 pandemic on children's oral health and access to oral health care in the United States. Specifically, we compared several indicators of children's oral health and use of oral health care early during the pandemic in 2020 with the same indicators 1 year before the pandemic using nationally representative data. In addition, we evaluated whether the pandemic's effects on these outcomes differed across demographic and socioeconomic subgroups.

METHODS

Study data and sample

Data were from the 2018 through 2020 waves of the National Survey of Children's Health (NSCH), sponsored by the Maternal and Child Health Bureau and conducted by the US Census Bureau. The NSCH is a nationally representative, cross-sectional survey using both web- and paper-based questionnaires to obtain information about several aspects of children's health and health care use. Questionnaires were completed by parents (91% of respondents) or other caregivers (9%). The NSCH randomly selects households with at least 1 child from all 50 states and the District of Columbia. In total, 125,443 households with children were selected from 2018 through 2020, and 102,740 of them completed the survey questionnaire (an interview completion rate of 82%).

The 2018 interviews were completed from June 2018 through January 2019. The 2019 interviews were completed from June 2019 through January 2020. The 2020 interviews were completed from July 2020 through January 2021. Of particular relevance to our study was that all interviews were completed at least 4 months after the COVID-19 pandemic started in the United States and after the initial widespread lockdowns and business and school closures in the United States from late March through May 2020. During the period of the 2020 NSCH wave interviews (July 27, 2020-January 22, 2021), there were more than 20 million new cases of COVID-19, with a daily average of 115,000 new cases. The main analytical sample ranged from 91,626 through 92,428 children (depending on outcome) aged 1 through 17 years with complete data on outcomes and explanatory model variables (described below). Infants aged 0 years were excluded from the main sample, as most (65%) had no teeth, but were added back to the sample in sensitivity analyses. Descriptive statistics for the main sample are presented in eTable 1 (available online at the end of this article).

Outcomes

Outcomes were measures of the child's oral health or oral health care use. The first outcome was dental health, as perceived by parents (or other responding primary caregivers) on a Likert scale (that is, excellent, very good, good, fair, or poor). The second outcome was based on a question about whether the child had frequent or chronic difficulty with oral health problems during the past 12 months, including toothaches, bleeding gingivae, or caries. We coded a binary (0 or 1) indicator
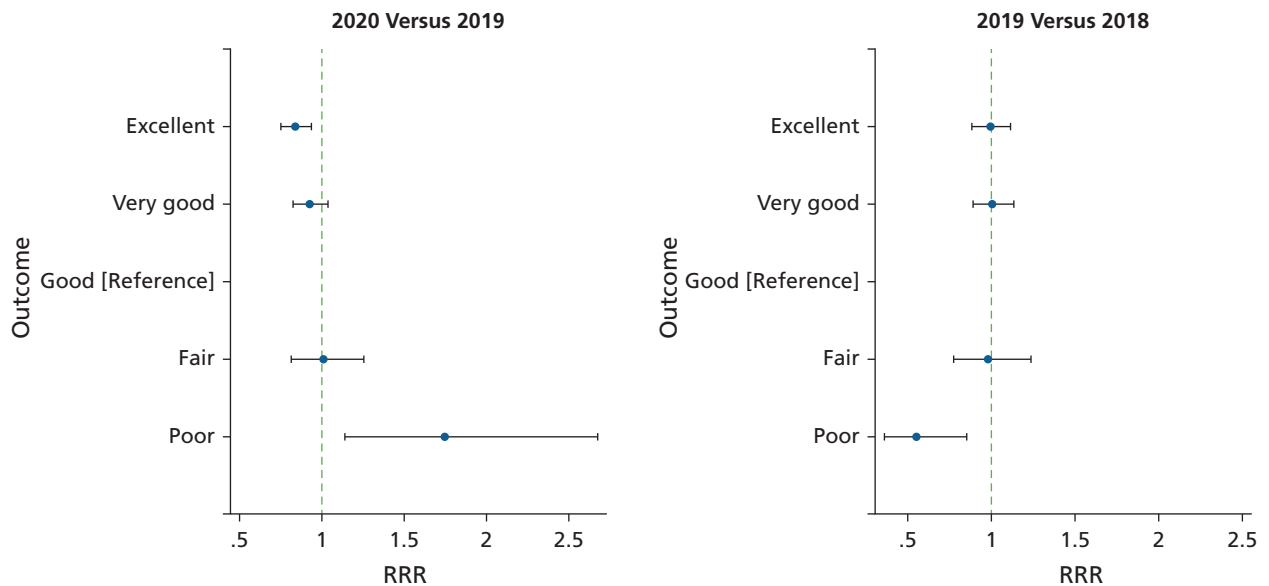
Figure 1. Differences (relative risk ratios [RRRs] with 95% CIs) in children's dental health as perceived by parents between 2020 and 2019 and between 2019 and 2018. The sample included children aged 1 through 17 years. The RRRs (dots) and 95% CIs (bars) were obtained from multinomial logistic regression estimates for the child's dental health as perceived by parents (5 categories ranging from excellent to poor, with good as the reference category) with separate regressions for comparing 2020 with 2019 and comparing 2019 with 2018. The model used data from the 2018 through 2020 waves of the National Survey of Children's Health and adjusted for age, sex, race or ethnicity, highest education of parents, number of children, marital status, any employment, income as a percentage of the federal poverty threshold, and state fixed effects. The model was weighted using the National Survey of Children's Health sampling weights to yield nationally representative estimates.

for reporting any of these problems and separate binary indicators for each of these problems. Use of dental services was measured by means of 2 variables on the basis of the survey questions: 1 was a binary indicator for whether the child had any dental visits in the past 12 months and 2 was a 3-category variable for whether the child had none, 1, or 2 or more preventive dental visits in the past 12 months. The questionnaire defined a preventive dental visit as one involving any of the following services: dental examination, dental prophylaxis, dental sealant, or fluoride treatment.

Statistical analysis

Oral health and oral health care use outcomes were compared between 2020 and 2019 using a regression model. Specifically, each outcome was regressed on a binary indicator (1 if 2020 survey wave and 0 if 2019 survey wave), adjusting for several conceptually relevant child, family, and state-level covariates.[31] The child's covariates were age (year-by-year binary indicators), sex, and race or ethnicity. The household covariates were the highest education of caregivers, number of children, marital status, any employment, and income as a percentage of the federal poverty threshold. The regression also adjusted for state fixed effects (binary indicators for states). To examine whether outcomes were changing before the pandemic (that is, if there were time trends), which would bias the comparison as capturing the pandemic effect, another regression model was estimated comparing the outcomes in survey wave 2019 through 2018 using the same set of covariates.

For the 2 multicategory ordered outcomes, dental health as perceived by parents (from excellent to poor) and the number of preventive dental visits, an ordered logistic regression was first considered. However, the proportional odds assumption was rejected on the basis of the Brant test.[32] Therefore, the model for these 2 outcomes was estimated using multinominal logistic regression (which drops the proportional odds assumption). For binary outcomes (any dental problem, any dental visit), a binary logistic regression was used. Regression models were estimated using the survey sampling weights to obtain nationally representative estimates.

The model was estimated first for the total sample. Additional models were estimated for demographic and socioeconomic subgroups to evaluate potential differences. In those analyses, the regression models were estimated according to child's age (1-5 years, 6-11 years, 12-17 years), sex, race or ethnicity (non-Hispanic White versus Hispanic or non-White), family income (< 200%,

200%-399%, and $\geq$ 400% of federal poverty threshold) and insurance status (publicly insured versus not).

RESULTS

Oral health

Figure 1 presents the relative risk ratios (RRRs) and their 95% confidence intervals (CIs) from the multinomial logistic regression for the child's dental health as perceived by parents (5 categories ranging from excellent to poor, with good as the reference category) comparing 2020 with 2019. Children in 2020 were 16% (RRR, 0.84; 95% CI, 0.75 to 0.93) less likely to have excellent (versus good) dental health as perceived by parents than children in 2019. Moreover, children in 2020 were 75% (RRR, 1.75; 95% CI, 1.14 to 2.67) more likely to have a poor dental health as perceived by parents than 2019. Also, there was a statistically nonsignificant decrease in the likelihood of very good dental health as perceived by parents (RRR, 0.92; 95% CI, 0.82 to 1.04). These differences were not observed when comparing children in 2019 with children in 2018; there were similar proportions with excellent or very good dental health as perceived by parents between those years. There was an opposite difference in poor dental health as perceived by parents, in that children in 2019 were less likely to have poor teeth than in 2018. The only exception was that children were approximately 45% (RRR, 0.55; 95% CI, 0.36 to 0.85) less likely to be rated at poor dental health relative to rating them at good dental health. Therefore, time trends (based on the comparison of 2019 with 2018) do not appear to explain the difference between 2019 and 2020. Results were similar when adding infants aged 0 years.

Figure 2 shows the odds ratios (ORs) from the logistic regression for oral health problems (toothaches, bleeding gingivae, caries) and for each problem separately. Children had a slightly elevated risk of any problem in 2020 compared with 2019, although the difference was not statistically significant (OR, 1.08; 95% CI, 0.97 to 1.20). When examining each problem separately, all 3 problems had elevated risks in 2020 but the difference between 2019 and 2020 was largest and statistically significant for bleeding gingivae only (OR, 1.46; 95% CI, 1.16 to 1.85). Differences between 2019 and 2018 were small and statistically nonsignificant, indicating no prepandemic time trends that would bias the observed differences between 2020 and 2019. Similar results were observed when adding infants aged 0 years.

Oral health care use

Figure 3 reports the estimates for oral health care use measures. The likelihood of having a dental visit in the past 12 months was 27% (OR, 0.73; 95% CI, 0.65 to 0.82) lower in 2020 than in 2019. Similarly, children were 18% (RRR, 0.82; 95% CI, 0.74 to 0.93) less likely to have had 1 preventive dental visit in the past 2 months and 40% (RRR, 0.60; 95% CI, 0.54 to 0.68) less likely to have had 2 or more preventive dental visits in 2020. All estimates comparing 2019 with 2018 were small and statistically nonsignificant, suggesting no bias from prepandemic trends. Results were similar when adding infants aged 0 years.

Subgroup analyses

Tables 1, 2, and 3 report the regression results for children's dental health as perceived by parents, oral health problems, and oral health care use, respectively, according to age, race or ethnicity, sex, income, and public health insurance status. Most estimates were generally similar across subgroups. The increased likelihood of poor dental health in 2020 was most pronounced among Hispanic or non-White children, those with household income from 200% through 399% of the federal poverty threshold, and those without public insurance coverage (Table 1). The increase in bleeding gingivae likelihood was largest among children aged 1 through 5 years (Table 2), also largest when adding infants aged 0 years (eTable 2; available online at the end of this article). All subgroups had statistically significant declines in oral health care use in 2020 (Table 3).

DISCUSSION

Using nationally representative data, we examined the early effects of the COVID-19 pandemic on oral health and oral health care use for children in the United States by means of comparing these outcomes between 2020 (the first year of the COVID-19 pandemic) and 2019 (1 year before the
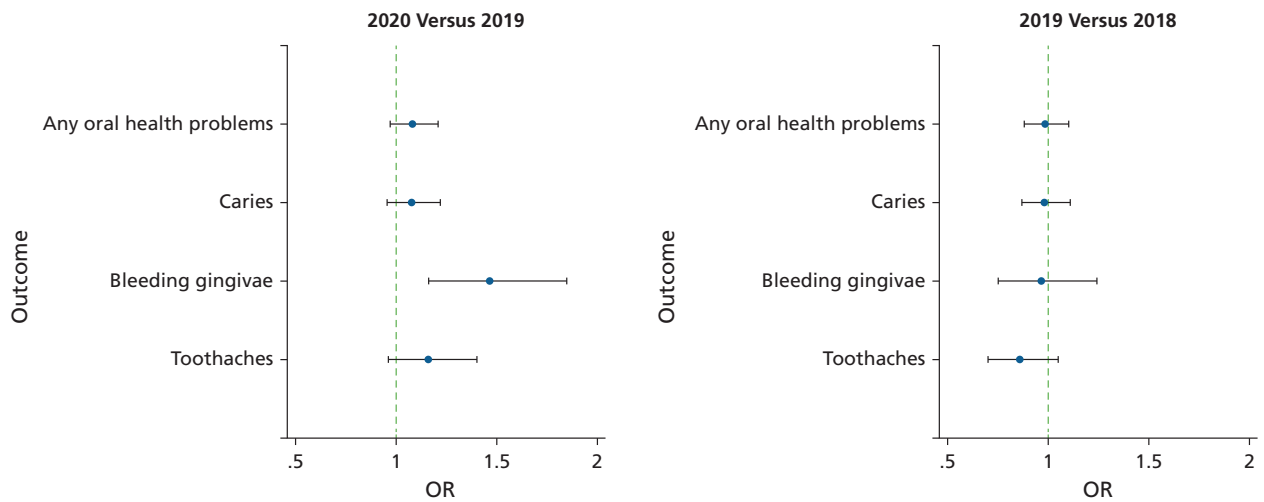
2020 Versus 2019

2019 Versus 2018

Figure 2. Differences (odds ratios [ORs] and 95% CIs) in children's oral health problems between 2020 and 2019 and between 2019 and 2018. The sample included children aged 1 through 17 years. The ORs (dots) and 95% CIs (bars) were obtained from logistic regression for oral health problems (toothaches, bleeding gingivae, caries) and for each problem separately, comparing 2020 with 2019 and comparing 2019 with 2018. All models used data from the 2018 through 2020 waves of the National Survey of Children's Health and adjusted for age, sex, race or ethnicity, highest education of parents, number of children, marital status, any employment, income as a percentage of the federal poverty threshold, and state fixed effects. The model was weighted using the National Survey of Children's Health sampling weights to yield nationally representative estimates.

2020 Versus 2019

2019 Versus 2018

Figure 3. Differences (odds ratios [ORs] or relative risk ratios [RRRs] and 95% CIs) in children's use of dental visits between 2020 and 2019 and between 2019 and 2018. The sample included children aged 1 through 17 years. The ORs (dots) and 95% CIs (bars) were obtained from logistic regression for any dental visits comparing 2020 with 2019 and comparing 2019 with 2018. The RRRs (dots) and 95% CIs (bars) were obtained from multinomial logistic regression estimates for number of preventive dental visits (3 categories of none, 1, or 2 or more visits, with no visit as reference group) comparing 2020 with 2019 and comparing 2019 with 2018. All models used data from the 2018 through 2020 waves of the National Survey of Children's Health and adjusted for age, sex, race or ethnicity, highest education of parents, number of children, marital status, any employment, income as a percentage of the federal poverty threshold, and state fixed effects. The model was weighted using the National Survey of Children's Health sampling weights to yield nationally representative estimates.
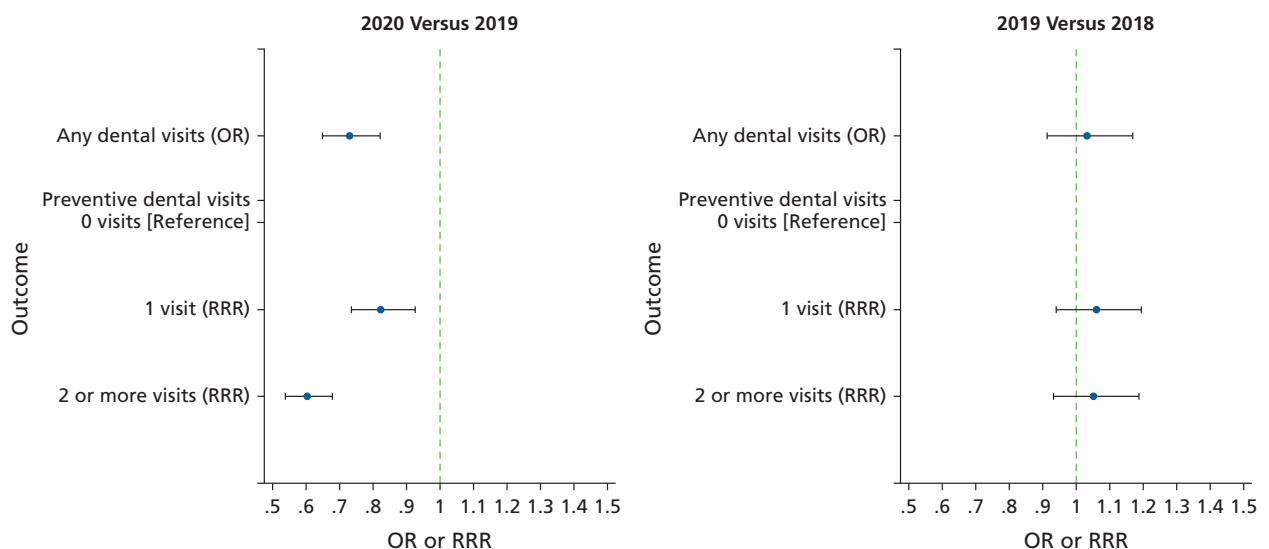
pandemic). There was a decline in children's dental health as perceived by parents as excellent and an increase in rating as poor in 2020. In addition, there was greater reporting of bleeding gingivae. Consistent with these differences in oral health, there was also a decline in the likelihood of dental visits, including preventive care visits. These differences between 2020 and 2019 were observed across a range of demographic and socioeconomic subgroups. Overall, there was no evidence of prepandemic trends based on comparisons between 2019 and 2018 that would explain the observed differences between 2020 and 2019. These results suggest that the COVID-19 pandemic had

Table 1. Differences (RRRs* with 95% CIs[†]) in children's[‡] dental health as perceived by parents between 2020 and 2019 and between 2019 and 2018.

		CHILDREN'S DENTAL HEALTH AS PERCEIVED BY PARENTS			
VARIABLE	No.	Excellent, RRR (95% CI)	Very Good, RRR (95% CI)	Fair, RRR (95% CI)	Poor, RRR (95% CI)
2020 Versus 2019					
Aged 1-5 y	16,756	0.73[§] (0.565 to 0.932)	0.80[¶] (0.610 to 1.039)	0.64 (0.377 to 1.090)	1.88 (0.790 to 4.468)
Aged 6-11 y	20,442	0.90 (0.753 to 1.072)	0.98 (0.827 to 1.173)	1.01 (0.740 to 1.367)	1.85[¶] (0.889 to 3.844)
Aged 12-17 y	27,488	0.84[§] (0.707 to 0.996)	0.92 (0.771 to 1.107)	1.23 (0.876 to 1.730)	1.39 (0.812 to 2.393)
Non-Hispanic White	44,497	0.88[§] (0.782 to 0.984)	0.91 (0.803 to 1.022)	0.98 (0.792 to 1.223)	1.21 (0.721 to 2.046)
Hispanic or non-White	20,189	0.80[§] (0.669 to 0.962)	0.96 (0.799 to 1.155)	1.04 (0.756 to 1.436)	2.49[#] (1.368 to 4.515)
< 200% federal poverty threshold	16,898	0.82[§] (0.680 to 0.989)	0.92 (0.764 to 1.116)	0.92 (0.677 to 1.261)	1.12 (0.660 to 1.912)
200%-399% federal poverty threshold	20,543	0.86 (0.719 to 1.033)	0.90 (0.748 to 1.083)	1.16 (0.834 to 1.613)	3.12[#] (1.465 to 6.637)
≥ 400% federal poverty threshold	27,245	0.86 (0.717 to 1.033)	0.98 (0.811 to 1.190)	1.08 (0.752 to 1.564)	1.31 (0.547 to 3.121)
Publicly insured	14,316	0.78[§] (0.638 to 0.958)	0.87 (0.711 to 1.054)	1.06 (0.760 to 1.491)	1.06 (0.591 to 1.887)
Not publicly insured	49,151	0.89[¶] (0.785 to 1.013)	1.01 (0.883 to 1.151)	1.36[¶] (1.043 to 1.762)	2.15[#] (1.205 to 3.851)
2019 Versus 2018					
Aged 1-5 y	13,916	1.17 (0.906 to 1.522)	1.12 (0.850 to 1.463)	1.03 (0.580 to 1.839)	1.00 (0.465 to 2.147)
Aged 6-11 y	17,206	1.02 (0.850 to 1.235)	1.02 (0.847 to 1.220)	1.11 (0.786 to 1.554)	0.48[§] (0.262 to 0.891)
Aged 12-17 y	23,087	0.88 (0.738 to 1.049)	0.96 (0.798 to 1.157)	0.84 (0.578 to 1.207)	0.54[¶] (0.267 to 1.079)
Non-Hispanic White	38,149	1.04 (0.926 to 1.170)	1.10 (0.971 to 1.241)	0.98 (0.789 to 1.226)	0.95 (0.535 to 1.671)
Hispanic or non-White	16,060	0.96 (0.793 to 1.169)	0.92 (0.759 to 1.121)	0.97 (0.676 to 1.385)	0.35[#] (0.192 to 0.647)
< 200% federal poverty threshold	13,898	0.95 (0.777 to 1.164)	0.96 (0.787 to 1.170)	1.07 (0.769 to 1.503)	0.55[§] (0.318 to 0.954)
200%-399% federal poverty threshold	17,269	1.03 (0.861 to 1.231)	1.08 (0.898 to 1.298)	0.83 (0.572 to 1.199)	0.80 (0.375 to 1.704)
≥ 400% federal poverty threshold	23,042	1.02 (0.842 to 1.229)	1.01 (0.826 to 1.231)	0.88 (0.589 to 1.307)	0.42[§] (0.179 to 0.980)
Publicly insured	11,781	0.94 (0.756 to 1.170)	0.99 (0.808 to 1.219)	0.93 (0.661 to 1.318)	0.71 (0.419 to 1.194)
Not publicly insured	41,304	1.01 (0.886 to 1.156)	1.01 (0.877 to 1.157)	0.93 (0.697 to 1.241)	0.47[§] (0.250 to 0.881)

* RRR: Relative risk ratio. † The RRRs and 95% CIs were obtained from multinomial logistic regression estimates for the child's dental health as perceived by parents (5 categories ranging from excellent to poor, with good as the reference category) with separate regressions for comparing 2020 with 2019 and comparing 2019 with 2018. The model used data from the 2018-2020 waves of the National Survey of Children's Health and adjusted for age, sex, race or ethnicity, highest education of parents, number of children, marital status, any employment, income as a percentage of the federal poverty threshold, and state fixed effects. The model was weighted by the National Survey of Children's Health sampling weights to yield nationally representative estimates. ‡ The sample included children aged 1-17 years. § $P < .05$. ¶ $P < .1$. # $P < .01$.

widespread adverse effects on children's oral health and oral health care use in its first year. These results are consistent with those of other studies in the United Kingdom, Israel, and Brazil, which also showed that the COVID-19 pandemic was significantly associated with reduced access to oral health care and poorer oral health status among children.[26,33-35]

Improving children's oral health and access to oral health care has long been a desired policy and public health objective in the United States, even before the COVID-19 pandemic. Preventable dental problems often lead to chronic oral health conditions among children. According to the Centers for Disease Control and Prevention, in 2011 through 2016, nearly one-half of children had caries.[36] The prevalence of untreated caries was high, ranging between 5% and 17% depending on age, including 10% among toddlers and 17% among adolescents.[36] At the same time, oral health care remains one of the greatest unmet health care needs among children, with multiple barriers to access, including unaffordable financial cost, lack of dental insurance coverage, difficulty finding a dental provider accepting Medicaid, and transportation costs.[37-40] The pandemic likely magnified 1 or more of these barriers to oral health care for most families, particularly with the widespread closures of dental practices early on, social distancing measures, and employment and income loss for some families. The decline in oral health status and oral health care use may result in more untreated oral health problems among children, which can adversely affect their overall health and development in several ways. Poor oral health can result in pain, infection, sepsis, sleep disruption, decreased appetite, and other health complications and is associated with lower psychosocial well-being and academic performance.[41-44]

Table 2. Differences (ORs* and 95% CIs[†]) in children's[‡] oral health problems between 2020 and 2019 and between 2019 and 2018.

	2020 VERSUS 2019			2019 VERSUS 2018		
VARIABLE	**No.**	**OR**	**95% CI**	**No.**	**OR**	**95% CI**
Any Oral Health Problems						
Aged 1-5 y	16,723	1.19	0.916 to 1.549	13,843	0.98	0.758 to 1.269
Aged 6-11 y	20,319	1.03	0.883 to 1.212	17,066	1.01	0.856 to 1.186
Aged 12-17 y	27,304	1.08	0.907 to 1.297	22,884	0.99	0.821 to 1.195
Non-Hispanic White	44,289	1.04	0.924 to 1.166	37,867	0.97	0.860 to 1.084
Hispanic or non-White	20,057	1.11	0.934 to 1.324	15,926	1.01	0.838 to 1.207
< 200% federal poverty threshold	16,813	1.06	0.879 to 1.267	13,819	0.98	0.813 to 1.179
200%-399% federal poverty threshold	20,441	1.11	0.923 to 1.325	17,139	0.99	0.826 to 1.177
≥ 400% federal poverty threshold	27,092	1.09	0.918 to 1.285	22,835	0.96	0.806 to 1.149
Publicly insured	14,248	1.00	0.825 to 1.216	11,722	1.19[§]	0.983 to 1.451
Not publicly insured	48,891	1.09	0.970 to 1.231	40,967	0.91	0.804 to 1.032
Caries						
Aged 1-5 y	16,825	1.10	0.808 to 1.501	13,967	0.95	0.700 to 1.286
Aged 6-11 y	20,432	1.04	0.879 to 1.234	17,179	1.03	0.865 to 1.225
Aged 12-17 y	27,467	1.12	0.917 to 1.378	23,032	0.95	0.776 to 1.172
Non-Hispanic White	44,541	1.04	0.913 to 1.173	38,137	0.92	0.814 to 1.046
Hispanic or non-White	20,183	1.11	0.914 to 1.350	16,041	1.03	0.844 to 1.263
< 200% federal poverty threshold	16,902	1.09	0.892 to 1.337	13,901	1.00	0.819 to 1.231
200%-399% federal poverty threshold	20,555	1.11	0.907 to 1.347	17,262	0.93	0.765 to 1.120
≥ 400% federal poverty threshold	27,267	1.00	0.830 to 1.209	23,015	0.97	0.794 to 1.180
Publicly insured	14,324	0.99	0.800 to 1.228	11,791	1.24[¶]	1.004 to 1.534
Not publicly insured	49,187	1.07	0.942 to 1.221	41,269	0.87[¶]	0.757 to 0.994
Bleeding Gingivae						
Aged 1-5 y	14,999	3.44[#]	1.849 to 6.395	9,745	1.36	0.682 to 2.716
Aged 6-11 y	20,365	1.39[§]	0.977 to 1.991	17,123	1.06	0.741 to 1.517
Aged 12-17 y	27,383	1.30	0.927 to 1.823	22,973	0.87	0.599 to 1.251
Non-Hispanic White	44,430	1.24	0.943 to 1.634	38,034	1.08	0.810 to 1.441
Hispanic or non-White	20,104	1.69[#]	1.195 to 2.378	15,654	0.89	0.619 to 1.286
< 200% federal poverty threshold	16,857	1.31	0.912 to 1.873	13,862	0.94	0.651 to 1.353
200%-399% federal poverty threshold	20,484	1.69[#]	1.141 to 2.493	16,949	1.09	0.696 to 1.719
≥ 400% federal poverty threshold	27,141	1.37	0.924 to 2.025	22,948	0.84	0.555 to 1.265
Publicly insured	14,171	1.41[§]	0.951 to 2.076	11,755	0.97	0.651 to 1.440
Not publicly insured	49,051	1.61[#]	1.216 to 2.139	41,148	1.11	0.826 to 1.485
Toothaches						
Aged 1-5 y	16,788	1.19	0.778 to 1.816	13,947	1.21	0.774 to 1.893
Aged 6-11 y	20,377	1.09	0.836 to 1.430	17,163	0.74[¶]	0.562 to 0.964
Aged 12-17 y	27,411	1.21	0.883 to 1.646	23,030	0.90	0.642 to 1.272
Non-Hispanic White	44,438	1.05	0.840 to 1.310	38,116	1.05	0.840 to 1.308

* OR: Odds ratio. † ORs and 95% CIs were obtained from logistic regression for oral health problems (toothaches, bleeding gingivae, caries) and for each problem separately, comparing 2020 with 2019 and comparing 2019 with 2018. All models used data from the 2018-2020 waves of the National Survey of Children's Health and adjusted for age, sex, race or ethnicity, highest education of parents, number of children, marital status, any employment, income as a percentage of the federal poverty threshold, and state fixed effects. The model was weighted by the National Survey of Children's Health sampling weights to yield nationally representative estimates. ‡ The sample included children aged 1-17 years. § $P < .1$. ¶ $P < .05$. # $P < .01$.

Table 2. Continued

VARIABLE	2020 VERSUS 2019			2019 VERSUS 2018		
	No.	OR	95% CI	No.	OR	95% CI
Hispanic or non-White	20,138	1.23	0.930 to 1.635	16,024	0.75[§]	0.559 to 1.014
< 200% federal poverty threshold	16,856	0.98	0.744 to 1.278	13,879	0.86	0.644 to 1.148
200%-399% federal poverty threshold	20,526	1.31	0.922 to 1.847	17,251	0.91	0.652 to 1.274
≥ 400% federal poverty threshold	27,194	1.54[#]	1.120 to 2.108	23,010	0.80	0.568 to 1.114
Publicly insured	14,292	1.15	0.850 to 1.550	11,777	0.94	0.693 to 1.269
Not publicly insured	49,081	1.24[§]	0.984 to 1.570	41,251	0.86	0.673 to 1.089

Table 3. Differences (ORs[*] or RRRs[†] and 95% CIs[‡]) in children's[§] use of dental visits between 2020 and 2019 and between 2019 and 2018.

	ANY DENTAL VISITS			NO. OF PREVENTIVE DENTAL VISITS (MULTINOMINAL LOGISTIC REGRESSION)				
					1 Preventive Visit		≥2 Preventive Visits	
VARIABLE	No.	OR	95% CI	No.	RRR	95% CI	RRR	95% CI
2020 Versus 2019								
Aged 1-5 y	16,857	0.67[¶]	0.572 to 0.795	16,836	0.73[¶]	0.612 to 0.865	0.57[¶]	0.471 to 0.701
Aged 6-12 y	20,458	0.78[#]	0.620 to 0.991	20,398	0.93	0.744 to 1.158	0.57[¶]	0.463 to 0.714
Aged 12-17 y	27,480	0.76[#]	0.621 to 0.941	27,428	0.84**	0.691 to 1.021	0.69[¶]	0.570 to 0.831
Non-Hispanic White	44,587	0.78[¶]	0.685 to 0.884	44,500	0.85[#]	0.754 to 0.964	0.62[¶]	0.549 to 0.703
Hispanic or non-White	20,208	0.67[¶]	0.563 to 0.808	20,162	0.78[¶]	0.654 to 0.935	0.57[¶]	0.477 to 0.687
< 200% federal poverty threshold	16,927	0.80[#]	0.673 to 0.960	16,876	0.85**	0.711 to 1.018	0.68[¶]	0.564 to 0.825
200%-399% federal poverty threshold	20,579	0.66[¶]	0.535 to 0.803	20,555	0.76[¶]	0.620 to 0.922	0.59[¶]	0.486 to 0.722
≥ 400% federal poverty threshold	27,289	0.68[¶]	0.557 to 0.822	27,231	0.80[#]	0.663 to 0.960	0.50[¶]	0.420 to 0.606
Publicly insured	14,344	0.62[¶]	0.506 to 0.752	14,317	0.69[¶]	0.569 to 0.844	0.51[¶]	0.413 to 0.629
Not publicly insured	49,245	0.76[¶]	0.653 to 0.885	49,150	0.86[#]	0.743 to 0.993	0.61[¶]	0.531 to 0.707
2019 Versus 2018								
Aged 1-5 y	14,002	1.01	0.863 to 1.194	13,981	1.09	0.922 to 1.293	0.95	0.772 to 1.160
Aged 6-12 y	17,223	0.94	0.718 to 1.223	17,179	0.91	0.710 to 1.168	1.06	0.835 to 1.345
Aged 12-17 y	23,114	1.14	0.904 to 1.432	23,037	1.19	0.961 to 1.473	1.08	0.883 to 1.331
Non-Hispanic White	38,249	0.99	0.873 to 1.123	38,156	1.05	0.928 to 1.188	1.05	0.928 to 1.184
Hispanic or non-White	16,090	1.08	0.887 to 1.309	16,041	1.08	0.893 to 1.309	1.07	0.880 to 1.297
< 200% federal poverty threshold	13,934	0.98	0.807 to 1.189	13,896	0.98	0.807 to 1.191	0.92	0.755 to 1.128
200%-399% federal poverty threshold	17,314	1.21**	0.997 to 1.472	17,279	1.24[#]	1.020 to 1.499	1.24[#]	1.021 to 1.502
≥ 400% federal poverty threshold	23,091	0.96	0.786 to 1.175	23,022	1.05	0.869 to 1.279	1.10	0.907 to 1.343
Publicly insured	11,813	1.09	0.883 to 1.352	11,787	1.05	0.851 to 1.297	1.09	0.872 to 1.356
Not publicly insured	41,418	1.10	0.938 to 1.280	41,314	1.13	0.975 to 1.311	1.12	0.965 to 1.291

* OR: Odds ratio. † RRR: Relative risk ratio. ‡ The ORs and 95% CIs were obtained from logistic regression for any dental visits comparing 2020 with 2019 and comparing 2019 with 2018. The RRRs and 95% CIs were obtained from multinomial logistic regression estimates for number of preventive dental visits (3 categories of none, 1, or 2 or more visits, with no visit as reference group) comparing 2020 with 2019 and comparing 2019 with 2018. All models used data from the 2018-2020 waves of the National Survey of Children's Health and adjusted for age, sex, race or ethnicity, highest education of parents, number of children, marital status, any employment, income as a percentage of the federal poverty threshold, and state fixed effects. The model was weighted by the National Survey of Children's Health sampling weights to yield nationally representative estimates. § The sample included children aged 1-17 years. ¶ $P < .01$. # $P < .05$. ** $P < .1$.

The findings highlight the importance of addressing unmet oral health care needs among children, including their increase during the pandemic, through effective policy interventions that address barriers, including the availability of providers and reducing patient out-of-pocket direct and indirect costs. Continuing to monitor children's oral health and access to dental services during the ongoing pandemic should also be a public health and policy priority. Real-time data collection and analysis, including through survey and administrative data analyses (such as Medicaid and private insurance claims data) are optimal for monitoring and prompt targeting of unmet needs. However, these data resources lag behind in time, as do most national health surveys, indicating the need for new surveys of families to monitor these trends across the population. These surveys can identify household-level factors that are promoting or worsening oral health and access to care during the pandemic. As such, they can inform the need for household and community-level interventions to mitigate the pandemic's effects on children's oral health, including promoting low-sugar diets, water fluoridation, and educating parents and children about dental hygiene practices. In a 2021 national survey, one-quarter of parents reported that their children improved in 1 or more oral health practices during the pandemic, including more frequent toothbrushing, flossing, use of fluoride mouthrinse, or consuming fewer sugar-containing beverages.[45] Although this represents only a small proportion of children with improved dental habits during the pandemic, there is both great potential and need to promote healthier behaviors.

Our study has some data limitations. Because all measures of children's oral health and access to oral health care in the NSCH are reported via parents (or for a small proportion via other caregivers), there is the possibility for measurement error. However, it is unlikely that any measurement error is different before and after the COVID-19 pandemic. Therefore, any measurement error is unlikely to bias the magnitude of differences between survey years, but can inflate the variance of estimates (that is, wider 95% CIs and higher P values). Another issue was that all outcomes, except for dental health as perceived by parents, covered the past 12 months. Therefore, it is possible that some of the responses to these questions in 2020 captured the prepandemic period. However, because the NSCH data were collected from July 2020 through January 2021 (at least 4 months after the pandemic was declared in March and after the early lockdowns and business, including dental practice, closures), these questions are likely to capture changes introduced during the COVID-19 pandemic. If anything, questions about the past 12 months might underestimate the pandemic's effects on these outcomes. Finally, it is possible that the pandemic's effects on children's oral health differ across areas according to availability of dentists or other related contextual factors. We leave this question for future research.

CONCLUSIONS

Our study provided evidence of widespread decline in oral health status and access to oral health care among children in the United States early during the COVID-19 pandemic. These findings highlight the need to monitor these trends through timely data collection and to counter the pandemic effects through prompt policies and oral health campaigns that increase awareness about household prevention activities, water fluoridation where needed, and timely access to dental services. ■

SUPPLEMENTAL DATA

Supplemental data related to this article can be found at: https://doi.org/10.1016/j.adaj.2022.02.008.

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eTable 1. Descriptive statistics* according to year for children aged 1 through 17 years using data from the 2018-2020 National Survey of Children's Health.

VARIABLE	2018	2019	2020
Rated Oral Health (%)			
Poor	1.0	0.6	1.0
Fair	4.3	4.2	4.4
Good	14.9	14.9	16.0
Very good	30.8	31.5	32.1
Excellent	48.9	48.9	46.6
Any Oral Health Problems (%)	13.8	13.7	14.1
Caries	11.5	11.3	11.6
Bleeding gingivae	1.9	1.8	2.5
Toothaches	4.4	3.7	4.0
Any dental visits	82.2	82.8	79.4
No. of Preventive Dental Visits (%)			
No preventive dental visit	20.5	19.6	23.7
1 preventive dental visit	34.3	34.9	38.1
2 or more preventive dental visits	45.2	45.5	38.2
Age (%)			
1-5 y	28.7	28.3	28.9
6-11 y	35.6	35.9	34.8
12-17 y	35.7	35.9	36.3
Sex (%)			
Male	51.2	51.2	51.0
Female	48.8	48.8	49.0
Race and Ethnicity (%)			
Non-Hispanic White	52.0	51.9	52.7
Non-Hispanic Black	11.9	12.0	11.6
Non-Hispanic others	10.7	10.9	11.1
Hispanic	25.5	25.2	24.7
Education (%)			
< High school	8.6	8.4	7.9
High school	17.8	17.8	18.0
Some college	22.0	21.4	20.5
≥ College	51.6	52.4	53.7
No. of Children (%)			
1	24.7	25.3	24.4
2	39.4	39.2	40.4
3	23.3	23.6	23.2
≥4	12.6	11.9	12.0
Income as Percentage of Federal Poverty Threshold (%)			
< 100% federal poverty threshold	16.8	15.8	14.3
100-200% federal poverty threshold	21.9	21.4	21.3

* The descriptive statistics are all weighted using the sampling weights.

VARIABLE	2018	2019	2020
200-300% federal poverty threshold	15.7	17.4	18.0
300-399% federal poverty threshold	12.4	12.5	13.3
≥ 400% federal poverty threshold	33.2	32.8	33.1
Marital Status (%)	82.3	82.7	83.0
Employment Status (%)	94.8	95.3	97.6
No.	27,050	26,316	37,548

eTable 2. Differences (RRRs* or ORs[†] with 95% CIs[‡]) in children's oral health and use of dental visits between 2020 and 2019 and between 2019 and 2018 in children aged 0 through 5 years.

VARIABLE	2020 VERSUS 2019			2019 VERSUS 2018		
	No.	RRR/ OR	95% CI	No.	RRR/ OR	95% CI
Dental Health as Perceived by Parents (Multinominal Logistic Regression, RRR)	17,501			14,556		
Excellent	—	0.78[§]	0.605 to 0.995	—	1.12	0.867 to 1.452
Very good	—	0.82	0.631 to 1.071	—	1.09	0.831 to 1.430
Fair	—	0.67	0.396 to 1.141	—	0.97	0.546 to 1.718
Poor	—	1.98	0.833 to 4.710	—	0.92	0.426 to 1.966
Any Oral Health Problems	18,867	1.17	0.911 to 1.512	15,602	0.92	0.707 to 1.191
Caries	18,981	1.11	0.819 to 1.517	15,737	0.94	0.698 to 1.277
Bleeding gingivae	17,245	2.60[¶]	1.322 to 5.123	11,765	1.51	0.819 to 2.800
Toothaches	18,940	1.11	0.746 to 1.640	15,719	0.98	0.644 to 1.495
Any dental visits	19,016	0.66[¶]	0.560 to 0.775	15,781	1.06	0.899 to 1.246
No. of Preventive Dental Visits (Multinominal Logistic Regression, RRR)						
1 preventive visit	Not applicable	0.71[¶]	0.598 to 0.843	Not applicable	1.13	0.956 to 1.342
≥ 2 preventive visits	18,997	0.55[¶]	0.450 to 0.670	15,760	1.00	0.813 to 1.229

* RRR: Relative risk ratio. † OR: Odds ratio. ‡ The RRRs and 95% CIs were obtained from multinomial logistic regression estimates for the child's dental health as perceived by parents (5 categories ranging from excellent to poor, with good as the reference category) and number of preventive dental visits (3 categories of none, 1, or 2 or more visits, with no visit as reference group) with separate regressions for comparing 2020 with 2019 and comparing 2019 with 2018. The ORs and 95% CIs were obtained from logistic regression for oral health problems (toothaches, bleeding gingivae, caries) and for each problem separately and any dental visits comparing 2020 with 2019 and comparing 2019 with 2018. All models used data from the 2018-2020 waves of the National Survey of Children's Health and adjusted for age, sex, race or ethnicity, highest education of parents, number of children, marital status, any employment, income as a percentage of the federal poverty threshold, and state fixed effects. The model was weighted by the National Survey of Children's Health sampling weights to yield nationally representative estimates. § *P* < .05. ¶ *P* < .01.