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Research Article

Dietary Sugar Intake, Dental Decay and Oral Health Outcomes in Vulnerable Pediatric Populations: A Study of Low-Income Children

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ABSTRACT

Dental caries and poor oral health outcomes are significant concerns among vulnerable pediatric populations, specially in low-income communities where access to dental care may be limited. High sugar raises risk of dental decay, making it crucial to understand this relationship in the context of socioeconomic disparities.

Objective: This research aims to investigate the relationship between dietary sugar intake, dental decay, and oral health outcomes in children from low-income families, providing insights into potential risk factors and areas for intervention.

Methodology: This cross-sectional study was conducted among 70 children ages between 8-10 years from low-income families, selected using a stratified random sampling technique. Sugar Intake Assessment Questionnaire was used to assess dietary sugar. Dental Decay assessed by cariogram model and Standardized Oral Hygiene Index (OHI) was used for assess the oral health outcomes. Descriptive statistics, independent t-test and Regression analysis was used for statistical analysis.

Results: The research revealed a clear positive link between dental caries and dietary sugar consumption ($r = 0.45$, $p < 0.001$), with greater sugar intake related to high prevalence of dental decay (OR = 2.5, 95% CI: 1.83.5). Additionally, children with higher sugar intake had poorer oral health outcomes, including higher plaque scores (mean difference = 1.2, $p < 0.01$) and increased gingivitis prevalence (35% vs. 15%, $p < 0.001$). The regression analysis showed that oral health outcomes and dental decay ($\beta = 0.3$, $p < 0.001$) were substantially predicted by dietary sugar intake.

Conclusion: This study emphasizes how important dietary sugar intake is for low-income children's development of dental decay and bad oral health outcomes. The results emphasize how important it is to have focused interventions aimed at lowering sugar intake and encouraging appropriate oral hygiene habits among underprivileged children. Reducing dental caries and raising general oral health in this group could depend much on public health efforts and parental education programs.

INTRODUCTION

Among the most often persistent diseases affecting children globally, nearly 97% of the world's population will experience tooth decay also called dental caries. The multifactorial character of the disease process involves (1) the interplay of oral bacteria, food choices—particularly those including fermentable carbs, sugars saliva flow, fluoride exposure, and oral hygiene practices (1). Among these factors,

particularly in youngsters (2), dietary sugar intake has repeatedly been shown as a significant driver of tooth decay.

Excessive free and added sugar consumption is strongly linked with the emergence and beginning of dental caries in youngest especially in the form of sugary snacks and drinks. Early exposure to high doses of dietary sugar forms youngsters' taste preferences, hence impacting their lifetime behaviors favoring sweet foods over more nutritional ones, therefore directly causing tooth decay (2)

Particularly disturbing in children from low-income homes, who are disproportionately impacted by both greater sugar consumption and higher prevalence of untreated dental caries(1), this pattern is Limited access to nutritious foods, domestic habits, and socioeconomic deprivation all further worsen these discrepancies, hence vulnerable children are more prone to unfavorable oral health consequences (3).

More common among those from lower socioeconomic backgrounds, minority racial groups, and families with lower parental education levels(2), recent systematic reviews and large-scale epidemiological studies have demonstrated a statistically significant association among free sugar intake and dental caries in youngest between the ages of 6 to 12 years. For instance, despite improvements in dental coverage and access to care, a scientific review on U.S. children from lowincome households revealed that higher sugar intake was consistently associated with more caries incidence and prevalence. Unaddressed dental caries in children causes suffering, infection, skipped school days and in extreme cases hospitalization (1), beyond their impact on oral health.

Handling the load of tooth decay in disadvantaged pediatric populations necessitates a strong understanding of the complex link between dietary sugar intake and oral health outcomes. Apart from personal level efforts such nutritional counseling and better dental care, this also includes broader public health programs targeting the underlying reasons for high sugar consumption (3).

Particularly common in underprivileged and atrisk groups, dental caries is a common chronic illness among youngsters. The principal nutritional risk factor for dental caries are free sugars, which oral bacteria metabolize quickly to produce acids that demineralize tooth enamel and beginning decomposition. Children who frequently eat sugary snacks and sweetsweetened beverages (SSBs) have a much higher frequency and severity of dental caries (6), according several research.

If dental caries has not treated it can cause pain, infection, eating difficulty, stunted growth, missed school days, and cycles of disadvantage among lowincome children(7). Hence, tackling more general social determinants of health, decreasing dietary sugar intake, and raising access to dental care must top priority among preventive strategies. Studies show how effective dietary education, sugar intake restriction, and targeted public health initiatives are in reducing caries risk and improving oral health equality (2).

Dietary sugar intake, particularly the consumption of free sugars, is widely recognized as the most significant dietary factor contributing to dental caries across all age groups, but especially among children(9). Free sugars, which include monosaccharides and disaccharides added to foods and beverages as well as sugars naturally present in honey, syrups, and fruit juices, are metabolized by oral bacteria to produce acids that demineralize tooth enamel, leading to decay(10).

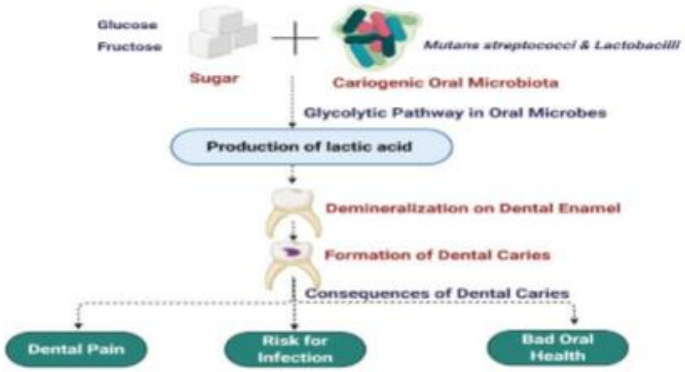

Figure1: Salivary proteins and sugary diets affect dental plaque and health

Both the quantity and frequency of sugar intake are critical determinants of caries risk. Frequent consumption of sugary foods and beverages especially between meals provides a constant substrate for acid production by dental plaque bacteria, resulting in prolonged periods of enamel demineralization. Sticky sugars and sugar-sweetened beverages are particularly harmful, as they tend to adhere to teeth and are often consumed outside of regular meals, increasing the risk of decay(6).

LITERATURE REVIEW

Although some studies have shown variation depending on the frequency and kind of sugar intake, a recent systematic review and meta-analysis discovered that children with higher sugar intake had an 18% higher likelihood of developing dental caries compared to those with lower sugar consumption. Specifically, frequent consumption of sugary snacks and beverages between meals, particularly more than three times daily, was linked with a two fold increase in early childhood caries risk(4). While drinking dairy products and water might provide some protection (5, 6) other research have shown that regular intake of sugary sweetened drinks and sweets greatly raises the caries risk.

Furthermore implying that the frequency of sugar consumption is a major component, the evidence shows caries risk to grow gradually with the number of daily sugar exposures. Children eating sugary snacks or beverages more than three times per day, for instance, had much higher caries prevalence than those who ate less frequently(5). This pattern is especially troubling in low-income children, who frequently consume more inexpensive, sugary foods and beverages and struggle to access dental care and oral health education (2, 7).

According a recent systematic analysis of U.S. children from low-income households, those in the top quartile for SSB consumption had a 59% greater mean number of tooth surfaces with caries relative to those in the lowest quartile (mean ratio = 1.59, 95% CI = 1.15–2.20; $p < 0.01$). Consuming SSBs more than four times a week was associated with more than double the risk of dental caries (prevalence risk ratio: 2.40, 95% CI = 1.30–4.44; $p < 0.01$), and every additional daily serving of SSB increased caries experience by 22% (adjusted prevalence ratio = 1.2, 95% CI = 1.1–1.3; $p < 0.05$). (Care quest)These findings are echoed in larger cross-sectional studies, such as those using National Health and Nutrition Examination Survey (NHANES) data, which reveal that children from lower socioeconomic backgrounds, minority ethnic groups, and those with less-educated parents have higher rates of untreated dental caries and greater average daily sugar intake(2).

Globally, the relationship between free sugar intake and dental caries is well established. Longitudinal and cross-sectional studies from countries such as Brazil, the United Kingdom, and India have consistently shown that higher sugar intake is associated with increased caries prevalence, particularly among children from socioeconomically disadvantaged backgrounds(8). The risk is particularly pronounced when high levels of free sugar consumption begin early in life and are sustained over time, leading to a cumulative effect on oral health outcomes(7).

Objectives

1. To investigate the relationship between dietary sugar intake and dental decay in low-income children.
2. To examine the association between dietary sugar intake and oral health outcomes (plaque scores and gingivitis prevalence) in low-income children.
3. To identify dietary sugar intake as a predictor of dental decay and oral health outcomes in low-income children.

METHODOLOGY

A crosssectional study was conducted to examine the connection between oral health outcomes, dental caries and dietary sugar consumption in children from low-income families. Data were gathered from dental hospitals and clinics. Within six months, the research was conducted. 70 children's aged 8–10 years were chosen using stratified random sampling.

Inclusion criteria: The study included 8-10 year old youngster. Only single children from impoverished households were included. Children with parental approval could participate.

Exclusion criteria: Children with systemic diseases or conditions that could impair oral

health, including diabetes or genetic disorders were not included. Children who had past orthodontic care and those on drugs like steroids or antibiotics that could impact oral health were excluded.

Data Collection Tools: To assess dietary sugar intake, the Sugar Intake Assessment Questionnaire was utilized. It's included 20 items with response ranging from 0 (daily) to 2 (monthly). The Cariogram Model evaluated dental decay. Bratthall and Hänsel Petersson created the Cariogram. This model assesses an individual's risk of developing dental caries depending on several variables including diet, oral hygiene, and prior caries experience. It included 10 items with number of responses 0 (low risk) to 3 (very high risk). Standardized Oral Hygiene Index (OHI) was used to assess oral health outcomes. OHI was developed by John C.Greene and Jack R. Vermillion in 1960-1964. It assesses oral hygiene status by evaluating debris and calculus on selected tooth surfaces. It included scoring system with 4 categories such as debris index (DI) scoring system 0 (No debris) to 3 (soft debris covering more than 2/3 of the tooth surfaces) and calculus index(CI) scoring system 0 (no calculus)to 3 (superagingival calculus covering more than 2/3 of the tooth surface).

Statistical Analysis: Descriptive Statistics was used to summarize demographic and clinical characteristics. Independent t-tests was used to Performed to compare mean sugar intake and oral health outcomes between groups. Regression Models was used to examined associations between sugar intake, dental decay, and oral health outcomes.

RESULTS

Table1: Demographic Characteristics of Study Participants

Characteristics	Frequency(n)	Percentage (%)
Age (8-10 years)	70	100%
Boys	35	50%
Girls	35	50%
Socioeconomic status(Low-income)	70	100%
Educational status of children		
• 3rd grade	20	28.6%
• 4th grade	25	35.7%
• 5th grade	25	35.7%
Family Educational Level		
• Primary Education	30	42.9%
• Secondary Education	25	35.7%
• Higher Education	15	21.4%
Ratio of Family Income to Poverty		
• Below Poverty Line (<1.0)	40	57.1%
• Near Poverty (1.0-1.99)	20	28.6%
• Above Poverty Line (≥2.0)	10	14.3%

Table2: Correlation Analysis Results

Variables	Correlation Coefficient (r)	p-value
Dietary Sugar Intake and Dental Decay	0.45	p<0.001
Dietary Sugar Intake and Oral Health Outcomes	0.35	p<0.01
Dental Decay and Oral Health Outcomes	0.60	p<0.001

This table presents the correlation analysis results between dietary sugar intake, dental decay, and oral health outcomes. Higher consumption of dietary sugar is associated with more tooth decay, as seen by a modest positive correlation ($r = 0.45$, $p < 0.001$). Increased dietary sugar consumption appears to be linked to worse oral health outcomes, as indicated by a little positive correlation ($r = 0.35$, $p < 0.01$). Higher dental rot is closely associated with lower oral health outcomes, as evidenced by a significant positive correlation ($r = 0.60$, $p < 0.001$).

Table3: Comparison of Oral Health Outcomes

Oral health outcomes	High sugar intake	Low sugar intake	Mean difference	p-value
Plaque scores	-	-	1.2	p<0.01
Gingivitis prevalence	35%	15%	-	p<0.001

Table 4: Independent t-test Results

Comparison	t-value	p-value
Mean Sugar Intake (Dental Caries vs. No Dental Caries	t(68)= 4.2	p<0.001
Mean Plaque Scores (High Sugar Intake vs. Low Sugar Intake)	t(68)=3.5	p<0.01

This table shows results of independent t-tests comparing mean sugar intake and plaque counts across groups. A significant difference ($t = 4.2$, $p < 0.001$) shows that people with dental caries have higher average sugar intake than those without. A significant difference ($t = 3.5$, $p < 0.01$) indicates that those with high sugar intake have greater mean plaque scores than those with low sugar intake.

Table5: Regression Analysis

Predictor	β Coefficient	p-value
Dietary Sugar Intake (Dental Decay)	β = 0.3	p < 0.001
Dietary Sugar Intake (Oral Health Outcomes)	-	p < 0.001

This table shows the results of regression analysis examining the relationship between dietary sugar intake and dental decay/oral health outcomes. There is significant positive relationship ($\beta = 0.3$, $p < 0.001$) indicates that higher dietary sugar intake is associated with increased dental decay. A significant relationship ($p < 0.001$) suggests that dietary sugar intake is a significant predictor of oral health outcomes.

Table6: Frequency of Sugary Drinks and Snacks

Drink/snack	Daily	Several times a week	Rarely	Never
Fruit Juice (n=70)	20 (28.6%)	30 (42.9%)	15 (21.4%)	5 (7.1%)
Soda (n=70)	15 (21.4%)	25 (35.7%	20 (28.6%)	10 (14.3%)
Sports Drinks (n=70	5 (7.1%	15 (21.4%)	30 (42.9%)	20 (28.6%)
Flavored Milk (n=70)	25 (35.7%)	20 (28.6%)	15 (21.4%)	10 (14.3%)
Sugary Snacks (n=70)	28 (40%)	25 (35.7%)	10 (14.3%)	7 (10%)

DISCUSSION

The findings of this study reinforce the robust and consistent evidence that dietary free sugars are the principal modifiable risk factor for dental caries in children, particularly among low-income and vulnerable pediatric populations (11). Multiple systematic reviews and cohort studies have demonstrated that caries prevalence and severity are directly related to both the amount and frequency of free sugar intake. Notably, the risk of dental caries increases substantially when free sugars comprise more than 10% of total daily energy intake, with further reductions in risk observed when intake is limited to below 5%(12).

The present analysis aligns with previous research showing that children who regularly consume sugar-sweetened beverages (SSBs) and sugary snacks are at significantly greater risk for developing dental caries. This risk is particularly pronounced when sugars are consumed between meals or in sticky forms that adhere to tooth surfaces, prolonging acid exposure and enamel demineralization. Early introduction of sugary foods and drinks, as early as six months of age, has also been connected with greater risk of caries in both primary and permanent teeth later in life(6). Children from poor homes are more likely to consume more daily sugar, have less access to preventative dental care, and be more

exposed to poor food environments, all of which enhance their risk for tooth caries. Socioeconomic inequalities exacerbate the influence of dietary sugar on oral health results. This is evident in population studies that continuously reveal more rates of caries and more severe illness in socioeconomically deprived children even after accounting for other risk variables(6).

Despite the obvious advantages of lowering sugar consumption, evidence also shows that caries is not completely eradicated even when free sugar intake is maintained below the advised limits(9). This indicates that dietary changes should be supported by other preventative measures, such frequent oral hygiene, community water fluoridation, and access to dental care, in order to optimize oral health outcomes (11).

CONCLUSION

This study offers a comprehensive overview of the relationship between sugar consumption, dental caries, and oral health outcomes among low-income children. Reducing dietary sugar intake both in terms of amount and frequency is critical for preventing dental caries and encouraging lifelong oral health, particularly in children and vulnerable populations.

Implications

1. Targeted Interventions: Reducing sugar intake and encouraging good oral hygiene habits are crucial for minimizing the weight of dental caries in at-risk pediatric groups.
2. Using public health programs and parent education programs can be very important in raising general oral health in low-income areas.
3. Early detection and intervention for children with high sugar consumption and poor oral health results can help avoid long-term dental problems.

Limitations

1. Cross-Sectional Design: Limited causal inference.
2. Limited Sample Size: May not be generalizable to larger populations

Future Directions

Future research should focus on designing, implementing, and rigorously evaluating interventions that address behavioral and social determinants of sugar consumption, such as family habits, food environment, and community norms. Future studies should explore models of care that facilitate access for low-income and high-risk children, including school-based programs and community partnerships

REFERENCES

1. Courtney Desrosiers and Lisa J Heaton. (2025). Links Between Sugar and Dental Decay in US Children from Low-Income Families: Results of a Systematic Review, Boston, MA: CareQuest Institute for Oral Health, DOI: 10.35565/CQI.2025.2001
2. Cheever VJ, Mohajeri A, Patel K, Burris RC, Hung M. (2025). Impact of Free Sugar Consumption on Dental Caries: A Cross-Sectional Analysis of Children in the United States. Dent J (Basel), 22; 13(2):48. doi: 10.3390/dj13020048. PMID: 39996922; PMCID: PMC11854531.
3. Chi DL, Scott JM. (2019). Added Sugar and Dental Caries in Children: A Scientific Update and Future Steps. Dent Clin North Am, 63(1):17-33. doi: 10.1016/j.cden.2018.08.003. Epub 2018 Oct 29. PMID: 30447790; PMCID: PMC6242348.
4. BMC Oral Health. (2024). A systematic review and meta-analysis of the association between sugar intake and dental caries in Nigeria
5. Mahboobi Z, Pakdaman A, Yazdani R, Azadbakht L, Montazeri A. (2021). Dietary free sugar and dental caries in children: A systematic review on longitudinal studies. Health Promot Perspect, 18;11(3):271-280. doi: 10.34172/hpp.2021.35. PMID: 34660221; PMCID: PMC8501477.
6. Jessica F Large, Claire Madigan, Rebecca Pradeilles, Oonagh Markey, Benjamin Boxer, Emily K Rousham. (2024). Impact of unhealthy food and beverage consumption on children's risk of dental caries: a systematic review, Nutrition Reviews, Volume 82, Issue 11, Pages 1539–1555, https://doi.org/10.1093/nutrit/nuad147
7. Desrosiers C, Heaton LJ.(2023). Links between Sugar and Dental Decay in US Children from Low-Income Families: Results of a Systematic Review. CareQuest Institute for Oral Health, Available at: https://www.carequest.org/system/files/CareQuest_Institute_Links-Between-Sugar-and-Dental-Decay_FINAL.pdf

8. L.P.A. Sandy, S. Helmyati, R. Amalia. (2024). Nutritional factors associated with early childhood caries: A systematic review and meta-analysis, The Saudi Dental Journal, Volume 36, Issue 3, Pages 413-419, ISSN 1013-9052, https://doi.org/10.1016/j.sdentj.2023.12.001. (https://www.sciencedirect.com/science/article/pii/S1013905223002663
9. Moynihan P. (2016). Sugars and Dental Caries: Evidence for Setting a Recommended Threshold for Intake. Adv Nutr, 15;7(1):149-56. doi: 10.3945/an.115.009365. PMID: 26773022; PMCID: PMC4717883.
10. Action on Sugar. Sugars and tooth decay. Wolfson Institute of Population Health. Queen Mary University of London. Charterhouse Square. EC1M 6BQ
11. WHO (2017). Sugars and dental caries.
12. Moores CJ, Kelly SAM, Moynihan PJ. (2022). Systematic Review of the Effect on Caries of Sugars Intake: Ten-Year Update. Journal of Dental Research, 101(9):1034-1045. doi:10.1177/00220345221082918