Research Report

Interrelationship of body mass index, dental caries, and oral health behaviour: Insights from Primary School in Surabaya, Indonesia

Ratri Maya Sitalaksmi[1], Nadia Kartikasari[1], Primanda Nur Rahmania[1], Onny Eryanto Limantoro[1], Yora Wardati[1], Charlie Saputra Prajugo[1], Annete Juwita Yukuri[1], Hananah Oktalidial Putri[1], Tiara Eva Dhamayanti[1], Riddo Adli Rudhanton[1], Aisyah Rachmadani Putri Gofur[2]

[1]Department of Prosthodontics, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia
[2]Department of Public Health, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia

ABSTRACT

Background: Dental caries is one of global health issues, with various factors such as Body Mass Index (BMI) and oral hygiene behaviours influencing its prevalence. Understanding the relationship between BMI and dental caries, as well as the oral hygiene practices, is essential for developing effective prevention strategies. Interventions on these factors are vital for mitigating the effects of dental caries on overall health. **Purpose:** This study aims to examine the correlation between dental caries and BMI in relation to oral and dental health behaviours. **Methods**: BMI and Decay, Missing, and Filled Teeth (DMF-T) data were collected from 5th-grade elementary school students, along with responses to an Oral and Dental Health Care Questionnaire. Statistical analysis was conducted using the Kruskal-Wallis Test ($p<0.05$) and Dwass-Steel-Critchlow-Fligner (DSCF) ($p<0.05$). **Results:** No significant differences in caries indices were observed between genders ($p>0.05$). The majority of participants were classified as underweight, and this group demonstrated a lower caries index. A comparison of DMF-T scores across various BMI categories revealed a statistically significant difference ($p<0.05$). Furthermore, the post hoc test indicated a significant difference in BMI between the very low and low groups within the DMFT category ($p<0.05$). **Conclusion:** The findings suggest that good oral health practices is affecting the relationship between BMI and dental caries. Thus, the importance of promoting proper oral hygiene and early intervention to prevent dental caries and improve overall health outcomes. Preventive efforts should target at-risk groups, focusing on lifestyle and oral health education.

Keywords: dental caries; body mass index; oral maintenance behaviour; medicine; child health

Correspondence: Ratri Maya Sitalaksmi, Department of Prosthodontics, Faculty of Dental Medicine, Universitas Airlangga. Jl. Mayjen Prof. Dr. Moestopo 47 Surabaya, 60132 Indonesia. Email: ratri.maya.s@fkg.unair.ac.id

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INTRODUCTION

Dental caries continues to represent one of the most prevalent yet preventable disorders affecting children, despite persistent efforts aimed at its reduction. Over recent decades, this condition has remained a significant global oral health concern.[1] The WHO Global Oral Health Status Report in 2022 indicates that approximately 3.5 billion individuals worldwide are affected by oral diseases, with a significant proportion—approximately 75%—residing in middle-income countries. Globally, an estimated 2 billion individuals experience dental caries in permanent teeth, while 514 million children are affected by caries in primary teeth. The prevalence of major oral diseases continues to escalate on a global scale, influenced by factors such as urbanization and shifts in living conditions.[2] In Indonesia, the 2018 Basic Health Research data indicated that 57.6% of the population experienced dental and oral health issues. Furthermore, among 12-year-old children, the prevalence of dental caries was recorded at 72%, with an average Decay-Missing-Filled Teeth (DMFT) index of 1.9. This statistic suggests that, on average, each child had 1 to 2 teeth impacted by caries.[3] The DMFT index, serves as an essential metric for evaluating oral health, facilitating both the measurement and comparison of tooth decay prevalence.[4]

Dental caries is a condition that arises from the fermentation of dietary carbohydrates by oral bacteria, resulting in acidic byproducts that contribute to the demineralization of dental enamel.[4] A comprehensive understanding of the multifactorial determinants of children's oral health is essential due to its significant clinical and public health implications. Factors such as dietary patterns, body mass index (BMI), and parental

socioeconomic and educational status are strongly correlated with oral health outcomes. Childhood obesity has been particularly associated with an increased risk of dental caries, primarily due to shared risk factors, including high sugar intake and poor dietary habits.[5] The World Health Organization (WHO) reported that in 2022, over 390 million children and teens aged 5 to 19 were overweight, including 160 million who were obese.[6] Furthermore, national report showed that obesity among boys aged 6 to 18 increased from 3.34% in 2004 to 13.58% by 2012. For girls in the same age group, the obesity rate rose from 3.50% to 10.15% during that time.[3] These emerging trends highlight the potential dual burden of childhood obesity and dental caries, thereby underscoring the urgent need for integrated preventive strategies that target dietary habits, lifestyle choices, and oral hygiene practices.

Body Mass Index (BMI) is a metric used to assess an adult's nutritional health.[7] In developed countries, high consumption of carbohydrate-rich meals is a primary contributor to obesity and dental caries. Obese children often favor diets high in fats and carbohydrates, while underweight children, often malnourished, experience impaired tooth development and a higher risk of caries. The relationship between BMI and dental caries has been inconsistent in various studies. Soelemani (2022) found no significant correlation between BMI and DMFT scores, with the exception of permanent teeth, where a noteworthy association was observed.[5] In contrast, Khalilnejad (2014) reported a significant relationship between BMI and DMFT.[8] These findings highlight the necessity for further research to elucidate the interaction between BMI and oral health.

Parental involvement and awareness of the development of primary and permanent dentition are essential components in the prevention of dental caries among children. Parents significantly influence the establishment of proper oral hygiene practices as children advance in their motor and cognitive skills. Oral hygiene practices, particularly effective tooth brushing, are paramount in the prevention of caries, as they serve as the primary method for removing food debris from tooth surfaces.[9] According to the 2018 Basic Health Research data, although 96.5% of children aged 10 to 14 brush their teeth on a daily basis, a mere 2.1% do so at the recommended frequency.[3] Consequently, oral health education is critical in shaping children's behaviours toward adopting enhanced oral hygiene practices. This

education should underscore the importance of brushing teeth at appropriate intervals and maintaining healthy dietary habits. Moreover, the integration of oral health education with nutritional counselling has the potential to improve both BMI and oral health outcomes.[10] This study aims to evaluate the correlation between dental caries and BMI in relation to oral and dental health behaviours.

MATERIAL AND METHODS

The ethical approval for the research was granted from the Health Research Ethical Clearance Committee of the Faculty of Dental Medicine at Universitas Airlangga (No. 0381/HRECC.FODM/III/2025). A cross-sectional study was conducted at an elementary school located in the centre of Surabaya, East Java, Indonesia. This school was selected due to the presence of an established Little Dentist program.[11] The fifth-grade students were specifically chosen as they possess the maturity necessary to understand the questionnaire and provide accurate responses for the questionnaire. The total sampling were utilized in this study. The study involved the distribution of paper-based self-administered questionnaires to 5th-grade students participating in an oral health education program. The oral health education program included presentations focused on oral health maintenance, as well as consultations addressing various oral health concerns. Students were asked to complete the questionnaires prior to the commencement of the program. Following the completion of the program, examinations to assess the dental caries index using Decay Missing Filling Teeth (DMF-T) were conducted and free consultation were given. Data collection took place in May 2024. Prior to administering the questionnaire, informed consent was obtained from the parents, and only those who granted permission were permitted to participate. All student responses were treated with the utmost confidentiality, and participation was voluntary. The criteria for inclusion in this study were as follows 1) Participants must be students at the designated elementary school in the center of Surabaya, 2) Participants must attend the oral health educational program, 3) Students must complete the questionnaire, and 4) Students must participate in the examinations to determine DMF-T scores.

This study employed the Oral and Dental Health Care Questionnaire for Primary School Students, developed in the

Tabel 1. Characteristic of the participant and DMF-T index

Characteristic	DMF-T				
	Very Low (0.0 - 1.1)	Low (1.2 - 2.6)	Moderate (2.7 - 4.4)	High (4.5 - 6.5)	Very high (>6.5)
Gender					
Boys	(9) 75.0%	(2) 16.7%	(1) 8.3%	(0) 0.0%	(0) 0.0%
Girls	(19) 82.6%	(2) 8.7%	(2) 8.7%	(0) 0.0%	(0) 0.0%
Body Mass Index (BMI)					
Underweight: BMI < 18.5	(21) 95.5%	(0) 0%	(1) 4.5%	(0) 0.0%	(0) 0.0%
Normal weight: BMI 18.5 - 24.9	(4) 57.1%	(1) 14.3%	(2) 28.6%	(0) 0.0%	(0) 0.0%
Pre-obesity: BMI 25.0 - 29.9	(2) 50.0%	(2) 50.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
Obesity class I: BMI 30.0 - 34.9	(0) 0.0%	(1) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
Obesity class II: BMI 35.0 - 39.9	(1) 100.0%	(0) 0.0%	(3) 8.6%	(0) 0.0%	(0) 0.0%
Obesity class III: BMI > 40	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%

Table 2. Questionnaires response of oral and dental health care

No	Question	Option	DMF-T				
			Very Low 0.0 - 1.1	Low 1.2 - 2.6	Moderate 2.7 - 4.4	High 4.5 - 6.5	Very high >6.5
1	How often do you brush your teeth?	Once a day	(4) 80.0%	(1) 20,0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Twice a day	(13) 81.3%	(1) 6.3%	(2) 12.5%	(0) 0.0%	(0) 0.0%
		Three times a day	(9) 81.8%	(1) 9.1%	(1) 9.1%	(0) 0.0%	(0) 0.0%
		Other	(2) 66.7%	(1) 33.3%	(0) 0.0%	(0) 0.0%	(0) 0.0%
2	How do you brush your teeth?	Down-Up	(10) 90.9%	(1) 9,1%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Right-Left	(3) 60.0%	(0) 0.0%	(2) 40.0%	(0) 0.0%	(0) 0.0%
		Circular	(12) 80.0%	(2) 13.3%	(1) 6.7%	(0) 0.0%	(0) 0.0%
		Other	(3) 75.0%	(1) 11.4%	(0) 0.0%	(0) 0.0%	(0) 0.0%
3	How long does it take you to brush your teeth?	0-1 minutes	(6) 66.7%	(1) 11.1%	(2) 22.2%	(0) 0.0%	(0) 0.0%
		1-2 minutes	(15) 83.3%	(3) 16.7%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		2-3 minutes	(2) 66.7%	(0) 0.0%	(1) 33.3%	(0) 0.0%	(0) 0.0%
		More than 3 minutes	(5) 100%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
4	When do you brush your teeth in the morning?	I never brush	(2) 66.7%	(1) 33.3%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		As soon as I get up	(5) 71.4%	(1) 14.3%	(1) 14.3%	(0) 0.0%	(0) 0.0%
		Before breakfast	(7) 77.8%	(1) 11.1%	(1) 11.1%	(0) 0.0%	(0) 0.0%
		After breakfast	(14) 87.5%	(1) 6.3%	(1) 6.3%	(0) 0.0%	(0) 0.0%
5	When do you brush your teeth in the evening?	I never brush	(3) 60%	(1) 20.0%	(1) 20.0%	(0) 0.0%	(0) 0.0%
		Before dinner	(3) 60%	(1) 20.0%	(1) 20.0%	(0) 0.0%	(0) 0.0%
		After dinner	(5) 83.3%	(1) 16.7%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Before going to bed	(17) 89.5%	(1) 5.3%	(1) 5.3%	(0) 0.0%	(0) 0.0%
6	How much toothpaste do you consume when brushing your teeth?	As big as a lentil	(3) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Half of toothbrush	(14) 77.8%	(2) 11.1%	(2) 11.1%	(0) 0.0%	(0) 0.0%
		Whole of toothbrush	(8) 80.0%	(1) 10.0%	(1) 10.0%	(0) 0.0%	(0) 0.0%
		Other	(3) 75.0%	(1) 25.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
7	Evaluate your oral dan dental health?	Very good	(0) 0.0%	(1) 50.0%	(1) 50.0%	(0) 0.0%	(0) 0.0%
		Good	(6) 75.0%	(1) 12.5%	(1) 12.5%	(0) 0.0%	(0) 0.0%
		Normal	(18) 85.7%	(2) 9.5%	(1) 4.8%	(0) 0.0%	(0) 0.0%
		Bad	(3) 100%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Very Bad	(1) 100%	(0) 0.0%	(3) 8.6%	(0) 0.0%	(0) 0.0%
8	What are your parents tooth brushing habits like?	Mum brushes	(3) 75.0%	(1) 25.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Dad brushes	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Both of them brushes	(8) 72.7%	(2) 18.2%	(1) 9,1%	(0) 0.0%	(0) 0.0%
		Neither of them brushes	(1) 100.0%	(0) 0.0%	(2) 10.5%	(0) 0.0%	(0) 0.0%
		I don't know	(16) 84.2%	(1) 5.3%	(3) 8,6%	(0) 0.0%	(0) 0.0%
9	What do you do to prevent your teeth from decaying?	I brush my teeth carefully before every meal	(5) 71.4%	(2) 28.6%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		I drink water after sugary foods	(12) 85.7%	(1) 7.1%	(1) 7.1%	(0) 0.0%	(0) 0.0%
		I go to the dentist every six months	(7) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		I do nothing	(2) 66.7%	(1) 33.3%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		I don't know	(2) 50.0%	(0) 0.0%	(2) 50.0%	(0) 0.0%	(0) 0.0%
10	How often have you experienced pain in your teeth in the last year?	Usually	(4) 66.7%	(1) 16.7%	(1) 16.7%	(0) 0.0%	(0) 0.0%
		Often	(2) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Occasionally	(5) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Rarely	(13) 76.5%	(3) 17.6%	(1) 5.9%	(0) 0.0%	(0) 0.0%
		Never	(4) 80.0%	(0) 0.0%	(1) 20.0%	(0) 0.0%	(0) 0.0%
11	Who/What did you first learn about brushing tooth from?	Family	(19) 79.2%	(3)12.5%	(2) 8.3%	(0) 0.0%	(0) 0.0%
		Teacher	(2) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Television, radio, newspaper, etc	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Dentist	(4) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		I don't know	(28) 80.0%	(1) 20.0%	(1) 20.0%	(0) 0.0%	(0) 0.0%
12	Why is regular dental check-up necessary?	For early diagnosis	(1) 33.3%	(2) 66.7%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		For protection of dental health	(20) 90.9%	(1) 4.5%	(1) 4.5%	(0) 0.0%	(0) 0.0%
		For the continuity of general health	(1) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		For cheap and easy treatment	(1) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		I don't know	(5) 62.5%	(1)12.5%	(2) 25.0%	(0) 0.0%	(0) 0.0%
13	Which one do you use for oral hygiene?	Floss	(5) 100.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Toothbrush	(22) 81.5%	(3) 11.1%	(2) 7,4%	(0) 0.0%	(0) 0.0%
		Toothpick	(0) 0.0%	(0) 0.0%	(1) 100.0%	(0) 0.0%	(0) 0.0%
		Mouthwash	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Gum	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%
		Electric toothbrush	(1) 50.0%	(1) 50.0%	(0) 0.0%	(0) 0.0%	(0) 0.0%

previous study.[12] We gathered data on student characteristics, including gender, weight, and height. Body mass index (BMI) was calculated using the height and weight using this formula: BMI= weight(kg)/ height(m)^2. BMI was calculated and categorized according to the World Health Organization (WHO) classification system: underweight: BMI < 18.5; normal weight: BMI 18.5 - 24.9; pre-obesity: BMI 25.0 - 29.9; obesity class 1: BMI 30.0 - 34.9; obesity class II: BMI 35.0 - 39.9; and obesity class III: BMI > 40. The questionnaire consisted of thirteen questions pertaining to the oral and dental health care of the students.[7] In addition, dental caries index examination was conducted to measure the DMF-T scores by a qualified dentist. The classifications for DMF-T scores were as follows: very low: 0.0 - 1.1; low: 1.2 - 2.6; moderate: 2.7 - 4.4; high: 4.5 - 6.5; and very high: > 6.5. Following the examinations, consultations were provided to both students and their parents regarding any identified oral health concerns.[13]

The data collected in this study were analysed using the SPSS program. Comparative analysis between groups was conducted using the Kruskal-Wallis's test to determine significant differences in the measured parameters (p<0.05). The Kruskal-Wallis test then followed by Dwass-Steel-Critchlow-Fligner (DSCF) multiple comparison analysis as post hoc comparative analysis to determine significant differences between DMFT group and BMI group in the measured parameter (p<0.05). These methods provide further insight into comparison between group and the variables.

RESULTS

A total of 57 students initially participated in the oral health educational program. Among these, 41 students completed both the questionnaire and oral health examination, resulting in a response rate of 71.9%. After applying the inclusion criteria, 35 students met the eligibility requirements and were included in the final analysis. Among the students, 65.7% (n=23) were girls, and 34.3% (n=12) were boys. The caries index revealed a wide range of values, ranging from very low to moderate, with no participants falling into the high or very high categories. The highest number of DMF-T index scores were observed within the very low range, and the distribution of these scores was nearly identical between girls and boys, indicating similar levels of dental caries among groups. The caries index for the boys have mean scores of 0.58, and the girls have the mean scores of 0.78.

The students' BMI displayed a wide range of categories, from underweight to obesity class II. Specifically, 48.9% were classified as underweight, 15.56% as having normal

weight, 8.89% as pre-obese, 2.22% as obesity class I, and 2.22% as obesity class II. The highest proportion of students fell into the underweight category, while obesity class I and obesity class II shared the lowest percentage. The characteristic of the participant and the DMF-T index are shown in the Table 1. Thus, it can be sum up the mean score for caries index for underweight is 0.92, the normal weight is 0.58, the pre-obese is 0.67, the obesity class I is 0.50, and the obesity class II is 1.00.

The Oral and Dental Health Care Questionnaire for Primary School Students consisted of 13 questions assessing brushing behaviours, caries prevention, experiences with tooth pain, dental check-ups, and oral hygiene maintenance. The findings revealed some notable gender differences in oral health practices. Specifically, boys reported brushing less frequently than girls. Both boys and girls employed the circular brushing technique and typically brushed their teeth for 1-2 minutes. Brushing occurred after breakfast and before bedtime, with students applying approximately half of the toothbrush with toothpaste. Both genders generally assessed their oral and dental health as normal. Regarding family influence, boys were more likely to be aware of both their mother's and father's brushing habits, whereas girls were unaware of their parents' oral care routines. Both boys and girls learned their brushing techniques from family members. In terms of caries prevention, boys reported brushing their teeth after meals, while girls tended to drink water following the consumption of sugary foods. Most participants reported rarely experiencing tooth pain in the past year. The students demonstrated an understanding of the importance of regular dental check-ups for maintaining oral health. However, it was observed that the majority used only toothbrushes, with limited use of floss for interdental cleaning. The response of Oral and Dental Health Care shown in the Table 2.

The comparison of DMF-T scores using the Kruskal-Wallis test indicated no significant difference between girls and boys, with a P-value greater than 0.05, suggesting that gender did not influence the DMF-T scores in this sample. However, when the DMF-T scores were compared across different BMI categories, a significant difference was found (P < 0.05). The results of the Kruskal-Wallis test are shown in Table 3. This finding suggests that BMI may have an impact on dental health, as reflected in the DMF-T index, highlighting the potential relationship between body weight status and dental caries in the study population. The post hoc test revealed a significant difference in Body

Table 4. The result of DSCF Pairwise test between DMF-T and BMI

Variable	P-value
DMFT	0.024[1],*
	0.534[2],*
	0.086[3],*

* Significant different P<0.05; [1] Comparison test between very low and low of DMF-T Group; [2] Comparison test between very low and moderate of DMF-T Group; [3] Comparison test between low and moderate of DMF-T Group

Table 3. The result of the Kruskal-Wallis test

Variable	P-value
Gender	0.786
BMI	0.018*

* Significant different P<0.05

Mass Index (BMI) between the very low and low groups within the DMFT category (P < 0.05; Table 4). Conversely, no significant differences were observed among the other DMFT groups (P > 0.05).

DISCUSSION

Caries is one of the most common dental health issues affecting children, however, in this study, we found that the majority of 5th-grade students displayed very low caries rates, with no participants falling into the higher-risk categories. While specific data on the DMF-T index for 11-year-old children in Indonesia is limited, studies on 12-year-olds provide valuable insights. In the previous study, research conducted in Jakarta reported a DMF-T index of 1.58 among 12-year-olds, indicating a relatively low prevalence of dental caries in this age group.[14] In comparison, another study in Jatinangor District found the DMF-T index for 12-year-olds to be 2.75 at Elementary School Sayang and 2.85 at Elementary School Cibeusi, which points to a moderate prevalence of dental caries.[15] Both Jatinangor and Jakarta, along with Surabaya, are large cities in Indonesia where the educational environment is generally more favourable than in rural areas. In these urban settings, access to dental services is typically higher, leading to better prevention and treatment. This likely contributes to the lower caries rates observed in these regions.

The prevalence of dental caries exhibits significant variation according to gender, influenced by factors such as socioeconomic status, cultural norms, and individual behavioural patterns.[16] Some studies have indicated that boys typically demonstrate a higher prevalence of dental caries compared to girls. This phenomenon is often attributed to less effective oral hygiene practices and dietary choices among boys, who tend to maintain inconsistent oral hygiene routines, consume a greater quantity of sugary snacks and beverages, and exhibit a lower propensity to seek dental care.[16] Conversely, other research suggests that girls may have a higher prevalence of dental caries. A study by Lukacs and Largaespada noted that females typically exhibit higher caries prevalence rates than males because earlier eruption of teeth in girls and frequent snacking.[17]

This study found no significant difference in the caries index between boys and girls, which is consistent with findings from Jose and Joseph's study in Kerala, India, that also reported no notable gender differences in dental caries among children and adolescents.[16] Additionally, a similar study on the prevalence of dental caries in first permanent molars among teenagers found no gender disparities.[18] Factors such as oral hygiene practices, dietary habits, socioeconomic status, and access to dental care likely play a more significant role in determining the prevalence of caries.[19] In this study, boys reported brushing their teeth less frequently than girls; however, both genders were aware of methods for preventing caries. Boys tended to brush their teeth after meals, while girls preferred to drink water

after consuming sugary foods. Both groups recognized the importance of regular dental check-ups for maintaining oral health. The similar oral health behaviours and equal access to dental care observed in this study may explain the lack of significant differences in the caries index between the genders.

The Body Mass Index (BMI) assessment of the fifth-grade students in this study indicated a notable prevalence of underweight individuals, with a minimal number classified as obese. This outcome stands in contrast to the findings from the previous study Oktaviani, which revealed a higher incidence of overweight and obesity among children in urban areas compared to their counterparts in rural regions of Indonesia.[20] Several factors are posited to contribute to this disparity, including dietary habits, psychosocial stress, mental health considerations, and environmental conditions.[21]

The association between BMI and the DMF-T index has been a significant focus within dental research. Previous investigations have identified a marked positive correlation between BMI and DMF-T, indicating that individuals with elevated BMI levels typically exhibit a higher prevalence of dental caries. Lifestyle and dietary changes, including increased consumption of high-calorie foods, soft drinks, and refined sugars, have contributed to the rising prevalence of obesity and dental caries. Early obesogenic behaviors, such as frequent snacking, are significant risk factors for both conditions.[21] Frequent consumption of carbohydrates, especially sugars, promotes the overgrowth of cariogenic bacteria in the oral cavity, such as *Streptococci mutans* and *Lactobacilli*. These bacteria metabolize the sugars through glycolysis, producing lactic acid as a byproduct. The production of acid lowers the pH in the dental plaque, creating an acidic environment that favors the survival of acid-tolerant bacteria. These bacteria are more resistant to the acidic conditions compared to less cariogenic species, which are inhibited by the lower pH. The acids produced by these bacteria demineralize the tooth enamel, leading to the formation of cavities. Additionally, mutans *Streptococci mutans* can utilize sucrose to synthesize extracellular polysaccharides, which enhance bacterial adhesion and biofilm formation on tooth surfaces, further contributing to the cariogenic process. This metabolic process explains how diets rich in sugars elevate the risk of developing dental caries.[22]

The relationship between BMI and DMF-T scores is further supported by the findings of the current study, which reveal children with lower BMI demonstrated reduced DMF-T scores, indicating a lower occurrence of dental caries. This phenomenon may be attributable to several factors, including dietary habits, oral hygiene routines, and overall health that vary across different BMI categories.[21] Children with lower BMI may engage in dietary practices less conducive to caries development, such as consuming fewer sugary foods and beverages; however, this assertion necessitates further investigation. Children residing in urban settings may exhibit suboptimal eating behaviours, such as meal skipping, consumption of low-nutrient foods,

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and irregular eating patterns. Children residing in urban environments frequently encounter a fast-paced lifestyle and various external influences that adversely affect their eating habits. Contributing factors include parental work schedules, easy access to fast food, and a tendency to prioritize convenience over nutritional value. As a result, poor dietary choices are common. Skipping meals, particularly breakfast, is prevalent due to hurried morning routines or diminished appetite, which can lead to reduced energy levels and impaired concentration throughout the day. Moreover, urban children are often subjected to increased exposure to highly processed, calorie-dense, and low-nutrient foods that are directly marketed to them, including sugary snacks, soft drinks, and fast food. Such options are frequently preferred over balanced meals, leading to deficiencies in essential nutrients. Additionally, irregular eating patterns may emerge as a consequence of round-the-clock food availability and a lack of structured meal times, which can disrupt metabolic processes and contribute to unhealthy weight gain or inadequate growth outcomes. These practices can detrimentally affect their nutritional status, potentially resulting in underweight conditions. Furthermore, urban children may encounter elevated stress levels due to academic pressures, which can lead to adverse eating habits, anxiety, or depression. The urban environment may also restrict opportunities for physical activity, as children often spend increased amounts of time indoors due to safety concerns, limited access to open spaces, or extensive use of digital devices. This interplay of factors can contribute to skipped meals and exacerbate underweight issues among this population. Additionally, results from the administered questionnaire indicated that children, regardless of BMI, exhibited sound oral hygiene practices, including regular tooth brushing and awareness of the importance of dental care. Such practices are likely to have played a pivotal role in the lower prevalence of dental caries observed in the lower BMI group. These findings elucidate the complex interplay between BMI, oral health practices, and dental caries, suggesting that effective oral health practice and behaviour may significantly influence the relationship between BMI and the incidence of caries.

This study has several limitations that should be considered when interpreting the findings. One significant limitation is the relatively small number of participants, which may affect the generalizability of the results. Additionally, the study did not record the participants' dietary behaviours, which are crucial in determining the prevalence of dental caries. Without this dietary information, the influence of sugary snacks, beverages, and other eating habits on caries development could not be fully assessed. Furthermore, other factors such as socioeconomic status, access to dental care, and genetic predispositions which could impact both BMI and caries index, were not controlled for in this study. Future research is necessary to include a larger sample size, more comprehensive data collection that encompasses dietary habits and other health-related factors, and a more precise study design, such as a cohort study. Additionally, involving rural, urban, and suburban populations would contribute to a more complete and thorough understanding of the relationship between BMI and dental caries.

In conclusion, this study highlights the relationship between BMI and dental caries in 5th-grade students, revealing that children with lower BMI had a lower DMF-T score, suggesting fewer dental caries. The study also found no significant gender differences in caries prevalence, with both boys and girls demonstrating good oral hygiene practices and a similar understanding of the importance of regular dental check-ups. These findings suggest that effective oral health practices and behaviours play a significant role in influencing the relationship between BMI and the incidence of dental caries.

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