

ABSTRACT

Purpose: To examine the association between depression and oral health outcomes in U.S. pediatric population.

Methods: Data obtained from 2022-2023 National Survey of Children's Health (NSCH) were analyzed. The study-sample included 104,777 individuals representing ≈68.78 million one to 17-year old children and adolescents in the United States. The outcome of interest was pediatric oral health problems including dental caries, toothaches, and/or bleeding gums within the past 12 months. Children's depression was the independent variable, based on diagnosis by a physician or other health care provider. Simple and multiple logistic regression analyses were performed to examine the association of depression with oral health outcomes.

Results: The prevalence of one or more oral health problems amongst children with depression was 22.48% and 13.61% amongst those who did not have a reported history of depression (P -value < 0.0001). The unadjusted odds ratio is 1.84 (95% CI: 1.61 - 2.11). After controlling for the participant's age, sex, race, ethnicity, family income-to-poverty ratio, place of birth, household language, health insurance type, parental education, parental emotional support, adverse childhood experience, household smoking exposure, neighborhood support, and dental visit within past year, children with depression were 31% more likely to have one or more oral health problems including toothache, bleeding gums, and/or dental decay or cavities (OR= 1.31; 95% CI: 1.11 - 1.54).

Conclusion: Findings from this study indicate a significant association between depression and oral health outcomes among U.S. children and adolescents, underscoring the need for more integrated pediatric healthcare approaches.

INTRODUCTION

Dental caries remains one of the most common chronic conditions among children and adolescents in the United States.¹ According to the Centers for Disease Control and Prevention, nearly half of individuals aged 2–19 have experienced either untreated or restored dental caries.¹ If left untreated, caries can lead to pain, infection, missed school days, and reduced quality of life.² These issues disproportionately affect vulnerable populations, including children from low-income and minority backgrounds, and may persist into adulthood.^{3,4} Oral health is related to overall health, and increasing evidence reveals a connection between physical health, behavior, psychosocial factors, and mental health.⁵

Depression is a diagnosable mental health condition that can severely affect daily functioning and well-being.⁶⁻¹¹ Common symptoms include social withdrawal, difficulty performing daily tasks, physical pain, and substance use.⁷⁻¹¹ Rates of anxiety and depression among adolescents have risen in recent years, with nearly one in five U.S. teens reporting depressive symptoms.⁶ These trends raise concern not only for emotional well-being, but also for secondary effects on self-care behaviors, including oral hygiene. Adolescents struggling with depression may neglect brushing, avoid dental visits, or engage in cariogenic habits, increasing their risk for dental caries.¹²

Previous research based on National Health and Nutrition Examination Survey in the adult population have shown that individuals with moderate to severe depression symptoms have an increased likelihood of mild periodontitis, missing teeth, and untreated root caries, though the association with untreated coronal caries remained unclear.^{7, 13-15} Individuals with self-reported depression symptoms also were more prone to report having fair/poor oral condition, oral pain, and difficulty accessing dental care.¹⁶

Though there is some literature on the association between oral disease and mental health in the adult population, there is scant research in the pediatric population. International studies on adolescents have inconclusive evidence linking depression with caries with possible increased caries risk being linked to use of psychoactive substances, frequent consumption of carbohydrates, and plaque accumulation linked to toothbrushing frequency.^{12,17}

The objective of this study was to evaluate the association between depression and oral health outcomes - including dental caries, toothache, and gingival bleeding - among a nationally representative sample of non-institutionalized U.S. children and adolescents aged 1–17 years. By examining this relationship within a pediatric population, the study contributes to the growing body of literature integrating mental and oral health. The findings may inform preventive strategies, including the integration of mental health screening into dental care settings and the enhancement of targeted care for at-risk youth.

MATERIALS AND METHODS

This population-based observational cross-sectional study was conducted using publicly available, de-identified data from the 2022 and 2023 cycles of the National Survey of Children's Health.¹⁸ The study-sample included 104,777 individuals representing ≈68.78 million (precisely 68,784,033) one to 17-years old children and adolescents in the United States. Inclusion criteria were participants within this age range whose parents completed both the depression and oral health questionnaires. Participants were excluded if they were missing key exposure, outcome, or covariates data.

Exposure: Children's depression history was the independent variable and the primary exposure of interest. Depression status was derived from the NSCH item asking whether a doctor or other health care provider had ever diagnosed the child with depression. Parents or guardians responded to the question: "Has a doctor or other health care provider EVER told you that this child has depression?".¹⁸ Response options included 1 = Yes and 2 = No. Consistent with NSCH documentation, depression was operationalized as a dichotomous variable, classifying children as having depression if their caregiver indicated "Yes" to a lifetime provider diagnosis. This measure reflects lifetime prevalence rather than current symptomatology.

Outcome of Interest: Presence of any oral health problems was the outcome of interest. Parents or guardians were asked whether, during the past 12 months, the child had experienced: (1) a toothache; (2) bleeding gums; or (3) decayed teeth or cavities, and each item was coded as "yes" or "no". Consistent with NSCH documentation and prior population-based studies using this dataset, a composite dichotomous oral health problems variable was created, classifying children as having an oral health problem if the respondent answered "yes" to any of the three items. Children were classified as having no oral health problems if the respondent answered "no" to all items. Based on the NSCH analytic guidelines, cases with no valid responses to all three questions were coded as missing and excluded from analyses involving this outcome.

Covariates: The list of covariates included the study-participants' age, sex, race and ethnicity, location of birth, household reference person's education, family income-to-poverty ratio, children's overall health status, special health care needs status, primary language spoken in the household, cigarettes use in the household, not able to receive needed dental care during the past 12 months, health insurance coverage, parental emotional support, and family structure.

Statistical Analysis: Descriptive statistical analyses were performed to characterize the study sample and to estimate the prevalence of depression and dental caries experience. Categorical variables were summarized using frequencies and proportions. Associations of each categorical variables with depression was examined using Rao-Scott chi-square tests. Simple and multiple logistic regression analyses were conducted to determine the association between depression and oral health outcome before and after controlling for covariates. Unadjusted and adjusted odds ratios and respective 95% confidence intervals were computed using logistic regression in order to examine the association between depression and oral health outcomes. Odds ratio will be adjusted for the covariates in the adjusted models. Type I error rate (significance level) was set to 5% to determine statistical significance. NSCH sample weights were applied in all the analyses to account for the complex survey design and to produce unbiased standard error estimates. Data management and statistical analyses were conducted using SAS software, version 9.4 for Windows (SAS Institute Inc., Cary, NC, 2018).

Table 1. Characteristics of the study-sample (one to 17-years old US Children), overall and by their depression status, NSCH 2022-2023*

Characteristics	Total Population		Patient's Depression Status				P-value**
	N	%	Yes		No		
			n	%	n	%	
	104,777	100	5,978	5.06	98,799	94.94	
			(+68,784,033)	(+3,479,637)	(+65,304,396)		
Age groups							
1-5 years old	37,185	27.26	1,04	1.04	36,141	28.66	
6-11 years old	30,402	35.11	15.53	15.53	36.15	36.15	<0.0001
12-17 years old	37,190	37.63	83.43	83.43	35.19	35.19	
Sex							
Male	53,976	51.24	38.49	38.49	51.92	51.92	<0.0001
Female	50,802	48.76	61.51	61.51	48.08	48.08	
Race/Ethnicity							
Hispanic	15,823	27.10	26.12	26.12	27.15	27.15	
Non-Hispanic White	67,614	47.62	50.48	50.48	47.47	47.47	0.1055
Non-Hispanic Black	6,364	12.69	12.62	12.62	12.68	12.68	
Others/Multi-Racial, non-Hispanic	14,978	12.60	10.78	10.78	12.7	12.7	
Location of birth†							
U.S. born	100,705	95.59	96.45	96.45	95.54	95.54	
Foreign born	3,231	4.41	3.55	3.55	4.46	4.46	0.0946
Highest level of education among reported adults							
< High School	2,660	8.65	8.71	8.71	8.65	8.65	
High School	13,219	18.81	22.17	22.17	18.64	18.64	<0.0001
Some college or technical school	21,484	19.51	20.08	20.08	19.16	19.16	
College degree or higher	67,414	53.03	43.04	43.04	53.56	53.56	
Income level based on federal poverty level ratios							
< 40% FPL	13,002	18.29	21.65	21.65	18.11	18.11	<0.0001
100-199% FPL	16,602	19.53	24.31	24.31	19.28	19.28	
200-399% FPL	20,803	28.99	29.52	29.52	28.87	28.87	
≥ 400% FPL	44,370	33.29	24.72	24.72	33.74	33.74	
Children's overall health status							
Excellent or very good	95,746	90.84	68.1	68.1	91	91	<0.0001
Good	7,600	8.70	24.62	24.62	7.86	7.86	
Fair or poor	1,266	1.45	7.28	7.28	1.14	1.14	
Special Health Care Status							
SHCN	26,109	21.59	77.69	77.69	18.6	18.6	<0.0001
Non-SHCN	78,668	78.41	22.31	22.31	81.4	81.4	
Primary language spoken in the household†							
English	95,159	84.67	90.29	90.29	84.37	84.37	0.0002
Other than English	8,861	15.33	9.71	9.71	15.63	15.63	
Cavities, yes in household†							
Yes	11,293	11.72	19.39	19.39	11.31	11.31	<0.0001
No	91,233	88.28	80.61	80.61	88.69	88.69	
Oral health problems							
One or more	12,478	14.96	22.48	22.48	13.61	13.61	<0.0001
None	92,299	85.94	77.52	77.52	88.39	88.39	
Not able to receive needed dental care during the past 12 months†							
Did not receive needed dental care	1,139	1.31	3.76	3.76	1.18	1.18	<0.0001
Received needed dental care	103,123	98.69	96.24	96.24	98.82	98.82	
Health insurance coverage†							
Currently insured	98,640	93.35	94.54	94.54	93.29	93.29	<0.0001
Currently uninsured	4,241	6.64	5.45	5.45	6.71	6.71	
Family structure†							
Two parents, currently married	72,688	65.09	50.87	50.87	65.85	65.85	<0.0001
Two parents, not currently married	5,924	6.72	5.99	5.99	6.76	6.76	
Single parent (mother or father)	19,674	21.69	13.71	13.71	21.15	21.15	
Grandparent household	2,678	3.21	5.79	5.79	3.07	3.07	
Other family type	1,066	1.29	1.64	1.64	1.17	1.17	

* Columns % in total column, and row % in other columns. ** Chi-square statistics except age (χ²-test). † Weighted sample. ‡ Excluded missing data. § Toothaches, bleeding gums, and/or decayed teeth or cavities.

Table 2. Association between depression and oral health outcomes in a sample of one to 17-years old children in the United States, NSCH, 2022-2023*

Model	Depression Status	Odds Ratio (OR)	95% Confidence Interval (CI)	Unweighted N	Weighted Sample Size	P-value
1	Yes	1.84	1.61 – 2.11	104,777	68,784,033	<0.0001
	No	Reference			Reference	
2	Yes	1.72	1.49 – 1.98	103,392	67,640,622	<0.0001
	No	Reference			Reference	
3	Yes	1.52	1.30 – 1.77	97,696	63,131,372	<0.0001
	No	Reference			Reference	
4	Yes	1.31	1.11 – 1.54	97,691	63,127,523	0.0011
	No	Reference			Reference	

Model 1: Unadjusted
 Model 2: Controlled for Age, Sex, Race/ethnicity, Location of birth, Poverty level, and Household language
 Model 3: Controlled for Age, Sex, Race/ethnicity, Family income-to-poverty ratio, Location of birth, Household Language, Health insurance type, Parental education, Parental emotional support, Household smoking exposure, Neighborhood support, Dental visit within past year
 Model 4: Controlled for children's Age, Sex, Race/ethnicity, Family income-to-poverty ratio, Location of birth, Household Language, Health insurance type, Parental education, Parental emotional support, Adverse childhood experience (ACE), Household smoking exposure, Neighborhood support, and Dental visit within past year



RESULTS

A total of 104,777 children and adolescents aged 1–17 years, representing approximately 68.78 million U.S. children, were included in the analysis. The demographic and socioeconomic characteristics of the study population stratified by depression status are presented in Table 1. The mean age of participants was 8.5 years. Among the study population, 48.76% were female and 51.24% were male, with female participants demonstrating a higher prevalence of depression.

The weighted prevalence of depression among the study population was 5.06%. There was a higher prevalence of depression observed among children aged 12-17 years. Among children who experienced depression, there was a greater proportion who identified as white, non-Hispanic (50.5%), overweight (21.02%), with SHCN (77.7%).

Overall, 14.06% of children experienced one or more oral health problems within the past 12 months, including toothache, bleeding gums, and/or dental decay or cavities. There was a statistically significant difference between the prevalence of oral health problems among children with a history of depression compared to those without depression (22.48% vs. 13.61%, $P < 0.0001$).

Table 2 summarizes the associations between depression and specific oral health outcomes, including toothache, bleeding gums, and dental decay or cavities. Children with depression consistently demonstrated higher odds of adverse oral health outcomes across individual and composite measures. In unadjusted analyses, children with depression had significantly greater odds of experiencing one or more oral health problems (OR = 1.84; 95% CI: 1.61–2.11). After controlling for child age, sex, race and ethnicity, nativity, poverty level, and household language, the association remained significant (OR = 1.72; 95% CI: 1.49–1.98; N = 103,392; weighted N = 67,640,622). In the final model controlling for age, sex, race and ethnicity, family income-to-poverty ratio, location of birth, household language, health insurance type, parental education, parental emotional support, household smoking exposure, neighborhood support, and dental visit within the past year, children with depression continued to have higher odds of oral health problems (OR = 1.52; 95% CI: 1.30–1.77; N = 97,696; weighted N = 63,131,372). After further adjustment for adverse childhood experiences, the association remained statistically significant (OR = 1.31; 95% CI: 1.11–1.54; N = 97,691; weighted N = 63,127,523).

DISCUSSION

Several limitations should be noted. The survey lacks behavioral factors (e.g., diet), and other NSCH mental health variables (e.g., anxiety, treatment, medication use) were not analyzed. Parent-reported data, rather than clinical assessments, may introduce misclassification or underreporting, though standardized diagnosis-based questions support population-level consistency.

Despite this, the study has key strengths, including a large, nationally representative sample and adjustment for multiple confounders. It adds novel evidence on links between mental and oral health in children.

Longitudinal studies are needed to clarify causality and identify early intervention opportunities.

CONCLUSIONS

Based on this study's results, the following conclusions can be made:

1. Children and adolescents with a history of depression exhibited a significantly higher prevalence of oral health problems compared to those without depression.
2. Depression was independently associated with increased odds of experiencing dental caries, toothache, and/or bleeding gums, even after controlling for multiple sociodemographic, household, and health-related factors, suggesting a relationship between mental health and oral health in pediatric populations.
3. These findings underscore the importance of integrating mental health awareness, screening, and referral into pediatric dental and primary care settings, to improve oral health outcomes and reduce disparities, while also highlighting the need for prospective research on mental health as a risk factor for adverse oral health outcomes in youth.

BIBLIOGRAPHY

Available Upon Request.