



Original Article

Exploring the Link between Diet, Obesity, and Dental Caries in Children

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ABSTRACT

Tooth decay which is the most common nutrition-related disease, was the focus of this study. Here, we investigated the association between diet, obesity, and dental caries in young children. This descriptive-analytical study included the assessment of children's oral health through the DMFT index to determine tooth decay. Body mass index was used to calculate the level of obesity, and a semi-quantitative food frequency questionnaire (FFQ) assessed food consumption patterns. The findings showed that overweight and obese young children had a significantly higher caries index compared to their peers ($P < 0.05$). Analysis of food consumption frequency showed that, except for dairy products, most children included fruits and vegetables in their diets. An inverse relationship was found between tooth decay and the consumption of milk, dairy, fruits, and vegetables, while a strong positive correlation was observed between BMI and the frequency of sweets consumption. This study identifies obesity, high intake of cariogenic snacks, and low consumption of fruits, vegetables, and dairy products as important risk factors for dental caries in children. Given the vital role of dental health in overall well-being, it is essential to educate parents and children about the importance of maintaining a balanced diet.

Keywords: Obesity, Children, Diet, Dental cavity

Introduction

Dental caries ranks as the most prevalent chronic disease among children [1-4] and remains a significant public health issue, particularly in developing nations [5-7]. A range of factors contribute to the development of tooth decay, including genetic predispositions, diet, obesity, dental structure, oral hygiene habits, fluoride exposure, age, gender, saliva composition, parental education, and socio-economic status [4-8]. Research has demonstrated a link between childhood nutrition and various adult health conditions [9, 10]. Furthermore, studies indicate that dietary habits play a crucial role in the development of obesity, early tooth loss, gum diseases, and poor breath [11, 12].

HOW TO CITE THIS ARTICLE: Arora A, Manohar N, Scott JA, Do LG, Bhole S, Hayen A. Exploring the Link between Diet, Obesity, and Dental Caries in Children. Turk J Public Health Dent. 2024;4(2):12-7. <https://doi.org/10.51847/MxRNKWK8jz>

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Received: 06/06/2024

Accepted: 14/09/2024



Carbohydrates are particularly conducive to the growth of bacteria responsible for dental decay. Foods high in sucrose, coupled with frequent eating patterns, promote the bacterial breakdown of sugary substances in the mouth. This process produces acids that lower the pH of saliva, creating an environment favorable for caries development. The longer sugary foods remain in contact with the oral cavity, the greater the potential for harm. As a result, sticky sweet foods like dried berries, raisins, and chocolate are especially damaging to dental health [13, 14]. This issue is particularly concerning for children [5, 6].

Proper nutrition from the early stages of life supports a child's development and physical growth [9] and also plays a vital role in maintaining optimal oral and overall health [15, 16]. When children's diets are high in sugary foods, it can condition their taste preferences toward sweetness, leading to a stronger inclination towards consuming sugary foods as they grow older. Poor dietary habits, particularly the consumption of sweet snacks outside the home, contribute to an increased risk of overweight, and dental caries among young children and adolescents [3, 4].

Obesity stands as the most prevalent nutritional issue linked to tooth decay in children [4-6]. Some studies have reported a positive correlation between dental caries and obesity [4], while others have found an inverse relationship [8], or no association at all [3, 5]. Given the significance of proper nutrition and the potential role of obesity in the development of tooth decay, this study aims to explore the connection between dietary habits, obesity, and dental caries in children.

Materials and Methods

This research was a cross-sectional and descriptive study involving 79 children, consisting of forty-seven girls and 32 boys. The size of the sample was calculated using the formula for cross-sectional studies, considering a tooth decay prevalence of 82%, a maximum margin of error of 8%, and an alpha level of 0.05. Initially, the Mothers of the children were informed about the research aims, and those whose children gave consent were in the study.

To assess tooth decay, the DMFT (decayed, missing, and filled teeth) index was utilized, which reflects the presence of untreated, restored, or extracted teeth due to decay. The examination was carried out by pediatric dentists in a dental clinic using standard equipment, including a dental unit, probe, and flat dental mirror. The severity of tooth decay was classified based on the DMFT scores: 0 (no decay), 1-3 (low decay), and ≥ 4 (high decay).

To assess obesity, BMI was measured for each child. The children were weighed while wearing minimal clothing and no shoes using a Bascoli scale, accurate to 100 grams. Their height was calculated with a Seca caliper, accurate to 0.5 cm. BMI percentiles, based on age and sex, were determined using data from the US Centers for Disease Control and Prevention (CDC) [17]. Due to the limited sample size, children were categorized into three groups according to BMI percentiles: underweight (below the 5th percentile), normal weight (5th-85th percentile), and overweight/obese (above the 85th percentile).

A semi-quantitative food frequency questionnaire (FFQ) was employed to evaluate the children's food intake, covering key food groups such as grains, dairy, fruits, proteins, and vegetables. The questionnaire also included foods like sweets (sugar, honey, jams, biscuits, cakes, chocolate, candies), snacks (chips, pretzels), and sugary drinks (carbonated beverages, desserts, fruit juices). Nutrition experts conducted face-to-face interviews with the children's mothers to complete the FFQ. The questionnaire's validity and reliability were established in previous research.

Data were analyzed using SPSS version 23. To examine the relationship between categorical variables, the χ^2 test was applied, while one-way ANOVA was used for quantitative variables related to tooth decay. Pearson's correlation experiment was employed to analyze the association between the DMFT index, background factors, and food consumption patterns. A P-value < 0.05 was considered statistically significant.

Results and Discussion

A total of 79 children, ranging in age from 6-11 years with a mean age of 9 ± 1.9 years, participated in the study. Among the participants, 25.3% (20 children) were classified as having normal weight, another 25.3% (20 children) were underweight, and 49.4% (39 children) were overweight or obese. The overall average DMFT index for the children was 3.97 ± 1.6 . Tooth decay was observed in 89.9% (71 children) of the children, with 10.1% (8 children)

having no decay (DMFT = 0). Of the remaining children, 46.8% (37 children) had low levels of decay (DMFT 1-3), while 43.1% (34 children) had high levels of decay (DMFT \geq 4).

Regarding the parents' background, 57% of fathers were employed, with 65.8% having a diploma or higher education. Most mothers (69.6%) were housewives, and 54.4% held a diploma or higher education. The average household size was 5.3 ± 1.3 individuals.

Table 1. Frequency distribution of BMI and severity of dental caries

BMI	DMFT		0		1-3		\geq 4		Total	
	N	%	N	%	N	%	N	%	N	%
Low weight	2	25	11	29.7	7	20.6	20	25.3		
Normal weight	3	37.5	11	29.7	6	17.6	20	25.3		
Overweight	3	37.5	15	40.6	21	61.8	39	49.4		
Total	8	100	37	100	34	100	79	100		

As illustrated in **Table 1**, a significant association was observed between the severity of tooth decay and BMI ($P = 0.05$; $X^2 = 7.2$). Specifically, 21 children (8.61%) who were classified as obese had a DMFT score of 4 or higher.

Table 2 provides an overview of the mean consumption of different food groups and their correlation with the severity of dental caries. The analysis revealed that the frequency of dairy product consumption ($P = 0.02$) as well as the intake of fruits and vegetables ($P = 0.04$) were significantly related to the extent of tooth decay.

Table 2. The mean food groups and the severity of tooth decay

Food groups	The severity of tooth decay			P
	0 (Mean \pm SD)	1-3 (Mean \pm SD)	\geq 4 (Mean \pm SD)	
Dairy products	2.3 \pm 1.8	1.5 \pm 1.2	0.7 \pm 0.09	0.02
Vegetables and fruits	2.6 \pm 1.5	2.4 \pm 1.7	1.9 \pm 1	0.04
Cereals and bread	5.7 \pm 2.3	5.8 \pm 1.9	5.6 \pm 2.1	0.55
Legumes, meats, and eggs	2.3 \pm 0.9	2.3 \pm 1.3	2.1 \pm 0.9	0.35

The frequency of consumption of various food items, including milk, dairy, fruits, vegetables, and foods that promote tooth decay (such as sweets, snacks, and sugary drinks), is outlined in **Table 3**. The findings indicated that most children (65.8%) consumed milk and dairy products and fruits and vegetables only 1-2 times per week. On the other hand, a larger number of children consumed sweets sugary beverages, and snacks five or more times a week (**Table 3**).

Table 3. Frequency distribution of consumption of food.

Food intake	Frequency of consumption		Never		1-2 times a week		3-4 times a week		\geq 5 times a week		χ^2	P
	N	%	N	%	N	%	N	%				
Dairy products	10	12.7	52	65.8	9	11.4	8	10.1	15.2	0.05		
Vegetables and fruits	14	17.7	50	63.3	10	12.7	5	6.3	11.3	0.02		

The correlation analysis between tooth decay and dietary habits revealed a significant positive relationship between tooth decay and BMI and the frequency of sweet consumption. Additionally, a negative correlation was found between tooth decay and the average intake of milk and dairy products as well as fruits and vegetables. However, no correlation was identified between tooth decay and other dietary factors (**Table 4**).

Table 4. Distribution of the frequency of consumption of food.

Abundance of decaying food	Frequency of consumption		Never		1-2 times a week		3-4 times a week		\geq 5 times a week		χ^2	P
	N	%	N	%	N	%	N	%				
Sweets	4	5.1	4	51.1	28	35.4	43	54.4	33.2	0.03		

Sweet and carbonated drinks	14	17.7	14	17.7	29	37.8	22	27.8	19.7	0.06
Snacks	21	26.5	6	7.6	10	12.7	42	53.2	32.3	0.055

Tooth decay is a multifactorial disease, and various factors contribute to its development, with nutrition being one of the main causes [17-20]. Oral hygiene during childhood is so important that highlights the significance of the factors influencing it. In recent times, much attention has been directed towards understanding the connection between dietary habits, obesity, and oral health [17-19]. This study aimed to explore the associations between tooth decay, nutritional status, and food consumption in children.

The association between childhood obesity and tooth decay is influenced by factors such as gender, age, race, and family income [8]. Research by Narksawat *et al.* [17] in Thailand and Parshnath *et al.* [8] in India demonstrated a negative relationship between BMI and tooth decay. However, the current study found a positive correlation between BMI and the DMFT index. It has been mentioned that poor eating patterns, particularly the excessive intake of carbohydrate-rich and sugary foods, may simultaneously increase the risk of both tooth decay and obesity in children [4, 5].

The findings related to food consumption patterns revealed that the children in the study generally consumed other primary food groups, excluding dairy products, fruits, and vegetables. In young children with a DMFT ≥ 4 , the average intake of milk, dairy products, vegetables, and fruits was significantly lower compared to other children, highlighting the influence of diet on tooth decay. Dairy products are rich in minerals such as calcium, phosphorus, and vitamins A and D, which play a crucial role in preventing dental caries [21, 22]. Calcium, in conjunction with vitamin D, strengthens bones and teeth, while phosphorus contributes to the formation of enamel. A deficiency in these minerals can lead to structural changes in teeth and gums, creating conditions favorable to tooth decay. It is important to note that poor nutrition over time exacerbates these issues [23, 24].

Numerous studies have investigated the connection between food consumption and tooth decay, producing varied results. Some studies [25] reported an inverse association between the intake of milk and dairy products and gum health and tooth wear, aligning with the findings of the current study. Similarly, Stewart *et al.* [26] found that children who consumed a diet rich in vegetables had a lower prevalence of caries compared to others. Although fruits and vegetables contain natural sugars, their high water content dilutes these sugars, resulting in a lower potential for causing decay. Moreover, the fiber in these foods, when chewed, helps neutralize bacteria that ferment sugars and also aids in cleaning teeth. The increased saliva production triggered by fresh fruits and vegetables further neutralizes the acids produced by carbohydrate fermentation, balancing the pH in the mouth and contributing to enamel protection and restoration. Additionally, vitamins such as C and A, abundant in fruits and vegetables, support gum health. In contrast, sugary foods and fermentable carbohydrates, like candies, biscuits, and cookies, are significant contributors to tooth decay [27, 28].

Research has indicated that frequent snacking, particularly on sugary foods, leads to a drop in oral pH, which is a significant factor contributing to tooth decay. The acidity produced by food by oral bacteria is directly linked to the sugar content of the consumed foods. Foods that are rich in sugars, especially those with high adhesive properties that stick to the teeth, have a more pronounced impact on dental health [29].

In this study, a notable correlation was found between the frequency of sweet consumption and the occurrence of tooth decay. Consistent with the findings of this study, Eronat and Koparal [30] reported similar trends, and Grenby's research [29] on students in England indicated that nearly all children regularly consumed snacks such as biscuits, cakes, and chips. In this research, 43 children (54.4%) consumed sweet snacks like chocolates, candies, and other treats more than five times a week. Of these, 21 children (48.8%) were classified as overweight or obese, and their DMFT index (DMFT ≥ 4) was significantly higher compared to other children. Additionally, the study revealed that children whose parents had at least secondary education had a lower average DMFT score compared to children with less educated parents. This suggests that educated parents are likely more aware of oral health issues and more attentive to their children's dental care, highlighting parental education as an important factor in the prevention of tooth decay [1-4].

Conclusion

The results of this study highlight a significant association between obesity and a higher caries index in children. Obese children exhibited noticeably higher rates of tooth decay compared to their peers with a healthy weight. The analysis of dietary habits showed that, apart from dairy products, children consumed fruits and vegetables

from other food categories. Additionally, the study found an inverse relationship between the consumption of dairy products, as well as fruits and vegetables, and the occurrence of tooth decay. This suggests that a higher intake of these food groups may help reduce the risk of cavities. On the other hand, a strong positive correlation was identified between body mass index (BMI) and the frequency of sweet consumption, indicating that children with higher BMI levels tend to consume more sugary foods, which are known to contribute to dental decay. This study underscores the critical role that both obesity and dietary choices play in the development of dental caries among children. The frequent intake of sugary snacks, combined with limited consumption of nutrient-dense foods like dairy, fruits, and vegetables, was identified as a key factor in increasing the risk of tooth decay. Given the strong connection between oral health and overall well-being, it is crucial to promote better dietary habits. Educating both parents and young children about the importance of a balanced, healthy diet could significantly reduce the incidence of dental issues and contribute to healthier lifestyles in the long term.

Acknowledgments: None

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

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