



RESEARCH ARTICLE

Dental caries and nutritional status among playgroup, kindergarten, and elementary school students: A study in Bina Talenta Graha School, Bekasi

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ABSTRACT

Background: Dental caries remains a widespread public health issue in pediatric populations that can severely impair oral function, school performance, and overall growth. School-based dental and anthropometric screenings offer a critical pathway for early detection, oral health promotion, and longitudinal monitoring. This study aimed to evaluate dental caries prevalence, tooth-level disease severity, and nutritional status among playgroup (PG), kindergarten (KG), and elementary school (ES) students at Bina Talenta Graha School, Bekasi, Indonesia, and to compare oral health outcomes across a two-year outreach intervention (2023 vs. 2025).

Methods: A two-phase repeated cross-sectional study was conducted in December 2023 and December 2025 during community service programs. In the 2025 screening cohort ($N = 193$; PG = 8, KG = 55, ES = 130), student-level caries experience (presence of decayed [D], missing [M], and filled [F] teeth) and tooth-level counts were assessed by calibrated dental professionals. Anthropometric measurements ($n = 187$) were evaluated using Weight-for-Age (WFA for PG/KG) and BMI-for-Age (BAZ for ES) Z-scores based on WHO standards. Comparative longitudinal trends in student-level disease burden between 2023 and 2025 were analyzed descriptively.

Results: In 2025, overall student-level caries prevalence was 59.1% ($n = 114/193$), missing teeth prevalence was 11.9% ($n = 23/193$), and filled teeth prevalence was 14.0% ($n = 27/193$). Caries prevalence peaked in kindergarten (67.3%), followed by playgroup (62.5%) and elementary school (55.4%). Missing teeth were most frequent in kindergarten (25.5%), whereas playgroup children had no missing or filled teeth. At the tooth level, 402 decayed teeth, 46 missing teeth, and 44 filled teeth were recorded (total 492 affected teeth; mean 2.55 affected teeth/child). Caries occurred across all nutritional categories, with the highest burden observed in normal-weight (70.8%) and overweight/obese (26.7%) children. Between 2023 and 2025, the number of students with untreated active caries decreased from 171 to 114 (a 33.3% reduction), and students with missing teeth dropped from 69 to 23 (a 66.7% reduction).

Conclusion: Dental caries remains a major burden among young school children, particularly in kindergarten. Integrated school-based oral health promotion, structured toothbrushing programs, and parental involvement demonstrated notable reductions in active caries and premature tooth loss over two years.

Keywords: dental caries; nutritional status; school health screening; pediatric dentistry; oral health promotion

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Introduction

Oral diseases, particularly dental caries, represent a major global public health challenge affecting children across all socioeconomic strata.¹ According to the Global Burden of Disease study, untreated caries in primary teeth affects more than 532 million children worldwide, predisposing them to chronic dental pain, systemic infections, malnutrition, missed school days, and impaired oral health-related quality of life.² In Indonesia, the 2018 Basic Health Research (Riskesdas) reported an alarming caries prevalence of 68.8% among children aged 5–12 years, with high rates of untreated decayed teeth and minimal restorative care.³ This high burden is driven by inadequate toothbrushing habits, high dietary free-sugar intake, poor oral health literacy among caregivers, and limited access to professional pediatric dental care.^{1,2,4}

Daily toothbrushing with fluoridated toothpaste is recognized as the cornerstone of primary caries prevention.^{5–7} Systematic reviews demonstrate that early initiation and optimal frequency of fluoridated toothbrushing significantly reduce early childhood caries (ECC) incidence.^{7,8} Furthermore, school-based screening programs coupled with parental engagement provide a highly effective platform for early diagnosis, oral hygiene education, and timely clinical referral.^{9,10}

Nutritional status is closely intertwined with pediatric oral health in a bidirectional relationship.^{11,12} Malnutrition and micronutrient deficiencies can lead to enamel hypoplasia, salivary gland dysfunction, and altered tooth eruption patterns, increasing caries susceptibility.^{13,14} Conversely, frequent consumption of cariogenic, energy-dense foods contributes to childhood overweight and obesity while simultaneously promoting acidogenic bacterial proliferation and enamel demineralization.^{12,15} Moreover, severe untreated caries causes masticatory discomfort and avoidance of nutrient-dense foods, further compromising child growth and development.^{11,12}

While school-based health outreach initiatives are increasingly conducted in urban Indonesian centers, comprehensive empirical evaluations combining both tooth-level severity metrics and standardized anthropometric profiles across multiple school levels remain limited. Therefore, this study aimed to: (1) evaluate dental caries experience (decayed, missing, filled teeth) at both the student level and tooth level among playgroup, kindergarten, and elementary school students; (2) assess nutritional status using WHO standardized growth standards; (3) explore the distribution of caries across nutritional categories; and (4) analyze changes in student-level oral health indicators over a two-year repeated screening period (2023 vs. 2025) at Bina Talenta Graha School, Bekasi, Indonesia.

Method

A two-phase repeated cross-sectional study was embedded within a community outreach health program conducted at Bina Talenta Graha School, an urban private educational institution located in Bekasi, West Java, Indonesia. The school comprises three educational levels: Playgroup (PG, aged 3–4 years), Kindergarten (KG, aged 5–6 years), and Elementary School (ES, aged 7–12 years). Oral health and anthropometric screenings were carried out in two distinct outreach cycles: Phase 1 in December 2023 (Baseline) and Phase 2 in December 2025 (Follow-up).

All enrolled students attending school during the screening dates whose parents provided informed consent were eligible for inclusion. In the Phase 2 (2025) primary analysis cohort, a total of 193 students completed the full dental clinical examination (PG: $n = 8, 4.1\%$; KG: $n = 55, 28.5\%$; ES: $n = 130, 67.4\%$). Students with incomplete examination forms or orthodontic appliances obscuring tooth surfaces were excluded. Anthropometric evaluations were successfully obtained for 187 students (PG/KG: $n = 65$; ES: $n = 122$).

Oral examinations were performed by trained and calibrated dental professionals assisted by medical students from Universitas Katolik Indonesia Atma Jaya. Examinations were conducted under natural and artificial ambient lighting using disposable diagnostic kits (mouth mirrors and dental probes) in accordance with World Health Organization (WHO) oral health survey guidelines [13]. For primary dentition (PG/KG) and mixed/permanent dentition (ES), individual teeth were examined and classified according to WHO criteria: 1) Decayed (d/D): Tooth with an open cavitation, visual enamel breakdown, or shadow beneath intact enamel; 2) Missing (m/M): Tooth extracted or missing due to caries (excluding naturally exfoliated primary teeth or physiological tooth loss during mixed dentition); and 3) Filled (f/F): Tooth restored with permanent or temporary filling materials without secondary caries. Data were documented at two levels: (1) *Student-level prevalence* (binary presence/absence of any decayed, missing, or filled tooth per child); and (2) *Tooth-level counts* (total aggregate sum of affected d/D, m/M, and f/F teeth across the cohort).

Body weight was measured to the nearest 0.1 kg using a calibrated digital scale, and height was measured to the nearest 0.1 cm using a portable stadiometer. Nutritional status was categorized according to the WHO Child Growth Standards (2006)¹⁶ and WHO Growth Reference (2007)¹⁷. For playgroup and kindergarten children aged under 5--6 years, nutritional status was assessed using Weight-for-Age Z-scores (WAZ). The classifications include Severely Underweight ($WAZ < -3$ SD), Underweight (-3 SD $\leq WAZ < -2$ SD), Normal (-2 SD $\leq WAZ \leq +1$ SD), Overweight ($+1$ SD $< WAZ \leq +2$ SD), and Obese ($WAZ > +2$ SD). For elementary school children aged 7--12 years, nutritional status was assessed using Body Mass Index-for-Age Z-scores (BAZ). The classifications include Severely Thin/Underweight ($BAZ < -3$ SD), Thinness/Underweight (-3 SD $\leq BAZ < -2$ SD), Normal (-2 SD $\leq BAZ \leq +1$ SD), Overweight ($+1$ SD $< BAZ \leq +2$ SD), and Obese ($BAZ > +2$ SD).

Data were processed and analyzed using Microsoft Excel and SPSS version 26.0. Continuous variables were summarized using means and standard deviations, while categorical variables were presented as absolute counts (n) and percentages (%). Cross-tabulations were generated to describe caries prevalence by gender, educational level, and nutritional status. Temporal shifts in the number of affected students between 2023 and 2025 were calculated to evaluate the overall impact of ongoing health education interventions.

Results

The demographic distribution of the 2025 screening cohort ($N = 193$) is summarized in Table 1. Females accounted for 55.4% ($n = 107$) and males accounted for 44.6% ($n = 86$) of the total population. Elementary school students comprised the largest subgroup (67.4%, $n = 130$), followed by kindergarten (28.5%, $n = 55$) and playgroup (4.1%, $n = 8$).

Table 1. Demographic characteristics of the study cohort (2025, $N = 193$)

Characteristic	Category	Count (n)	Percentage (%)
Gender	Male	86	44.56
	Female	107	55.44
Educational Level	Playgroup (PG)	8	4.14
	Kindergarten (KG)	55	28.50
	Elementary School (ES)	130	67.36
Total	-	193	100.00

Among the 187 students with complete anthropometric records, the majority displayed normal nutritional status (71.1%, $n = 133$). In the PG/KG group assessed by Weight-for-Age ($n = 65$), 70.8% ($n = 46$) were normal, 6.2% ($n = 4$) were underweight, 18.5% ($n = 12$) were overweight, and 4.6% ($n = 3$) were obese. In the elementary school group assessed by BMI-for-Age ($n = 122$), 71.3% ($n = 87$) were normal, 1.6% ($n = 2$) were severely underweight, 2.5% ($n = 3$) were underweight, 12.3% ($n = 15$) were overweight, and 12.3% ($n = 15$) were obese (Table 2).

Table 2. Nutritional status distribution according to educational level (2025, $n = 187$)

Nutritional Status Category	Playgroup & Kindergarten (WAZ, $n=65$)	Elementary School (BAZ, $n=122$)	Total Cohort ($n=187$)	Percentage (%)
Severely Underweight	0	2	2	1.07
Underweight	4	3	7	3.74
Normal	46	87	133	71.12
Overweight	12	15	27	14.44
Obesity	3	15	18	9.63
Total	65	122	187	100.00

At the *student level* ($N = 193$), 114 students (59.07%) had at least one active decayed tooth, 23 students (11.92%) had missing teeth due to caries or premature extraction, and 27 students (13.99%) had restored/filled teeth. As shown in Table 3, caries prevalence was highest in kindergarten students (67.27%, $n = 37/55$), followed by playgroup (62.50%, $n = 5/8$) and elementary school (55.38%, $n = 72/130$). Missing teeth were significantly more frequent in kindergarten (25.45%, $n = 14$) than in elementary school (6.92%, $n = 9$), whereas no missing or filled teeth were recorded in playgroup children.

At the *tooth level*, a total of 492 affected teeth were recorded across the 193 students, representing an overall disease burden of 2.55 affected teeth per child. This total comprised 402 decayed teeth (d/D), 46

missing teeth (m/M), and 44 filled teeth (f/F). Female students accounted for 57.21% of decayed teeth ($n = 230$), 52.17% of missing teeth ($n = 24$), and 54.55% of filled teeth ($n = 24$).

Table 3. Student-level dental health status and tooth-level severity across educational levels (2025, $N = 193$)

School Level	Total Students (N)	Students with Decayed n (%)	Students with Missing n (%)	Students with Filled n (%)	Total Affected Teeth (d/m/f sum)
Playgroup (PG)	8	5 (62.50%)	0 (0.00%)	0 (0.00%)	18
Kindergarten (KG)	55	37 (67.27%)	14 (25.45%)	7 (12.73%)	184
Elementary School (ES)	130	72 (55.38%)	9 (6.92%)	20 (15.38%)	290
Total Cohort	193	114 (59.07%)	23 (11.92%)	27 (13.99%)	492

Dental caries was detected across all nutritional categories without exception (Table 4). In terms of absolute counts, the majority of caries cases occurred in children with normal nutritional status ($n = 59$ for decayed, $n = 10$ for missing, $n = 11$ for filled). However, overweight and obese children combined accounted for 35.8% of all decayed teeth ($n = 43/120$) and 28.3% of missing teeth ($n = 10/35$) within the anthropometric subsample, demonstrating a high co-occurrence of excess body weight and oral disease.

Table 4. Distribution of tooth-level oral health conditions across nutritional categories (2025, $n = 187$)

Nutritional Category	Decayed Teeth (d/D)	Missing Teeth (m/M)	Filled Teeth (f/F)	Total Affected Teeth
Severely Underweight	2	0	0	2
Underweight	7	3	2	12
Normal	59	10	11	80
Overweight	25	8	4	37
Obesity	18	2	9	29
Total	111*	23	26	160

*Note: Includes tooth counts for the 187 students with complete anthropometric profiles.

A comparison of student-level oral health indicators between the baseline screening in 2023 and follow-up screening in 2025 revealed substantial improvements in student oral health status (Table 5). The overall number of students presenting with active untreated decay decreased from 171 in 2023 to 114 in 2025—representing a 33.3% net reduction in active caries burden. Concurrently, the number of students suffering from missing teeth dropped by 66.7% (from 69 in 2023 to 23 in 2025). The proportion of students with restored/filled teeth remained relatively stable (30 students in 2023 vs. 27 students in 2025).

Table 5. Comparison of student-level oral health indicators between 2023 and 2025 screening cycles

School Level	Screening Year	Students with Decayed n (%)	Students with Missing n (%)	Students with Filled n (%)
Playgroup (PG)	2023	4 (2.34%)	1 (1.45%)	0 (0.00%)
	2025	5 (4.39%)	0 (0.00%)	0 (0.00%)
Kindergarten (KG)	2023	35 (20.47%)	6 (8.70%)	3 (10.00%)
	2025	37 (32.46%)	14 (60.87%)	7 (25.93%)
Elementary School (ES)	2023	132 (77.19%)	62 (89.85%)	27 (90.00%)
	2025	72 (63.15%)	9 (39.13%)	20 (74.07%)
Total Cohort	2023	171 (100.0%)	69 (100.0%)	30 (100.0%)
	2025	114 (100.0%)	23 (100.0%)	27 (100.0%)

Discussion

This study provides a comprehensive evaluation of dental caries and nutritional status among Indonesian schoolchildren across playgroup, kindergarten, and elementary school levels. Our findings confirm that dental caries remains a major public health challenge, with an overall student-level prevalence of 59.1% and a high tooth-level severity (402 decayed teeth). This aligns with national data from Indonesia's Riskesdas (68.8% caries prevalence in 5–12 year-olds) and underscores the continuous necessity of structured school-based oral health promotion.³

Notably, caries prevalence was highest among kindergarten students (67.3%), outstripping both playgroup (62.5%) and elementary school students (55.4%). Kindergarten children (aged 5–6 years) represent a highly vulnerable transitional period characterized by complete primary dentition, dietary transition toward cariogenic snacks, and incomplete fine motor skills required for effective unassisted toothbrushing.^{18,19} Furthermore, kindergarten students exhibited the highest frequency of missing teeth

(25.5%), reflecting premature extractions resulting from severe, neglected early childhood caries (ECC). In contrast, the lower prevalence of missing teeth in elementary school students (6.9%) reflects physiological exfoliation during the mixed dentition phase as well as better oral hygiene self-efficacy.^{20,21}

The relationship between nutritional status and oral health is complex and multifaceted. In our study, caries occurred across all nutritional categories. While normal-weight children comprised the largest absolute number of caries cases due to sample size dominance, overweight and obese children exhibited a substantial proportion of decayed teeth.^{22–24} This co-occurrence is largely explained by common dietary risk factors, specifically, frequent consumption of sugar-sweetened beverages and ultra-processed cariogenic foods.^{25,26} Simultaneously, underweight children remain vulnerable due to enamel hypoplasia, reduced salivary buffering capacity, and delayed dental eruption associated with micronutrient deficiencies.^{27,28}

A critical contribution of this study is the evaluation of longitudinal shifts over a two-year repeated cross-sectional screening period (2023 to 2025). Following the implementation of interactive oral hygiene workshops, toothbrushing demonstrations, and individualized dental report cards sent to parents, the number of students with active untreated caries dropped significantly from 171 to 114 (a 33.3% reduction), and premature tooth loss fell from 69 to 23 students (a 66.7% reduction). These positive changes demonstrate that school-based oral health screening coupled with parental awareness campaigns can effectively drive preventive behaviors and encourage timely care-seeking at local dental clinics.^{29,30}

Several limitations should be acknowledged. First, the study employed a repeated cross-sectional design rather than a strictly tracked prospective cohort; thus, individual-level longitudinal trajectories could not be evaluated due to student turnover. Second, complete anthropometric records were unavailable for a small subset of students ($n = 6$), restricting nutritional cross-tabulations to 187 participants. Third, behavioral confounders such as exact daily toothbrushing frequency, dietary sugar exposure logs, and household socioeconomic status were not recorded. Finally, as the study was conducted at a single urban private school in Bekasi, generalizability to rural or public school settings across Indonesia may be limited.

Conclusion

Dental caries remains highly prevalent among early childhood and elementary school students in urban Indonesia, with peak vulnerability observed during kindergarten. The integration of anthropometric screening with dental examinations highlights the dual burden of oral disease and dietary nutritional imbalances. School-based health outreach programs involving routine clinical screening, practical toothbrushing education, and proactive parent-school communication produce tangible reductions in active caries and tooth loss over time. Sustained multi-sectoral collaboration between schools, healthcare professionals, and families is essential to ensure long-term oral and general child health improvement.

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