

# Association of Dental Caries and Weight Status Among US Children and Adolescents in the NHANES Dataset

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## ABSTRACT

**Objectives:** To determine if an association exists between dental caries and weight status measured by BMI among US Children and Adolescents.

**Methods:** Data from the National Health and Nutrition Examination Survey (NHANES) 2015-2016 and 2017-2020 surveys were analyzed. A total of 7,950 non-odontulous children 2-18 years of age were included from the combined NHANES 2015-2020 analyses. The primary variable of interest was BMI percentile. Analyses included descriptive, simple, and multiple regression analyses. Unadjusted and fully adjusted models controlling for sex, race or ethnicity, nativity, family income-to-poverty ratio, blood lead level, and cotinine level were constructed. Unadjusted and adjusted odds ratios and respective 95% confidence intervals were calculated.

**Results:** For children 2-5 years of age, subjects who were obese were more likely to have caries experience than overweight and normal weight children, though not statistically significant. For children 6-11 years old in the primary dentition obese and overweight children were less likely to have caries experience than normal weight children. Conversely, in the permanent dentition of 6-11 year olds obese and overweight children were more likely to have caries experience than normal weight children, though not statistically significant. For children 12-18 years of age, obese and overweight children were more likely to have caries experience than normal weight children, though not statistically significant.

**Conclusions:** Combined analyses from the most recent NHANES 2015-2020 surveys does not provide conclusive evidence to suggest that obese and overweight children are at a higher odds to experience dental caries. However, obese 12-18 year olds trend towards a higher caries odds. Interestingly, for children 6-11 years of age, obese and overweight children may be less likely to experience primary tooth caries.

## INTRODUCTION

Dental caries is one of the most common childhood diseases in the United States and worldwide.<sup>1,2</sup> According to the Surgeon General's 2000 Oral Health Report, more than half of US children 5 to 9 years old had at least one carious lesion or filling (51.6%), and this only increased when expanded to 17-year old's (77.9%).

Having dental caries can interfere with eating, adequate nutritional intake, speaking, self-esteem, and daily activities, not to mention it's broader impacts related to associated pain and it's negative impacts on development.<sup>3,4</sup>

Both environmental and genetic factors influence caries prevalence.<sup>5</sup> Diet plays a key role in the formation of caries. Caries are associated with frequent consumption of fermentable carbohydrates, especially sugars.<sup>6</sup> Obesity risk has also been shown to increase with higher intake of carbohydrates.<sup>7</sup> By contrast, some studies have shown that there may be a relationship between high caries and being underweight.<sup>8</sup> In these cases it is thought that because of the pain experienced by these children, they may eat less and therefore be underweight.<sup>9</sup> In these cases it is thought that because of the pain experienced by these children, they may eat less and therefore be underweight.<sup>10</sup> However, current literature is inconclusive as to whether dental caries is associated with an increased risk of being overweight or underweight.<sup>11</sup>

Caries and BMI data from the NHANES has not been evaluated since the NHANES 1999-2002.<sup>12,13</sup> Separate evaluations of the NHANES 1999-2002 data provided no evidence to suggest that obese/overweight children were at an increased risk for dental caries.<sup>12,13</sup> Evaluation of NHANES III (1988-1994) interestingly suggested that overweight children (defined as BMI  $\geq$ 95th percentile) may be associated with lower caries rates.<sup>13</sup>

## MATERIALS AND METHODS

An observational cross-sectional study was conducted using a nationally representative sample of U.S. children and adolescents. Existing publicly available deidentified data from the NHANES 2015 to 2016, and 2017 to 2018 was utilized.

The primary variable of interest was BMI percentile. The 2000 CDC BMI-for-Age growth charts were used to define BMI categories and classified into: Obese ( $\geq$ 95th percentile), Overweight ( $\geq$ 85th -  $<$ 95th percentile), and Normal weight ( $<$ 85th percentile). The CDC does not endorse BMI calculations for children younger than 2 years of age, therefore these children were excluded from the analyses. A total of 7,950 study participants were identified between the ages of 2-18 who received a complete dental examination and whom height and weight measurements were available.

Caries experience was the dependent variable and calculated in the primary dentition by dft (decayed and filled teeth) and permanent dentition by DMFT (Decayed, Missing and Filled Teeth). Caries experienced was treated as a binary value and was not surface specific.

The covariables included: age, sex, race/ethnicity, nativity, poverty status, lead level and cotinine level.

Analyses included descriptive, simple, and multiple regression analyses. Unadjusted and fully adjusted models controlling for sex, race or ethnicity, nativity, family income-to-poverty ratio, blood lead level, and cotinine level were constructed. Unadjusted and adjusted odds ratios and respective 95% confidence intervals were calculated.

**Table 1. Study-sample characteristics by dental caries experience in primary and permanent teeth (NHANES 2015 - March 2020)**

Characteristics	2-5 years old			6-11 years old				12-18 years old				
	n*	% with any primary caries (SE)**	P-value	n*	% with any primary caries (SE)**	P-value	% with any permanent caries (SE)**	P-value	n*	% with any permanent caries (SE)**	P-value	
<b>Overall</b>	2083	21.29 (1.42)		3066	42.21 (1.75)		14.44 (1.11)		2801	51.04 (1.54)		
<b>Weight status</b>	BMI $\geq$ 95th percentile	262	28.13 (3.20)	0.06	660	37.44 (2.46)	0.01	18.38 (1.99)	0.0008	664	56.18 (2.30)	0.007
	BMI $\geq$ 85th - $<$ 95th percentile	292	23.14 (3.20)		479	39.69 (2.49)		16.93 (2.25)		498	52.91 (2.56)	
	BMI $<$ 85th percentile	1427	20.60 (1.56)		1900	44.66 (2.16)		12.69 (1.01)		1603	48.43 (1.90)	
<b>Sex</b>	Male	1060	22.86 (1.89)	0.12	1544	44.69 (1.97)	0.01	12.57 (1.09)	0.007	1433	50.44 (2.07)	0.64
	Female	1023	19.69 (1.58)		1522	39.61 (2.09)		16.39 (1.54)		1368	51.65 (1.96)	
<b>Race/ethnicity</b>	Mexican American	323	35.79 (3.84)	$<$ .0001	574	56.49 (4.14)	$<$ .0001	22.76 (2.53)	$<$ .0001	502	61.45 (3.40)	0.005
	Other Hispanics	211	22.94 (3.85)		350	46.25 (3.26)		19.13 (2.41)		276	53.75 (3.05)	
	Non-Hispanic white	655	15.54 (1.53)		861	37.08 (2.17)		9.49 (0.9955)		826	48.84 (2.29)	
	Non-Hispanic Black	545	20.79 (2.62)		771	39.89 (2.91)		18.26 (2.15)		687	47.69 (3.33)	
	Other/Multi-Racial	349	25.21 (2.52)		510	44.11 (2.68)		15.93 (1.98)		510	49.48 (3.26)	
<b>Nativity</b>	US Born	2002	20.99 (1.43)	0.13	2896	42.11 (1.83)	0.63	13.91 (1.13)	0.0001	2517	50.49 (1.66)	0.06
	Foreign Born	81	30.07 (6.60)		170	44.42 (4.40)		26.45 (3.88)		283	58.37 (3.60)	
<b>Poverty status</b>	Family income: poverty $<$ 1	661	31.40 (2.54)	$<$ .0001	838	53.55 (3.34)	$<$ .0001	22.16 (2.01)	$<$ .0001	672	61.79 (2.94)	$<$ .0001
	Family income: poverty $\geq$ 1	1207	16.48 (1.37)		1917	38.42 (1.66)		11.77 (1.08)		1838	47.70 (1.41)	
<b>Lead level</b>	$>$ Median	473	24.16 (2.80)	0.06	1275	47.80 (2.16)	0.01	16.36 (1.42)	0.32	691	52.48 (2.95)	0.54
	$\leq$ Median	151	17.39 (3.99)		1101	41.57 (2.47)		14.55 (1.61)		1285	50.47 (2.02)	
<b>Cotinine level (ng/ml)</b>	Non-exposed ( $<$ 0.2)	602	25.60 (2.56)	N/A	1819	43.24 (2.15)	0.02	15.53 (1.30)	0.82	1770	48.86 (1.76)	0.02
	Passive exposure (0.2-10)	307	33.48 (3.44)		479	51.89 (3.11)		16.22 (2.49)		494	58.06 (3.46)	
	Active ( $>$ 10)	4	Could not be computed		6	59.27 (21.45)		7.94 (8.12)		160	59.94 (6.24)	

\* Unweighted sample size  
\*\* Weighted prevalence / SE = standard error of the percentage

**Table 2. Association between BMI and dental caries experience in 2 to 18 years old children in the United States (NHANES 2015 - March 2020)**

Model		2 - 5 years old children		6 - 11 years old children				12 - 18 years old children	
		Any primary caries		Any primary caries		Any permanent caries		Any permanent caries	
		Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
1	Obese	1.51	1.08 - 2.11	0.74	0.60 - 0.91	1.55	1.18 - 2.03	1.37	1.11 - 1.67
	Overweight	1.16	0.81 - 1.67	0.82	0.64 - 1.04	1.401	1.04 - 1.88	1.197	0.93 - 1.53
	Normal	Reference		Reference		Reference		Reference	
2	Obese	1.103	0.54 - 2.25	0.68	0.52 - 0.88	1.24	0.896 - 1.73	1.29	0.94 - 1.77
	Overweight	0.68	0.24 - 1.88	0.73	0.55 - 0.96	1.13	0.76 - 1.68	1.12	0.84 - 1.50
	Normal	Reference		Reference		Reference		Reference	

Model 1: Unadjusted  
Model 2: Controlled for sex, race or ethnicity, nativity, family income-to-poverty ratio, lead level, and cotinine level

## RESULTS

A total of 7,950 study participants aged 2-18 years were included from the combined NHANES 2015-2020 analyses. The characteristics of the study sample and caries experience were examined in Table 1. The association between BMI and caries using adjusted and unadjusted models were examined in Table 2.

As shown in Table 1, caries prevalence and weight status were significantly associated in the primary and permanent teeth of 6-11 year olds ( $P = 0.01$ ,  $P = 0.0008$ ), and in the permanent teeth of 12-18 year olds ( $P = 0.007$ ). There was a trend towards an association in the primary dentition of 2-5 year olds but not a statistically significant ( $P = 0.06$ ). Males had a higher caries experience in the primary dentition of 6-11 year olds ( $P = 0.01$ ), and females had a higher experience in the permanent dentition of 6-11 year olds ( $P = 0.007$ ). Higher caries experience was significantly different among race/ethnicity groups of all ages ( $P \leq 0.005$ ). Subjects below the federal family income poverty line were found to have a significantly higher odds of caries across all age groups ( $P < 0.0001$ ). Greater than median blood lead levels was associated with higher caries experience only in the primary dentition of 6-11 year olds ( $P = 0.01$ ). Subjects with cotinine levels  $>$ 0.2 ng/ml were found to have a higher caries experience only in the primary dentition of 6-11 year olds ( $P = 0.02$ ), and in the permanent dentition of 12-18 year olds ( $P = 0.02$ ).

Unadjusted and adjusted models were created to investigate the association between BMI and dental caries experience in 2 to 18 year old children in Table 2. The adjusted model controlled for sex, race/ethnicity, nativity, family income-to-poverty ratio, lead level and cotinine level. For children 2-5 years of age, there was no statistically significant association between BMI and caries in obese (OR = 1.103, 95% CI 0.54-2.25) or overweight (OR = 0.68, 95% CI 0.24-1.88) children. For children 6-11 years of age in the primary dentition obese (OR = 0.68, 95% CI 0.52-0.88) and overweight (OR = 0.73, 95% CI 0.55-0.96) children were statistically less likely to have caries experience than normal weight children. Conversely, in the permanent dentition of 6-11 year old children there was no statistically significant association between obese (OR = 1.24, 95% CI 0.90-1.73) or overweight children (OR = 1.13, 95% CI 0.76-1.68). For children 12-18 years of age there was no statistically significant association between BMI and caries in obese (OR = 1.29, 95% CI 0.94-1.77) or overweight children (OR = 1.12, 95% CI 0.84-1.50).

## CONCLUSIONS

- The current literature is inconclusive as to whether dental caries is associated with an increased risk of being overweight or underweight and several recently published systematic reviews have not come to a general consensus on the issue.
- Poverty and race/ethnicity were significantly associated with an increased experience of caries in all age groups and across the primary and permanent dentition.
- After controlling for confounding variables the only statistically significant association between caries and weight status was within the primary dentition of 6-11 year olds who were found to have a lower odds of caries experience compared to normal weight children.
- Though not statistically significant, it is clinically relevant that permanent tooth caries odds appear to trend towards higher BMI, most notably in obese 12-18 year olds.
- Further research is needed and should attempt to perform longitudinal studies as well include a radiographic examination to continue to assess the potential relationship between caries and BMI.

## BIBLIOGRAPHY

References available on request.