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The Relationship between Cariogenic Food Consumption and Tooth Brushing Habits to Dental Caries in 4th, 5th and 6th Grade Students at SDN 1 Cikulur, Lebak Banten Regency.

Weny Martalinda, Nur Asniati Djaali, Brian Sri Prahastuti
Universitas MH Thamrin, Indonesia
Email: weny.martalinda1411@gmail.com, nurdjaali@gmail.com,
brian.sriprahastuti@gmail.com

ABSTRACT

Dental caries is one of the most common oral health problems among school-aged children and is often neglected, despite its potential impact on quality of life, academic achievement, and overall health. High consumption of cariogenic foods such as candies, chocolates, sugary drinks, and other sweet snacks, combined with poor and irregular tooth-brushing habits, are the main contributing factors to the occurrence of dental caries in elementary school children. This research analyzed the relationship between cariogenic food consumption and tooth-brushing habits with the incidence of dental caries among 4th–6th graders at SDN 1 Cikulur, Lebak, Banten, and examined the confounding effects of gender, parental education, and socioeconomic status. A cross-sectional design with stratified random sampling was used, involving 76 respondents. Data were collected via questionnaires and visual dental examinations, then analyzed using Chi-Square and Multiple Logistic Regression to assess relationships while controlling for confounders. The findings revealed a significant relationship between cariogenic food consumption and tooth-brushing habits with dental caries. Children with high cariogenic food consumption were seven times more likely to develop caries, while those with poor tooth-brushing habits had an 11.6 times greater risk after adjusting for parental education and socioeconomic status. The study recommends strengthening oral health education in schools, enforcing stricter supervision of children's food consumption through school policies and Puskesmas programs, and increasing family involvement in shaping healthy behaviors. Cross-sectoral collaboration is expected to sustainably reduce the prevalence of dental caries among elementary school children.

KEYWORDS *dental caries, cariogenic food, tooth brushing habits, parental education, socioeconomic status*

INTRODUCTION

Dental caries is a significant health problem among children, especially those of elementary school age. According to the World Health Organization (2022), dental caries is prevalent in European, American, and Asian countries, including Indonesia. The incidence of caries reaches 80–90% of children under the age of 18, namely 6–12 years old, who are affected by dental caries. Dental caries is a dental disease that mostly affects children worldwide. It is estimated that around 90% of school children worldwide, as well as the majority of adults, have experienced dental caries.

The incidence of dental caries in children in Indonesia is still high, as shown by data from the Indonesian Health Survey (2023). In the 5–6 age group, the caries rate reached 48.4%, while in 12-year-olds it was recorded at 35.3%. In the Java region, Banten Province is one of the areas with a high incidence of dental caries. Based on the results of the Indonesian Health Survey (2023), the incidence of dental caries was recorded at 34.2% in DKI Jakarta, 42.3% in Banten, 48% in West Java, 42.8% in Central Java, 41.7% in DI Yogyakarta, and 38.6% in East Java. Based on the Indonesian Health Survey (2023), Banten Province has a caries incidence

rate among children aged ≥3 years that is above the national average (56.9%). Lebak Regency is included in the Banten Province region, which has the highest caries incidence rate. According to data from the Lebak Regency Health Office, referring to the results of the Indonesian Health Survey (2023), the incidence of dental caries in children aged 5–6 years in Lebak Regency reached 70.2%, while in the 12-year-old age group, the incidence was recorded at 52.1%.

Dental caries is an infectious condition caused by the demineralization process in hard tooth tissue, particularly the enamel and dentin layers. One of the main factors contributing to caries is a cariogenic diet, namely foods that are high in sugar and carbohydrates (Cheever et al., 2025). This type of food, especially those high in sugar, is known to contribute significantly to the formation of dental caries because it supports the activity of acid-producing bacteria in the oral cavity (Daud et al., 2022; Pham et al., 2025). This phenomenon is a serious concern because elementary school-aged children often consume unhealthy foods and have poor toothbrushing habits, which can worsen their dental health (Jiménez et al., 2025). Not only that, this phenomenon is also a serious concern for children's quality of life, including their ability to learn and interact socially (Zaborskis et al., 2025). Dental caries can also cause various significant negative impacts on children's health and development. Some of these impacts include pain, difficulty chewing, and sleep disturbances (Pujiana, 2024; Hidayati et al., 2024). In Lebak Regency, the situation is no different. Many children in the region are exposed to cariogenic foods, such as candy and sweetened beverages, which are often their preferred choices.

According to previous studies, several studies have shown a strong relationship between the consumption of cariogenic foods and the incidence of dental caries in children. Children who frequently consume sweet foods and drinks such as chocolate, candy, and sweetened beverages have a higher risk of dental caries than children with low cariogenic consumption patterns (Febrianty et al., 2023; Cheever et al., 2025). On the other hand, findings from Maharani et al. (2023) also show that children who have a habit of consuming cariogenic foods can increase their risk of dental caries by 2.8 times compared to children who do not have a habit of consuming cariogenic foods (Maharani et al., 2023). This shows that high consumption of cariogenic foods can contribute to an increase in the incidence of dental caries in children.

Oral health behaviors in children are greatly influenced by various external factors, including gender, parental education, and socioeconomic status (Ehizele et al., 2025). Research shows that girls tend to have better toothbrushing habits than boys (Javadzadeh et al., 2023). In addition, children from families with low levels of education and lower-middle economic conditions are more prone to consuming cariogenic foods and have poor toothbrushing habits (Blanco et al., 2025; Campus et al., 2022). Socioeconomic inequality exacerbates the situation, as low-income families tend to have limited access to dental health services, thereby increasing the risk of caries (Lam et al., 2022; Alshayeb et al., 2025). This situation is particularly relevant for study at SDN 1 Cikulur, Lebak Regency, Banten, which is known for its diverse socioeconomic background and limited dental and oral health education.

In addition, inadequate toothbrushing habits are also a significant risk factor for dental caries in children (Rusnoto et al., 2023). Toothbrushing habits are also a crucial factor in the prevention of dental caries. A finding from Prayitno et al. (2024) showed that children with poor toothbrushing habits had a 7.3 times higher risk of experiencing dental caries compared

to children with good toothbrushing habits. This was also shown in previous studies that children who have irregular toothbrushing habits or use incorrect techniques have a higher risk of developing dental caries (Eshraqi et al., 2025; Khanagar et al., 2025).

Thus, it is important to further explore the correlation between toothbrushing habits and cariogenic food consumption in the context of this study. Although previous studies have highlighted the role of these two factors in the incidence of dental caries, there is still a research gap that specifically links the two in Lebak Regency, particularly at SDN 1 Cikulur.

The purpose of this study is to analyze the relationship between cariogenic food consumption and toothbrushing habits and the incidence of dental caries in 4th, 5th, and 6th grade students at SDN 1 Cikulur, Lebak District, Banten, as well as to assess the influence of confounding factors such as gender, parental education, and socioeconomic status on this relationship. In addition, the challenges faced in this study include the lack of awareness among parents and children about the importance of maintaining oral and dental health. Low knowledge about the impact of cariogenic food consumption and poor toothbrushing habits can exacerbate this situation (Fuentes et al., 2024). Thus, this study will not only provide empirical data on the correlation between these two factors, but also provide insight into the need for dental health education among children and parents.

It is hoped that this study can contribute new insights and information, especially in the field of children's dental health. In practice, the findings from this study can be used to create more optimal intervention programs to increase awareness and habits of maintaining dental health among children and parents. Therefore, this study does not only focus on dental health aspects, but also on broader health education, which can help reduce the incidence of dental caries among children in Lebak Regency.

Through this comprehensive approach, it is hoped that a generation that is more aware of the importance of maintaining oral and dental health from an early age can be created. Given the importance of this issue, further research in this field is urgently needed to develop more effective and sustainable prevention strategies. Therefore, the researchers were motivated to conduct research on “The Relationship between Cariogenic Food Consumption and Tooth Brushing Habits on Dental Caries in Grade 4, 5, and 6 Students at SDN 1 Cikulur, Lebak Regency, Banten.”

The research question in this study focuses on the high incidence of dental caries among elementary school children in Lebak Regency, particularly at SDN 1 Cikulur, which is a significant health problem based on data from the Indonesian Health Survey (2023), which shows that the incidence of dental caries reaches 70.2% in children aged 5–6 years and 52.1% in children aged 12 years, indicating that dental caries is still a major health burden. Several factors are thought to contribute to this condition, including high consumption of cariogenic foods and poor toothbrushing habits. Previous studies have shown a correlation between cariogenic diets and dental caries, where children who consume sugary foods have a 2.8 times higher risk of caries, and children who do not brush their teeth regularly have a 7.3 times higher risk. However, there is still a gap in research investigating the correlation between these two factors in Lebak Regency, particularly at SDN 1 Cikulur. Therefore, the purpose of this study was to examine the correlation between cariogenic food consumption and toothbrushing habits and the incidence of dental caries in 4th, 5th, and 6th grade students at SDN 1 Cikulur, as well as to provide empirical contributions to the development of educational and dental health

behavior interventions at the local level. Based on this background, the research questions include the description of dental caries incidence, the level of cariogenic food consumption, and toothbrushing habits, as well as the relationship between these factors and the incidence of dental caries, including the influence of gender, parental education, and socioeconomic status. The general objective of this study is to analyze the relationship between cariogenic food consumption and toothbrushing habits with dental caries, while the specific objectives include further understanding of the description and analysis of the relationship between these variables. The benefits of this study are expected to contribute to science, government, and society through the development of dental health science, the formulation of dental caries prevention programs, and increased public awareness of the importance of dental health and changes in children's eating habits and health behaviors.

RESEARCH METHOD

This research used a quantitative method with an observational analytical approach and a cross-sectional design to collect data on all variables at one time. Data collection was conducted through questionnaires given to children to observe their eating patterns and toothbrushing habits, supplemented by visual clinical examinations by dental health workers to assess the incidence of caries. The collected data were analyzed using the Chi-Square test in bivariate analysis and multiple logistic regression of risk factors in multivariate analysis. This study was conducted at SDN 1 Cikulur, Lebak Regency, for one week from July 14, 2025, to July 19, 2025, with a population of 171 students in grades 4, 5, and 6. The sampling technique used was probability sampling through stratified random sampling, which was determined using the Sample Size Test for Two Proportions formula, with a sample size of 76 students. This study obtained research ethics recommendation number 061/S.Ket/KEPK/UMHT/VII/2025 from the Faculty of Public Health, Universitas Muhammadiyah Husni Thamrin, prior to data collection at SDN 1 Cikulur, Lebak District. This was followed by an explanation to parents regarding the objectives, benefits, risks, and rights of respondents, as well as obtaining consent through an informed consent form. The data obtained were analyzed using univariate analysis to describe the characteristics of the variables, bivariate analysis with the Chi-Square test to examine the relationship between the consumption of cariogenic foods and toothbrushing habits and the incidence of caries, and multivariate analysis with multiple logistic regression of risk factors to determine the most influential risk factors after controlling for other variables (confounders).

RESULTS AND DISCUSSION

Univariate Analysis

Distribution of respondents based on dental caries occurrence, level of cariogenic food consumption, tooth brushing habits, gender, parental education, and socioeconomic status among 4th, 5th, and 6th grade students at SDN 1 Cikulur, Lebak Regency, Banten. Details of the distribution can be seen in the following table:

Table 1. Distribution of Respondents Based on Variables

Variable	Category	Number (n)	Percentage (%)
Dental Caries (Dependent)	Present	51	67
	Absent	25	32.9
Level of Consumption of Cariogenic Foods (Independent)	High	48	63.2
	Low	28	36.8
Toothbrushing Habits (Independent)	Poor	46	60.5
	Good	30	39.5
Gender (Confounding)	Male	37	48.7
	Female	39	51.3
Parental Education (Confounding)	Low	66	86.8
	High	10	13.2
Socioeconomic (Confounding)	Low	42	55.3
	High	34	44.7

Source: Primary data processed (2025)

Based on the results of a study of 76 respondents, most students (67.1%) had dental caries, indicating that dental health problems are still high in the region. A total of 48 students (63.2%) had a high consumption of cariogenic foods, and 46 students (60.5%) had poor toothbrushing habits. These findings indicate that high consumption of cariogenic foods and poor toothbrushing habits contribute to the increase in dental caries among elementary school students. In terms of respondent characteristics, the gender distribution was relatively balanced between 37 male students (48.7%) and 39 female students (51.3%). Most respondents came from families with low parental education, namely 66 students (86.8%), and only 10 students (13.2%) came from families with higher education. Based on socioeconomic status, the majority of respondents came from families in the low category, totaling 42 students (55.3%), while 34 students (44.7%) were in the high category.

Bivariate Analysis

Bivariate analysis was conducted to identify the relationship between the level of cariogenic food consumption and confounding factors, including gender, parental education, and socioeconomic status, with the incidence of dental caries in elementary school students. The results of the Chi-Square test describing the relationship between these variables are presented in the following table.

Table 2. Bivariate Analysis Results

Independent Variables	Category	Dental Caries	No Caries	Total	p-value	OR (95% CI)
Consumption of cariogenic foods	High	42 (87.5%)	6 (12.5%)	48 (100%)	0.001	14.778 (4.603–47.447)
	Low	9 (32.1%)	19 (67.9%)	28 (100%)		
Toothbrushing habits	Not good	42 (91.3%)	4 (8.7%)	46 (100%)	0.001	24,500 (6,751–88,916)
	Good	9 (30.3%)	21 (70.0%)	30 (100%)		
Gender	Male	29 (87.9%)	4 (12.1%)	33 (100%)	0.001	14.667 (3.843–55.980)

	Female	22 (51.2%)	21 (48.8%)	43 (100%)		
Parental education	Low	49 (74.2%)	17 (25.8%)	66 (100%)	0.002	11,529 (2,226–59,720)
	High	2 (20%)	8 (80%)	32 (100%)		
Socioeconomic status	Low	38 (90.5%)	4 (9.5%)	42 (100%)	0.001	15.346 (4.437–53.079)
	High	13 (38.2%)	21 (61.8%)	34 (100%)		

Source: Primary data processed using SPSS (2025)

The results of the bivariate analysis showed that all independent variables had a significant relationship with the incidence of dental caries in students at SDN 1 Cikulur ($p < 0.05$). Students with a high level of cariogenic food consumption were found to have a significant relationship with the incidence of dental caries ($p = 0.001$; OR = 14.778). Similarly, students with poor toothbrushing habits also showed a significant relationship with dental caries ($p = 0.001$; OR = 24.500). These findings indicate that the consumption of sugary foods and dental hygiene habits are important factors that contribute to an increased risk of dental caries in elementary school children.

In addition, the results of the analysis showed that gender was also significantly associated with the incidence of dental caries in students ($p = 0.001$; OR = 14.667). Likewise, parental education level had a significant relationship with the incidence of dental caries ($p = 0.002$; OR = 11.529), indicating that the lower the parental education level, the higher the risk of children developing dental caries. Socioeconomic factors also showed a significant relationship with the incidence of dental caries ($p = 0.001$; OR = 15.346), where students from families with low socioeconomic status were at greater risk of experiencing caries than students from families with better economic conditions. These findings confirm that demographic and family socioeconomic factors play an important role in determining children's dental health status.

Multivariate Analysis

Multivariate analysis was performed on each independent variable, namely the consumption of cariogenic foods and toothbrushing habits. All independent variables were included in the model and then analyzed using a logistic regression risk factor model. Multivariate analysis was conducted to determine the relationship between each main independent variable and the dependent variable after controlling for gender, parental education, and socioeconomic status. The following are the stages of the multivariate analysis of the risk factor model: In the initial stage, all candidate variables (consumption of cariogenic foods, toothbrushing habits, gender, parental education, and socioeconomic status) were analyzed bivariately. Variables with a p-value < 0.25 were then included in the full model as candidates for multivariate testing.

Next, a confounding test was performed using the principle of percent change in OR, which is used to see the change in the odds ratio of the main exposure when the candidate variable is removed from the model. If the change in OR is ≥10%, then the variable is retained as a confounder; otherwise, if it is <10%, the variable can be removed from the model. In the

model with cariogenic food consumption as the main variable, the gender variable was removed because it was not proven to be a confounder (the change in OR was only about 3%). Meanwhile, parental education and socioeconomic status were retained in the final model because they showed an influence as confounding factors.

In the model with toothbrushing habits as the main variable, the confounding test results were the same as those for the main variable of cariogenic food consumption. The results showed that parental education and socioeconomic status produced a significant change in OR (≥10%), so both were retained in the final model. Thus, the final model obtained shows that high cariogenic food consumption and poor toothbrushing habits are the main risk factors for dental caries in students, even after controlling for parental education and socioeconomic status.

Table 3. Final Modeling of Cariogenic Food Consumption Variables

Variable	P-Value	OR	95% CI
Cariogenic Food Consumption	0.008	7.056	1.684-29.571
Parental Education	0.014	13,296	1,677-105,43
Socioeconomic	0.012	7,046	1,531-32,421

Source: Primary data processed using SPSS (2025)

After conducting a confounding test, the p-value of the parental education variable (p-value 0.014 and OR of 13.296) and socioeconomic variable (p-value 0.012 and OR of 7.046) were confounding variables in the relationship between cariogenic food consumption and dental caries in fourth, fifth, and sixth grade students at SDN 1 Cikulur, Lebak Regency, Banten. Multivariate analysis results obtained the variable of cariogenic food consumption with an OR of 7.056, which means that there is a relationship between cariogenic food consumption and dental caries in 4th, 5th, and 6th grade students at SDN 1 Cikulur, Lebak Regency, Banten, and students with high cariogenic food consumption have a 7 times greater risk of experiencing dental caries after controlling for parental education and socioeconomic status.

Regression Equation (Y) = $-3.111 + 1.954X_1 + 2.587X_2 + 1.953X_3$
Explanation:
p = probability of students experiencing dental caries
X_1= consumption of cariogenic foods (1 = high, 0 = low)
X_2= parental education (1 = low, 0 = high)
X_3= socioeconomic status (1 = low, 0 = high)

Based on the analysis results, consumption of cariogenic foods, parental education, and socioeconomic status are variables that act as risk factors for dental caries after controlling for other variables. The model constant of -3.111 indicates that students with low cariogenic consumption, highly educated parents, and high socioeconomic status only have a 4.3% chance of experiencing dental caries.

Cariogenic food consumption has a coefficient of B=1.954 with OR = 7.056 (95% CI: 1.684–29.571; p = 0.008), which means that students with high cariogenic food consumption

have a 7 times greater chance of experiencing dental caries than students with low consumption, after controlling for parental education and socioeconomic status.

Parental education has a coefficient of B=2.587 with OR = 13.296 (95% CI: 1.677–105.430; p = 0.014), indicating that students with low parental education are 13.3 times more likely to experience caries than students with high parental education, after controlling for other variables.

Socioeconomic status has a coefficient of B=1.953 with an OR = 7.046 (95% CI: 1.531–32.421; p = 0.012), which means that students from families with low socioeconomic status are 7 times more likely to experience dental caries than students from families with high socioeconomic status.

Overall, this model shows that high consumption of cariogenic foods, low parental education, and low socioeconomic status are significant risk factors for dental caries in students.

Next is determining the coefficient of determination (*Nagelkerke R Square*), where the value is as follows:

Table 4. Coefficient of Determination

Cox & Snell R Square	Nagelkerke R Square
0.412	0.573

Source: Primary data processed using SPSS (2025)

Based on Table 4, the *Nagelkerke R Square* value in testing the model in this study is 0.573, which means that the independent variables explain 57.3% of the dependent variable (dental caries), while the remaining 42.7% is explained by other variables outside this study.

Table 5. Final Modeling of Tooth Brushing Habit Variables

Variable	P-Value	OR	95% CI
Toothbrushing Habit	0.040	11.635	1.122-120.63
Parental Education	0.107	4,856	0.711-33.159
Socioeconomic	0.011	7,919	1.623-38.648

Source: Primary data processed using SPSS (2025)

After conducting a confounding test, the p-value of the parental education variable (p-value 0.107 and OR of 4.856) and socioeconomic status (p-value 0.011 and OR of 7.919) were confounding variables in the relationship between toothbrushing habits and dental caries among fourth, fifth, and sixth graders at SDN 1 Cikulur, Lebak Regency, Banten. Multivariate analysis results obtained the variable of tooth brushing habits with an OR of 11.635, which means that there is a relationship between tooth brushing habits and dental caries in 4th, 5th, and 6th grade students at SDN 1 Cikulur, Lebak Regency, Banten, and students with poor tooth brushing habits have an 11.6 times greater risk of experiencing dental caries after controlling for parental education and socioeconomic status.

Regression Equation (Y) = −3.128 + 2.454X1 − 1.580X2 + 2.069X3

Explanation:

p = probability of students experiencing dental caries

$X1$ = toothbrushing habits (1 = poor, 0 = good)
$X2$ = parental education (1 = low, 0 = high)
$X3$ = socioeconomic status (1 = low, 0 = high)

Based on the analysis results, tooth brushing habits, parental education, and socioeconomic status are variables that act as risk factors for dental caries after controlling for other variables. The model constant of -3.128 indicates that if all variables are in the reference category (good tooth brushing, high parental education, and high socioeconomic status), the probability of dental caries is 4.2%.

The tooth brushing habit variable has a B coefficient of 2.454 with an OR value of 11.635 (95% CI: 1.122–120.630; p = 0.040), which means that students with poor tooth brushing habits are 11.6 times more likely to experience dental caries than students with good tooth brushing habits, after controlling for parental education and socioeconomic status.

Parental education had a B of 1.580 with an OR = 4.856 (p = 0.107), indicating that low education increases the odds of caries by almost 5 times compared to high education.

Socioeconomic status showed a significant association with dental caries (B = 2.069; OR = 7.919; 95% CI: 1.623–38.648; p = 0.011), meaning that students with low socioeconomic status were nearly 8 times more likely to experience caries than students with high socioeconomic status.

Overall, this model shows that poor tooth brushing habits, low socioeconomic status, and low parental education are significant risk factors for dental caries in students.

Next is determining the coefficient of determination (*Nagelkerke R Square*), whose values are as follows:

Table 6. Coefficient of Determination

Cox & Snell R Square	Nagelkerke R Square
0.421	0.587

Source: Primary data processed using SPSS (2025)

Based on Table 6, the *Nagelkerke R Square* value in testing the model in this study is 0.587, which means that the independent variables explain 58.7% of the dependent variable (dental caries), while the remaining 42.7% is explained by other variables outside this study.

Strengths and Limitations of the Study

1) Strengths of the Study

This study has a major strength in its specific and contextual focus, namely the relationship between the consumption of cariogenic foods and toothbrushing habits with the incidence of dental caries in elementary school children. The location of the study at SDN 1 Cikulur, Lebak Regency, provides practical value because it represents an area with limited access to information and dental health services.

The quantitative approach with a *cross-sectional* design and Chi-Square and Logistic Regression analyses enabled objective testing of variable relationships. The instruments used, such as the Food Frequency Questionnaire (FFQ) and tooth brushing habit questionnaire, which had been tested for validity and reliability, ensured data accuracy. Caries examinations were

conducted by health workers according to WHO standards, increasing the reliability of the results. Substantially, this study contributes scientifically and practically to the development of promotive and preventive dental health programs for children in schools.

2) Research Limitations

This study did not encounter any limitations, as all stages of the research proceeded according to plan and the instruments had been well tested. However, there were several technical obstacles in the field, such as adjusting the data collection schedule with school activities and coordination with parents who were not yet optimal in providing *informed* consent. Nevertheless, these obstacles did not affect the quality and validity of the research results, so the findings remain scientifically accountable.

The Relationship Between Cariogenic Food Consumption and Tooth Brushing Habits on Dental Caries After Controlling for Parental Education and Socioeconomic Status

The results of this study indicate a significant relationship between cariogenic food consumption and toothbrushing habits and the incidence of dental caries in elementary school students, even after controlling for parental education and socioeconomic status. Multivariate analysis showed that students with high cariogenic food consumption had a 7 times greater risk of dental caries compared to students with low consumption (OR = 7.056; 95% CI: 1.684–29.571; p = 0.008). Meanwhile, students with poor toothbrushing habits had an 11.6 times greater risk of developing caries compared to students with good toothbrushing habits (OR = 11.635; 95% CI: 1.122–120.630; p = 0.040). These findings reinforce the theory that dental caries is a multifactorial disease influenced by individual behavior, environment, and family factors. Although parental education and socioeconomic status have been shown to play an important role as determinants, sweet food consumption behavior and toothbrushing habits remain dominant risk factors. Thus, children from families with good education and economic conditions remain at risk of caries if they have high cariogenic food consumption patterns and poor toothbrushing habits.

These findings are consistent with the study by Maharani et al. (2023), which reported that consumption of sugary foods increases the risk of caries by up to 2.8 times, and the study by Prayitno Suhadi et al. (2024), which showed that children who do not brush their teeth regularly are 7.3 times more likely to develop caries. From the perspective of the PRECEDE–PROCEED theory, the consumption of cariogenic foods and toothbrushing habits are predisposing factors, as are the knowledge, attitudes, and habits of children and parents. Enabling factors are reflected in the availability of toothbrushes, fluoride toothpaste, and school policies on the provision of healthy snacks. Reinforcing factors are demonstrated through parental supervision, teacher encouragement, and peer support. Parental education and socioeconomic status, which were found to be confounding variables in this study, can be understood as structural determinants that can strengthen or weaken the influence of predisposing, enabling, and reinforcing factors.

At the PROCEED stage, the results of this study provide practical guidance for the implementation of children's dental health interventions. Strategies that can be implemented include school policies to limit the consumption of sugary foods in the canteen, adjusting the Free Nutritious Food (MBG) program menu by reducing sugar intake, and providing healthy alternatives such as fresh fruit, low-sugar milk, and high-fiber foods. In addition, it is necessary

to implement scheduled mass toothbrushing programs with proper technique training, develop simple educational modules for parents with low education levels, and establish a system for monitoring children's behavior through teachers and community health centers. In this context, parental education and socioeconomic status remain important supporting factors that influence children's food consumption patterns and toothbrushing behavior.

The implications of these research findings are highly relevant to school-based dental health interventions. First, the Free Health Check (CKG) program can serve a dual purpose as early detection of caries and evaluation of the effectiveness of educational interventions through a simple questionnaire on toothbrushing habits. Second, the findings on the strong influence of cariogenic food consumption reinforce the urgency of implementing Free Nutritious Food (MBG) based on a negative list of foods high in sugar, with the integration of balanced nutrition education to form healthy eating patterns from an early age. Third, caries prevention efforts require a comprehensive approach through synergy between schools, health centers, local governments, and parents. Schools play a role in supervising canteens and implementing mass toothbrushing, Puskesmas strengthen the function of UKS or UKGS through counseling and supervision, local governments provide support through regulations and budget allocations, while parents supervise their children's food consumption at home and instill proper toothbrushing behavior.

The results of this study confirm that preventing dental caries in elementary school children requires more than just individual behavioral education; it also requires supportive environmental policies, monitoring of food consumption, and increased capacity of families and schools to promote healthy behaviors. The integration of national programs such as Free Health Checkups (CKG) and Free Nutritious Meals (MBG) with the local evidence found in this study can be an important basis for designing more effective and sustainable promotive–preventive interventions, both in Lebak District and other regions with similar characteristics. The findings of this study also reinforce the PRECEDE–PROCEED theoretical framework and emphasize the need for targeted school-based interventions.

In this context, UKS and UKGS can be strategic platforms for following up on the results of this study because they have been proven effective in instilling healthy lifestyles while reducing the prevalence of dental caries in children. Ramadhani et al. (2022) reported that UKGS can still be effective if implemented with innovative strategies that utilize adaptive promotion methods. In line with this, research by Putri et al. (2024) shows that WhatsApp video-based dental health education can reduce oral hygiene indices, proving that interactive education methods can strengthen the effectiveness of UKGS in elementary schools. However, the effectiveness of UKGS is inseparable from managerial factors. An evaluation of UKGS management in elementary schools found that limited teacher training, the absence of detailed operational guidelines, and low frequency of dental examinations (only once a year) are the main obstacles to program optimization. This is in line with the findings of Putri et al. (2024), which emphasize that consistent and coordinated implementation of UKGS with Puskesmas can improve children's dental hygiene index. Therefore, the optimization of UKS and UKGS needs to be accompanied by increased teacher capacity, the provision of clear guidelines, and close collaboration between schools, Puskesmas, and health offices.

In addition, the findings of this study are also consistent with the research by Trimble et al. (2024), which shows that giving pocket money to children encourages the consumption of

foods and beverages high in sugar, thereby increasing the prevalence of caries. Chou et al. (2025) emphasized that parents' health beliefs, particularly their perceptions of risk, barriers, and self-efficacy in caring for their children's teeth, significantly influence the incidence of caries. Research by Kamolchaiwanich et al. (2025) even proves that low oral health literacy (OHL) among mothers is associated with poor toothbrushing behavior among children, including infrequent nighttime toothbrushing and continued consumption of sweetened bottled milk while sleeping. Family-based interventions have also been proven effective, as reported by Limo et al. (2025), who found that educating parents about brushing techniques reduced the oral hygiene index scores of preschool-aged children. Furthermore, socioeconomic factors and disparities in access to health services exacerbate the situation. Luo et al. (2024) found that first-generation immigrant children in the United States have a higher risk of caries and rarely access preventive dental services compared to non-immigrants, with a greater risk among minority groups. This condition is in line with the situation in Lebak District, where parental economic and educational limitations worsen children's consumption patterns and low toothbrushing habits

Thus, the findings of this study emphasize the importance of school-based promotive–preventive interventions integrated with family, socioeconomic, and environmental factors in addressing dental caries in elementary school children.

CONCLUSION

Based on the results of this study, it can be concluded that the prevalence of dental caries among 4th, 5th, and 6th grade students at SDN 1 Cikulur in Lebak Regency is still high (67.1%), with a high proportion of cariogenic food consumption (63.2%) and poor toothbrushing habits (60.5%) as the dominant factors. Multivariate analysis showed that high consumption of cariogenic foods increased the risk of caries sevenfold, while poor toothbrushing habits increased the risk by 11.6 times after controlling for parental education and socioeconomic status. These findings confirm that dental caries is a multifactorial problem that requires integrated promotive–preventive interventions. Therefore, it is recommended that local governments optimize the integration of the Dental Health Check (CKG) and Free Nutritious Food (MBG) programs with strict supervision of sugar intake in schools, provide support in the form of hygiene kit subsidies and healthy food for families with low socioeconomic status, and strengthen the role of Community Health Centers (Puskesmas) through routine dental checkups, education on proper toothbrushing, and the use of digital monitoring. Schools are also expected to strengthen UKS/UKGS through the curriculum, mass toothbrushing activities integrated with MBG, and control of cariogenic snacks in the school environment. Cross-sector synergy between the government, Puskesmas, schools, and families is expected to create an environment that supports healthy living behaviors and sustainably reduces the prevalence of dental caries in children in Lebak District.

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