



## **Relationship Between Dental Caries and Nutritional Status Among Kindergarten Children at Darul Imarah, Aceh Besar Regency**

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### **Abstract**

Dental caries is one of the most common oral health problems among preschool children, often causing pain, difficulty in chewing, and reduced food intake, which in turn may affect their nutritional status. This study aimed to determine the relationship between dental caries and nutritional status among children at Darul Imarah Kindergarten, Aceh Besar District. An analytical study with a cross-sectional design was conducted, involving 35 children aged 4–5 years selected using purposive sampling. Nutritional status was assessed through weight and height measurements using the DietDucate application, while dental caries was evaluated using the def-t index. Data analysis was performed using the Chi-Square test with SPSS software. The study was conducted between April and November 2025, including several stages such as obtaining research permits, preparing informed consent, measuring children's weight and height, calculating body mass index, and assessing dental caries using the def-t index. The results showed a significant relationship between dental caries and nutritional status ( $p = 0.003$ ;  $p < 0.05$ ). In conclusion, dental caries is significantly associated with children's nutritional status. Therefore, parents are encouraged to pay greater attention to their children's oral health by ensuring regular dental check-ups and promoting the habit of brushing teeth twice daily.

**Keywords:** dental caries, nutritional status, Kindergarten Children

### **Introduction**

Dental and oral diseases remain one of the major global public health problems, with a high prevalence across all age groups (Sultana et al., 2022). According to the World Health Organization (WHO), nearly 3.5 billion people worldwide suffer from oral diseases, with permanent dental caries being the most common condition affecting humans globally (Jain et

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al., 2024). Dental caries is a multifactorial disease resulting from the interaction of four main factors: the host (individual with specific tooth and saliva characteristics), the agent (cariogenic bacteria), the substrate (food debris, particularly carbohydrate-rich foods), and time. This interaction leads to acid production that gradually demineralizes tooth enamel. The caries process is progressive, and if left untreated, it may result in severe tooth destruction, dental abscesses, and even sepsis(Shoae et al., 2024).

In children, the consequences are more severe, as dental caries can impair masticatory function, cause pain during chewing, reduce food intake frequency, and disrupt sleep, ultimately affecting nutritional status and overall quality of life(Beyer et al., 2024). The impact of dental caries extends beyond oral health, with systemic implications, especially in young children undergoing critical phases of growth and development(Pai et al., 2024). Untreated caries may compromise chewing ability, leading children to avoid certain foods, particularly those with harder textures. This avoidance may reduce energy intake and essential nutrients, contributing to undernutrition or even malnutrition(Kazemi et al., 2011). Previous studies have reported that 73.8% of children with dental caries were undernourished, and nearly 90.9% of preschool-aged children experienced caries. In Indonesia, the prevalence of dental caries among school-aged children remains alarmingly high at approximately 70%, with national prevalence reaching 97.5%(Badrov et al., 2025; Chen et al., 2024; Shokravi et al., 2023). This indicates that nearly all children are affected by dental caries.

These figures are considerably higher compared to many developed countries, underscoring that oral health remains a critical public health challenge in Indonesia. National data also reveal regional variations. The 2023 Basic Health Research Survey (Riskesdas) reported that the prevalence of dental caries in Aceh Province was 36.17%, with the highest prevalence found among children aged 5–9 years (53.03%) (riskesdas 2023). These findings are consistent with field reports documenting a high number of pediatric visits for caries treatment in health care facilities(Chairunisa et al., 2024; Sofian et al., 2025). Furthermore, data from the Indonesian Nutritional Status Survey (SSGI) showed that the prevalence of underweight children in Aceh Province was 24.3%, with Aceh Besar District experiencing an increase from 23.8% to 24.3% in the most recent survey period.

These statistics suggest a strong interrelation between high caries prevalence and nutritional problems in children. Poor nutritional status in childhood is known to have serious consequences on both physical and mental development, and is associated with reduced intelligence, creativity, and productivity in later life. Local studies further reinforce these findings. Data from the Darul Imarah Health Center in Aceh Besar District reported 20 cases of rampant caries among children aged 3–5 years during February–March, highlighting the substantial burden of caries in preschool-aged children that requires urgent attention. This situation emphasizes that dental caries should not be regarded merely as an oral health problem but as a condition with broader implications for children’s overall well-being, including their nutritional status (Rahayu et al., 2024). Therefore, this study was conducted to examine the relationship between dental caries and nutritional status among kindergarten children in Darul Imarah Subdistrict, Aceh Besar District, in order to provide evidence-based insights that may serve as the foundation for more integrated and comprehensive public health interventions.

## **Literature Review**

### **Dental caries**

Dental caries, or tooth decay, is one of the most common chronic diseases affecting children, including those of kindergarten age, and it remains a significant public health problem in both developed and developing countries(Wang et al., 2024). The onset of dental caries is driven by a complex interaction among the host, oral microorganisms within dental plaque, fermentable carbohydrate substrates, and the factor of time. Key bacteria, such as *Streptococcus mutans* and *Lactobacillus* species, play a central role in fermenting simple sugars, producing acids that lower the pH of the oral environment. When this acidic condition persists repeatedly and over prolonged periods, the enamel undergoes demineralization. In the early stage, this process manifests as white spot lesions, which are still reversible; however, without appropriate management, these lesions can progress to permanent cavities in the enamel and dentin(Maklennan et al., 2024). The progression of dental caries is not only influenced by biological factors but also by behavioral and environmental determinants, such as the frequent consumption of sugary foods and drinks, irregular toothbrushing habits or the absence of fluoride toothpaste use, limited parental knowledge of oral hygiene, and restricted access to dental care services.

Among kindergarten-aged children, dental caries has implications that extend beyond oral health, including chronic pain, difficulty in chewing food, sleep disturbances, loss of appetite, and ultimately poor nutritional outcomes such as low body weight, stunting, or wasting. Conversely, children with poor nutritional status are more vulnerable to caries because malnutrition can impair the formation and mineralization of enamel, making teeth more susceptible to damage. Several studies have highlighted a bidirectional relationship between dental caries and nutritional status: severe caries can limit food intake due to pain during eating, while early-life undernutrition can increase susceptibility to caries development(Wong, 2022; Wong et al., 2006). In other contexts, obesity has also been associated with frequent consumption of sugary foods, which not only heightens the risk of caries but also contributes to nutritional imbalance, although findings regarding the caries–obesity relationship remain inconsistent. Clinically, untreated dental caries can progress to pulpal infection, abscess formation, and broader impacts on a child’s general health. Preventing caries in early childhood is therefore crucial and should involve promotive and preventive efforts both in the family setting and within early childhood education institutions, such as kindergartens. These measures include oral hygiene education, limiting sugar intake, establishing the habit of brushing with fluoride toothpaste from an early age, the application of topical fluoride, and improving access to affordable dental health services(Majorana et al., 2014; Schwendicke et al., 2018).

International meta-analyses and systematic reviews have consistently reported a significant prevalence of Early Childhood Caries (ECC) and linked it to socioeconomic determinants, feeding practices, sugar consumption patterns, and access to oral health services—factors that are also commonly associated with children’s nutritional status. This overlap has led to the hypothesis of a bidirectional relationship between dental caries and nutrition. Empirical evidence from recent cohort and cross-sectional studies supports this

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notion, showing that children with severe caries are more likely to experience reduced food intake due to pain, sleep disturbances, and a diminished quality of life, which in turn may contribute to weight loss or impaired growth (stunting/underweight). Conversely, early-life malnutrition can disrupt enamel mineralization, thereby increasing susceptibility to caries, highlighting the mutually reinforcing biological and behavioral mechanisms involved. However, the relationship between caries and overweight or obesity appears more complex and heterogeneous: while some studies report a positive association—likely mediated by frequent sugar intake—others find no relationship or even an inverse association once socioeconomic factors are controlled for (Uribe et al., 2021; Wen et al., 2022). Thus, the current literature emphasizes that outcomes depend heavily on population context, the definitions of caries and nutritional indicators used, and the degree of control for confounding variables. From a policy and programmatic perspective, intervention evidence remains limited but promising. Several studies suggest that treating severe caries in children is associated with improved appetite and subsequent weight gain, while integrated preventive programs—such as caregiver education, reduced frequency of sugar consumption, topical fluoride application, and oral health screening in kindergartens—are recommended to reduce the burden of ECC while simultaneously supporting nutritional status (Bernabe et al., 2025; Kassebaum et al., 2017; Marcenes et al., 2013). Nevertheless, more longitudinal studies and well-designed clinical trials that assess medium-term nutritional outcomes are needed to strengthen causal evidence and identify which interventions are most effective across diverse settings.

### **Nutritional Status**

The relationship between nutritional status and dental caries in young children is complex, bidirectional, and influenced by a multitude of biological, behavioral, and environmental factors. Nutritional status, commonly assessed through anthropometric indicators such as weight-for-age, height-for-age, and body mass index (BMI)-for-age, reflects a child's overall growth and health, encompassing both undernutrition—including stunting, wasting, and underweight—and overnutrition, such as overweight and obesity (Ghodsi et al., 2023). Early-life undernutrition can impair enamel formation and mineralization due to deficiencies in critical nutrients such as calcium, phosphate, protein, and vitamins A and D, leading to structural weaknesses that predispose primary teeth to caries. Children with poor nutritional status may also experience weakened immune responses, delayed eruption of teeth, and altered salivary composition, all of which increase vulnerability to oral microbial colonization and the progression of carious lesions (Ahmed et al., 2023).

On the other hand, untreated dental caries, particularly severe or multi-surface lesions, can directly compromise food intake by causing pain during chewing, leading to selective feeding, reduced dietary variety, and decreased caloric and nutrient intake, which in turn can exacerbate undernutrition and hinder growth trajectories. Several longitudinal and cross-sectional studies support this bidirectional relationship, demonstrating that children with higher caries severity are at increased risk of stunting or being underweight, while children with early-life malnutrition are more susceptible to developing dental caries, highlighting the reinforcing nature of the interaction between oral health and nutrition (Khan et al., 2022; Lutter & Rivera, 2003).

At the same time, overnutrition and childhood obesity present a different dimension of the caries–nutrition nexus. High consumption of energy-dense and sugar-rich foods and beverages is a shared risk factor for both overweight and dental caries. Empirical evidence indicates that children who are overweight or obese often exhibit higher caries prevalence, though the relationship is inconsistent across populations and appears to be influenced by socioeconomic status, dietary habits, oral hygiene practices, and access to preventive care. In some contexts, studies have reported weak or inverse associations between obesity and caries once confounders are controlled, suggesting that the link is multifactorial and context-specific rather than universally direct (Murphy et al., 2017; Słowik et al., 2019). Furthermore, socioeconomic and environmental determinants, including parental education, household income, food availability, cultural feeding practices, and access to oral and nutritional health services, simultaneously affect both nutritional outcomes and caries risk, indicating that interventions need to address shared determinants rather than isolated factors.

Given these interconnections, integrated public health strategies are essential for young children, particularly in preschool and kindergarten settings where early dietary habits and oral health behaviors are established. Such strategies may include caregiver education on balanced diets and limiting sugar intake, routine oral hygiene promotion with fluoride toothpaste, topical fluoride applications, regular dental screenings, and coordinated nutrition programs that ensure adequate macro- and micronutrient intake. Evidence from intervention studies suggests that treating severe dental caries can improve appetite, food intake, and weight gain, while preventive programs targeting both nutrition and oral health simultaneously are likely to produce synergistic benefits, enhancing overall child growth and quality of life (Kassebaum et al., 2015). Despite these insights, gaps remain in the literature: there is a need for more longitudinal and interventional studies that monitor growth and nutritional outcomes following caries management, as well as studies exploring the biological mechanisms linking diet, immunity, enamel formation, and oral microbial ecology. Addressing these research gaps will provide stronger causal evidence and inform context-specific interventions that can effectively reduce the dual burden of dental caries and malnutrition in early childhood.

## **Research Method**

This study employed an analytic observational method with a cross-sectional design to analyze the relationship between dental caries and nutritional status among early childhood students. The study population consisted of all children aged 4–6 years enrolled at Darul Imarah Kindergarten, Aceh Besar District, totaling 35 children, all of whom were included in the sample through a total sampling technique. The inclusion criteria were children officially registered as active students at the kindergarten, aged between 4 and 6 years, present during the study period, and whose parents or guardians provided informed consent for participation. The exclusion criteria were children who were ill or had systemic diseases that could affect nutritional status, children who were uncooperative during the dental or anthropometric examinations, and those with incomplete measurement data. The study was conducted at Darul Imarah Kindergarten, Aceh Besar District, from April to November 2025.

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Research instruments included a dental examination form to assess caries, a nutritional status form based on anthropometric indicators, a digital weighing scale for body weight measurement, a stature meter for height measurement, and a demographic form for recording participant identity. Data collection consisted of primary data obtained from direct dental examinations and anthropometric measurements, as well as secondary data from school administrative records and children's health documentation, where available. Data analysis was carried out in two stages: univariate analysis was used to describe the frequency distribution of the independent variable (nutritional status) and the dependent variable (dental caries), while bivariate analysis was performed to determine the association between variables using the Chi-Square test with a significance level of  $\alpha = 0.05$ . All statistical analyses were conducted using the latest version of SPSS software, ensuring reliability and accuracy of the results.

### **Result**

#### **Dental Caries Status**

**Table 1.** Distribution of Dental Caries Status in Children Aged 4–6 Years at Darul Imarah Kindergarten, Aceh Besar District (n = 35)

| <b>No</b> | <b>Dental Caries Status</b> | <b>Frequency (n)</b> | <b>Percentage (%)</b> |
|-----------|-----------------------------|----------------------|-----------------------|
| 1         | Very Low                    | 6                    | 17.1                  |
| 2         | Low                         | 4                    | 11.4                  |
| 3         | Moderate                    | 5                    | 14.3                  |
| 4         | High                        | 10                   | 28.6                  |
| 5         | Very High                   | 10                   | 28.6                  |
| Total     |                             | 35                   | 100                   |

Table 1 shows the distribution of dental caries status among 35 children aged 4–6 years at Darul Imarah Kindergarten, Aceh Besar District. The findings indicate that only a small proportion of children were classified in the *very low* (17.1%) and *low* (11.4%) categories, while 14.3% were in the *moderate* category. In contrast, the majority of children were found in the *high* (28.6%) and *very high* (28.6%) categories, together accounting for 57.2% of the total population studied. This suggests that more than half of the children are experiencing advanced dental caries, reflecting a high prevalence of oral health problems in this age group. The predominance of children in the high and very high categories highlights the urgency of implementing preventive measures, particularly because early childhood caries can progress rapidly and negatively affect mastication, nutritional intake, and overall health. The relatively small percentage of children with very low and low caries status (28.5% combined) further demonstrates that protective behaviors such as good oral hygiene, parental supervision of tooth brushing, and regular dental visits are not yet optimal in this population. These results reinforce the need for school-based oral health programs and parental education to reduce the burden of caries in preschool children.

## Nutritional Status

**Table 2.** Distribution of Nutritional Status in Children Aged 4–6 Years at Darul Imarah Kindergarten, Aceh Besar District (n = 35)

| No    | Nutritional Status | Frequency (n) | Percentage (%) |
|-------|--------------------|---------------|----------------|
| 1     | Severely Thin      | 0             | 0.0            |
| 2     | Thin               | 14            | 40.0           |
| 3     | Normal             | 17            | 42.9           |
| 4     | Overweight         | 3             | 14.3           |
| 5     | Obese              | 1             | 2.9            |
| Total |                    | 35            | 100            |

Table 2 presents the distribution of nutritional status among 35 children aged 4–6 years at Darul Imarah Kindergarten, Aceh Besar District. The findings show that the majority of children were classified as having *normal nutritional status* (17 children; 42.9%). However, a considerable proportion of children fell into the *underweight* categories, with 14 children (40.0%) identified as *thin*, indicating that malnutrition is still a significant concern in this population. Interestingly, none of the respondents were categorized as *severely thin* (0%), while a smaller number of children were found in the categories of *overweight* (3 children; 14.3%) and *obesity* (1 child; 2.9%).

These results illustrate that although a slightly higher proportion of children had normal nutritional status, nearly half of the respondents suffered from some degree of undernutrition, which could have long-term implications for their growth, development, and overall health. Malnutrition during the preschool years is often associated with impaired cognitive development, reduced school performance, increased susceptibility to infections, and, in severe cases, growth stunting. Conversely, the presence of overweight and obesity, though relatively small in proportion (17.2% combined), signals the emerging “double burden of malnutrition,” a phenomenon increasingly reported in many developing regions where undernutrition and overnutrition coexist within the same community.

## Relationship between Dental Caries Status and Nutritional Status

**Table 3.** Distribution of the Relationship between Dental Caries Status and Nutritional Status among Children Aged 4–6 Years at Darul Imarah Kindergarten, Aceh Besar District (n = 35)

| No    | Dental Caries Status | Relationship between Dental Caries Status and Nutritional Status |               |                   |              | Total (n) | p-value |
|-------|----------------------|------------------------------------------------------------------|---------------|-------------------|--------------|-----------|---------|
|       |                      | Thin (n, %)                                                      | Normal (n, %) | Overweight (n, %) | Obese (n, %) |           |         |
| 1     | Very Low             | 0 (0.0)                                                          | 3 (8.6)       | 3 (8.6)           | 0 (0.0)      | 6         | 0.003   |
| 2     | Low                  | 0 (0.0)                                                          | 3 (8.6)       | 0 (0.0)           | 1 (2.9)      | 4         |         |
| 3     | Moderate             | 2 (5.7)                                                          | 3 (8.6)       | 0 (0.0)           | 0 (0.0)      | 5         |         |
| 4     | High                 | 5 (14.3)                                                         | 5 (14.3)      | 0 (0.0)           | 0 (0.0)      | 10        |         |
| 5     | Very High            | 7 (20.0)                                                         | 3 (8.6)       | 0 (0.0)           | 0 (0.0)      | 10        |         |
| Total |                      | 14 (40.0)                                                        | 17 (48.6)     | 3 (8.6)           | 1 (2.9)      | 35        |         |

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Table 3 presents the cross-tabulation of dental caries status with nutritional status among 35 children aged 4–6 years at Darul Imarah Kindergarten, Aceh Besar District. The results demonstrate a statistically significant association between the two variables, with a *p*-value of 0.003 ( $\alpha = 0.05$ ), indicating that dental caries status is significantly related to the nutritional status of children. The distribution shows that children with *very low caries status* were mostly classified as *normal* (8.6%) or *overweight* (8.6%). Children with *low caries status* were predominantly in the *normal* category (8.6%), with one case of *obesity* (2.9%). In contrast, children with *moderate caries status* were mostly classified as *thin* (5.7%) and *normal* (8.6%).

A more concerning trend was observed among children with *high* and *very high caries status*, where the majority were classified as *thin*—5 children (14.3%) in the high group and 7 children (20.0%) in the very high group. Only a small proportion of children with high or very high caries maintained normal nutritional status (14.3% and 8.6%, respectively). These findings suggest that children with more severe levels of dental caries tend to have poorer nutritional outcomes, particularly being classified as *thin*. This is consistent with the biological plausibility that untreated dental caries can impair mastication, reduce appetite, and cause pain during eating, thereby lowering dietary intake and ultimately contributing to undernutrition. Conversely, children with lower caries status were more likely to fall within the normal or even overweight categories, reflecting the protective role of better oral health in maintaining adequate nutrition.

## **Discussion**

The most important finding of this study is the statistically significant relationship between dental caries status and nutritional status among children aged 4–6 years at Darul Imarah Kindergarten, Aceh Besar District ( $p = 0.003$ ). Children with high and very high caries status were predominantly classified as *thin*, whereas those with very low or low caries were more frequently found in the normal, overweight, or obese categories. This pattern strongly supports the hypothesis that severe dental caries negatively affects children's nutritional outcomes by impairing food intake and reducing dietary adequacy. The analysis further revealed that more than half of the study participants (57.2%) had advanced caries, categorized as high or very high. This finding is consistent with national data from Indonesia, where dental caries prevalence among children has reached 97.5%, one of the highest reported globally.

The high burden of caries in this study population highlights an urgent need for preventive oral health strategies, particularly given the long-term consequences of untreated caries, such as impaired mastication, recurrent infections, and reduced quality of life. Nutritional status assessment showed that while the largest proportion of children fell into the normal category (42.9%), nearly as many (40.0%) were classified as *thin*. This dual picture reflects the persistence of undernutrition alongside emerging cases of overweight and obesity (17.2% combined), illustrating the “double burden of malnutrition” increasingly reported in low- and middle-income countries. Malnutrition at this age is particularly concerning, as it is associated with stunted growth, delayed cognitive development, poorer school performance, and increased vulnerability to infections. The association between advanced caries and thinness

in this study is biologically plausible. Severe caries is often painful, leading children to avoid hard or fibrous foods such as fruits, vegetables, and protein-rich items, instead preferring soft or processed foods that are easier to chew but nutritionally inferior (Marqués-Martínez et al., 2022).

Over time, this results in decreased energy intake and micronutrient deficiencies, contributing to undernutrition. On the other hand, children with minimal caries may be better able to consume a varied diet, which supports normal or even excessive weight gain (Sofian et al., 2025). Interestingly, the small proportion of overweight and obese children may also reflect the increasing consumption of cariogenic foods, such as sugary snacks and beverages, which simultaneously raise the risk of caries and contribute to excess caloric intake. Taken together, these findings underscore the interconnected nature of oral health and nutrition. Interventions targeting only one domain are unlikely to be sufficient (Nakamura et al., 2021; Peres et al., 2020). Instead, integrated approaches are needed, combining school-based oral health education, routine dental screenings, parental involvement in supervising toothbrushing, and nutritional counseling to encourage balanced diets. Such strategies would not only help reduce the burden of caries but also improve nutritional outcomes and overall well-being in preschool-aged children.

## **Conclusion**

This study concludes that there is a statistically significant association between dental caries status and nutritional status among children aged 4–6 years at Darul Imarah Kindergarten, Aceh Besar District. Children with high and very high caries were more likely to be classified as thin, whereas those with low or very low caries were more frequently found in the normal, overweight, or obese categories. These findings reinforce the evidence that advanced dental caries not only affect oral health but also negatively influence children's nutritional outcomes by impairing mastication, causing pain, and reducing intake of nutrient-rich foods.

The high proportion of children with advanced caries observed in this study is consistent with national data indicating that dental caries prevalence among Indonesian children is among the highest globally, underscoring the urgent need for stronger preventive oral health strategies. From a nutritional perspective, the coexistence of undernutrition alongside rising cases of overweight and obesity reflects the “double burden of malnutrition,” a growing public health concern in many low- and middle-income countries. Both undernutrition and overnutrition during the preschool years are particularly worrisome because of their long-term consequences, including stunted growth, delayed cognitive development, lower academic performance, and greater susceptibility to infections. The practical implications of these findings highlight the necessity of integrated and sustained health interventions. School-based programs should incorporate oral health education, routine dental screening, and preventive care as part of early childhood health promotion. At the same time, nutrition counseling should be emphasized to encourage balanced dietary practices, while parents play an active role in supervising daily toothbrushing and shaping healthy eating habits.

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at home. Strengthened collaboration between dental health professionals, nutritionists, teachers, and parents is crucial to ensure that interventions are comprehensive and effective.

### **Declaration of conflicting interest**

The authors declare that there is no conflict of interest in this work.

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