



## Exploring the high-sugar diet and oral health outcomes in preschool children: a cross-sectional analysis

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### Abstract

**Background:** Oral health problems can occur easily. The most common and one of the biggest burden diseases is dental caries. Caries occurred in children aged five with a very high index. Children are susceptible to oral health problems, including dental caries and also a low levels of oral hygiene. Preschool children are one of the age groups with a high risk of experiencing caries. They tend to consume sweet drinks and beverages. The higher consumption of this sugar can have a greater impact on the condition of children's tooth decay.

**Aim:** This study aims to explore the correlation between a high-sugar diet and oral health outcomes in preschool children.

**Materials and Methods:** This study was an analytic observational which was conducted in 2023. The population of this study was parents and the preschool children who were admitted to the playgroup and kindergarten in South region of Surabaya. The total of the participants was 252.

**Results:** There is a correlation between a high-sugar diet with dental caries and oral hygiene significantly ( $p$ -value  $< 0.05$ ). Children who eat more high-sugar foods or drinks will susceptible to a higher number of caries and causes more plaque to adhere to the teeth surface.

**Conclusion:** High-sugar food such as candy, cookies, chocolate, donuts, or cake, and drinks like milk and syrup can impact oral health outcomes in preschool children. The more they have a high-sugar diet, the more they are susceptible to dental caries and dental plaque that can affect oral health outcomes.

**Keywords:** Dental caries, dental plaque, high-sugar diet, medicine, sugar consumption

### Introduction

One of the predictors of general health is oral health since oral health is an important part of general health. However, oral health problems can occur easily. The most common and one of the biggest burden diseases is dental caries [1]. The causes of caries are multifactorial, which are microorganisms, hosts, substrates, and time. According to WHO, there are 514 million children experiencing caries in their primary teeth, and it can be said that the prevalence of primary tooth caries reaches 43% in the world [2]. The prevalence of dental caries in primary teeth of children aged 6 years in Australia is recorded at more than 50% [3]. The prevalence of dental caries in children aged 3-5 in China reaches 70.4% [4]. Meanwhile, based on Riskesdas in 2018, there were 41.1% of children aged 3-4 years who experienced dental and oral health problems in Indonesia [5]. The Health Ministry of Indonesia reported in the Indonesia Health Survey 2023 that dental caries occurred in children aged five with a very high indeks (6.7 index) according to the WHO classification [6]. These four factors are the main factors and are interrelated with each other; they can lead to pain, permanent tooth growth, and loss of appetite, which

can result in malnutrition, growth, and development in children. In addition to the main four internal factors, there are also external factors as predisposing factors for dental caries, including age, gender, cariogenic foods, socioeconomics, oral hygiene, frequency of dental care, and difficulty in accessing dental health services [7, 8].

The other oral health problem that is most commonly found in children is poor oral hygiene. Children are susceptible to oral health problems, including dental caries and also a low levels of oral hygiene [9]. Preschool children are one of the age groups with a high risk of experiencing caries. Dental caries in preschool children is a common problem that can significantly impact dental health and child development. Caries occur faster in children because the enamel of primary teeth is thinner than the enamel of permanent teeth, and children tend to prefer sweet foods that can cause dental health problems, including caries and plaque retention [10]. Data from the South Surabaya Public Health Center shows that the incidence of dental caries is one of the 10 most common health problems experienced by the surrounding community. A preliminary survey was conducted on 23 children aged 2-6 years in 3 places, namely Kuncup Harapan 2 Playgroup, Dahlia Kindergarten, and Al-Wahyu

Kindergarten. The results of caries prevalence were 57% in Kuncup Harapan 2 Kindergarten, 83% in Dahlia Playgroup, and 60% in Al-Wahyu Kindergarten. One of the main potential factor is cariogenic foods. Children tend to like sweet foods and drinks that can stick to their teeth easily and can impact tooth decay. Most sweet drinks and beverages that children like are sources of sugar content that enters the children's body. The higher consumption of this sugar can have a greater impact on the condition of children's tooth decay <sup>[11]</sup>. Parents, especially mothers, play an important role as educators, health promoters and role models for children <sup>[12]</sup>. However, mothers' role in their children's high-sugar diet still needs to be considered <sup>[13, 14]</sup>. Due to this explanation, other efforts have been made to prevent dental caries and bad oral hygiene in preschool children. However, the number of caries is still high. Therefore, this study aims to explore the correlation between a high-sugar diet and oral health outcomes in preschool children.

### Materials and Methods

The study was conducted in Surabaya and has been approved ethically by the health research ethical commission of the Faculty of Dental Medicine, Universitas Airlangga (Number: 1153/HRECC.FODM/XII/2024). This study was an analytic observational which was conducted in 2023. The population of this study was parents and the preschool children who were admitted to the playgroup and kindergarten in South region of Surabaya, Indonesia. The inclusion criteria were all children who were  $\leq 6$  years old, both mothers and children willing to contribute to this study, while the exclusion criteria were the children who were disabled and had medical conditions that led to unstable condition medically and mentally. The technique sampling used in this study was cluster random sampling. The amount of the participants was 252.

The data were obtained using a questionnaire about the food frequency diet of their children in the last several months ( $\leq 3$  months). The food frequency questionnaire contained of the frequency of high sugar drinks and foods. The questionnaire was distributed to the mother. The oral health outcome data of children were obtained through the clinical examination, which resulted in the number of dental caries and the Personal Hygiene Performance Modified (PHP-M) score.

The clinical examination was done by collecting the number of tooth decayed, missing and filling. The other clinical examination was done with the observation of the plaque that was attached at the labial surface of the right-central-upper incisor, the buccal surface of the upper-right and upper-left first molar, labial surface of the left-lower-central incisor, the lingual surface of first molar lower-right and lower-left. Each tooth would be observed into 5 region which were occlusal or incisal, central, cervical, mesial, and distal. Each tooth was scored from zero, which means there was no plaque, and five, which means the surface was covered by plaque. The scores from each tooth were added up then divided into six, then it would be the score for PHP-M of the children. All of the data were analyzed statistically using statistic software (p-value  $< 0.05$ ; CI: 95%).

### Results

According to Table 1, preschool children are mostly between five and six years old. However, they have mostly experienced dental caries. The results of the oral hygiene examination in the preschool children are also poor, with most of the children in the high range score. This means that they have poor oral hygiene, and there are no children who had a zero score of PHP-m, and all of the children have plaque.

**Table 1:** Characteristic of respondents

Characteristics	N	Percentage
Age of Children		
2 years old	1	0.4%
3 years old	10	4%
4 years old	64	25.4%
5 years old	90	35.7%
6 years old	87	34.5%
Incidence of Caries		
Caries-free	47	18.7%
Caries	205	81.3%
PHPm Score		
0 $\leq$ 1	1	0.4%
1.1-2	37	14.68%
2.1-3	92	36.51%
$>3$	122	48.41%
Age of Mother		
20-30 years old	54	21.43%
31-40 years old	155	61.51%
41-50 years old	42	16.67%
$> 50$ years old	1	0.39%
Household's Income		
$< \text{IDR } 3.000.000$	95	37.7%
$\text{IDR } 3.000.000 - 5.000.000$	66	26.2%
$\text{IDR } 5.000.000 - 7.000.000$	43	17.1%
$> \text{IDR } 7.000.000$	48	19%



**Fig 1: High sugar diet distribution**

Figure 1 explains the distribution of the high-sugar diet according to each type of high-sugar food and drink. Children aged five and six years old mostly drink milk more than once a day. Children at the age of six years eat candy more frequent than other age groups. The six years old age group has the highest

number of children who eat candy more than once a day than other age groups. However, from the age of four until six years old, most tend to eat candy once a week. It is similar to chocolate, they mostly eat chocolate once a week, yet they also tend to eat or drink using sugar addition or eat sugar on their own once a day.

Children age five and six years old mostly eat ice cream once a week. For cookies, they also eat only once a week, still, there are also many children eat cookies once a day. Most of the respondents like to eat cakes or donuts, because they eat cakes or donuts once a day or a week. Different from other high-sugar foods or drinks, preschool children do not like to drink syrup or eat syrup as an addition to their food. Most of the children never or only once to three times a month eats or drink syrup during the last three months. Based on the table 2, there is a correlation between high-sugar diet with dental caries and oral hygiene significantly ( $p$ -value  $< 0.05$ ). Children who eat more high-sugar foods or drinks will have a higher number of caries and causes more plaque to adhere to the teeth surface. This can result to the poor oral health outcome.

**Table 2:** Correlation test result between high sugar diet, dental caries, and oral hygiene of children

Variables	Mean $\pm$ Standard Deviation	P value	Correlation Coefficient
Dental caries	5.07 $\pm$ 4.6	0.048	0.125
Oral hygiene	3.02 $\pm$ 0.85	$<0.001$	0.235

### Discussion

This study shows that preschool children often eat candy, chocolate, sugar, ice cream, cookies, donuts or cakes and drink syrup and milk. A recent study revealed that preschool children have a strong preference for high-sugar diets; they frequently consume sweets like candy, chocolate, and sugary drinks. Children are most likely to eat sweets or candies; this finding is in accordance with the study from Chambers and Skafida. They reported that children by age five ate sweets or chocolates once a day in everyday, while children age two mostly ate meals, they do not eat much sweets or snacked all day [15]. The finding in this study report that preschool-age children tend to eat sugar on their own, or adding sugar separately to their food [16]. This is in accordance with the study from Mahajan *et al.* The previous study state that preschool children often exceed 5% of their total daily energy intake [11].

Result from the study also state that high-sugar drinks such as syrup is not likely consumed by children. However, according to other study, children more like to have soft drinks than other sweet beverages such as fruit juice because it contains higher sugar. High-sugar drinks can result into plaque adhered, especially in children who can not brush their teeth correctly. It is similar with cookies or chocolate [17, 18]. The cookies, candy or chocolate easily sticks to the tooth surface, which lead to the dental caries and dental plaque [10, 19].

The results state that there is a significant correlation between a high-sugar diet and dental caries and dental hygiene. The more they eat sugar, the higher caries and plaque attached in their teeth surface. This in accordance with the study Xu *et al.* The study found that children with frequent snacking habits are 3.452 times more likely to develop dental caries compared to those with lower snacking frequencies [18, 20].

### Conclusion

In conclusion, high-sugar foods such as candy, cookies, chocolate, donuts, and cake, and drinks like milk and syrup can affect oral health outcomes in preschool children. The more they have a high-sugar diet, the more they are

susceptible to dental caries and dental plaque that affect the oral health outcomes. The correlation between a high-sugar diet, dental caries, and oral hygiene has been declared significant.

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