Early Childhood Caries, Masticatory Function, and Stunting among Young Children in Rural and Coastal Indonesia: Systematic Review

Razin Alifahrezy Setyaliani[1]
[1]Department of Public Health, Faculty of Health Sciences, Universitas Jenderal Soedirman, Indonesia
Corresponding email: alifahrezy.setyaliani@mhs.unsoed.ac.id

Abstract

Early childhood caries (ECC) and growth stunting are major public health concerns in Indonesia, particularly across underserved rural and coastal communities. Malnutrition impairs salivary function and enamel development, while severe tooth decay causes oral pain, potentially interfering with eating ability and nutrient intake. This systematic literature review evaluated the observational association between ECC, masticatory function, and stunting among children aged 0-6 years in rural and coastal Indonesia. Following Joanna Briggs Institute (JBI) guidelines, 23 high-quality primary empirical studies were synthesized. The findings revealed a high caries burden (def-t/dmft) among stunted children in rural subdistricts and coastal fishing settlements. Severe pulp-involving caries was associated with stunting, frequently mediated by reported eating discomfort and cariogenic dietary patterns. Acidic salivary pH and delayed tooth eruption further exacerbated caries severity. However, because included studies were predominantly cross-sectional and direct measurements of masticatory performance were scarce, a causal bi-directional relationship cannot be established. In conclusion, evidence demonstrates a consistent observational association between early childhood caries and stunting in rural and coastal Indonesian children. Integrated public health strategies combining early dental screening with nutritional support are recommended at primary health facilities.

Keywords: Coastal; Early childhood caries; Masticatory function; Rural; Stunting

I. INTRODUCTION

Stunting, defined as impaired linear growth resulting from chronic or recurrent undernutrition (height-for-age Z-score < −2 SD), remains a major public health problem in Indonesia, particularly among children living in vulnerable rural and coastal communities (Setiawan et al., 2022). Its occurrence is influenced by multiple factors, including inadequate dietary intake, recurrent infections, limited healthcare access, food insecurity, and unfavorable environmental conditions (Kemenkes RI, 2023). At the same time, Early Childhood Caries (ECC) is one of the most common chronic conditions among children under six years of age, with a high prevalence reported in Indonesia (Huang et al., 2025; Kementrian Kesehatan, 2018).

The relationship between ECC and nutritional status may be bidirectional. Poor nutritional status may affect tooth development, enamel quality, and salivary function, increasing susceptibility to dental caries (Folayan et al., 2020; Setiawan et al., 2022). Conversely, severe ECC may cause dental pain and impaired chewing, which can affect food intake and dietary patterns (Berat et al., 2025). These interconnected pathways suggest that dental caries, masticatory function, and stunting may influence one another, although the direction and mechanisms of this relationship remain incompletely understood.

This relationship may be particularly relevant in rural and coastal communities, where socioeconomic conditions, healthcare access, food environments, and health literacy may affect both oral and nutritional health (Aulia et al., 2023). However, evidence on the interrelationship between ECC, masticatory function, and stunting in these populations remains fragmented. Therefore, this systematic review aimed to synthesize empirical evidence regarding the relationship between ECC, masticatory or chewing function, and stunting among children aged 0-6 years in rural and coastal Indonesia.

II. METHOD

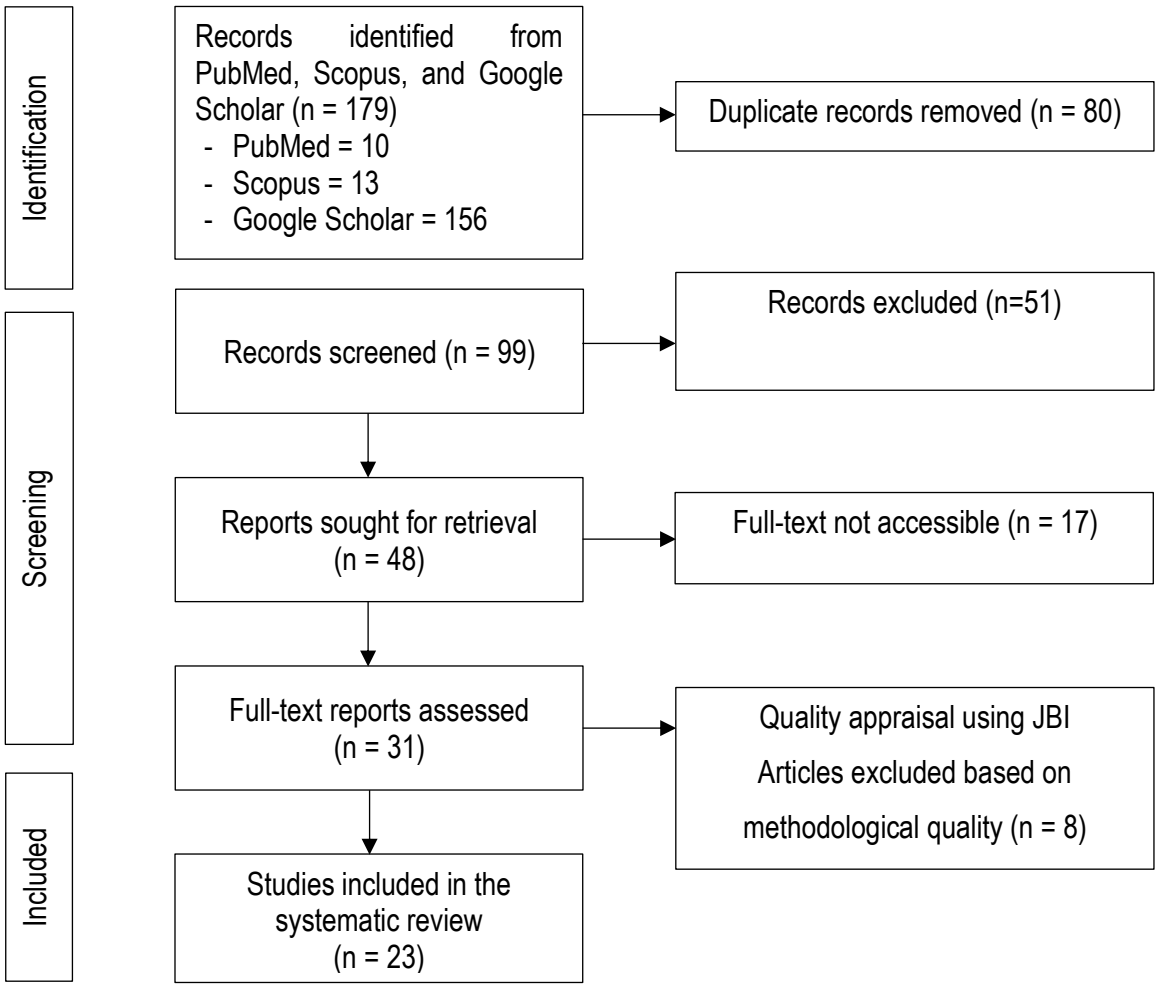
This study was a systematic review conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The research question was formulated using the PICO (Population, Intervention/Exposure, Comparison, and Outcome) framework. The population of interest was children in Indonesia. The exposures examined included dental caries, including early childhood caries (ECC), severe dental caries, and def-t index, as well as impaired masticatory or chewing function. The comparison groups consisted of children without dental caries or with low levels of caries and/or children with normal masticatory function. The outcomes of interest included stunting, malnutrition or undernutrition, and impaired growth and development.

A literature search was conducted in September 2026 using three databases: PubMed, Scopus, and Google Scholar. The search strategy was adapted to the characteristics of each database. In PubMed, the following search terms were used: ("dental caries" OR "early childhood caries" OR "def-t") AND ("stunting" OR "malnutrition") AND ("Indonesia" OR "Indonesian"). In Scopus, the search strategy was: ("early childhood caries" OR "severe dental caries" OR "def-t") AND ("masticat" OR "chewing" OR "oral function") AND ("stunting" OR "malnutrition" OR "growth retardation") AND ("Indonesia" OR "Indonesian"). Google Scholar was searched using a combination of Indonesian terms: ("karies gigi anak" OR "karies anak" OR "def-t") AND ("stunting" OR "malnutrisi" OR "gizi kurang") AND ("fungsi mengunyah" OR "daya kunyah"), as well as equivalent terms in English.

The inclusion criteria were observational studies using analytical cross-sectional, cohort, or case-control designs; published between 2020 and 2026; written in Indonesian or English; conducted among children in Indonesia; and evaluating the association between dental caries and/or masticatory function and stunting, nutritional status, or child growth and development. Systematic reviews, case reports, editorials, and other non-observational studies were excluded. Articles without full-text availability or without the variables relevant to the research question were also excluded.

III. RESULTS AND DISCUSSIONS

A. Result



All records retrieved from the three databases were compiled, followed by duplicate removal. The remaining records were screened based on their titles and abstracts, followed by full-text assessment according to the predefined inclusion and exclusion criteria. A total of 31 articles underwent full-text assessment, of which 23 met the eligibility criteria and were included in the systematic review synthesis. The identification, screening, eligibility assessment, and inclusion processes were documented using a PRISMA flow diagram.

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklists. The JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies was used for cross-sectional studies. Each article was independently assessed to evaluate internal validity, methodological quality, and potential risk of bias. The results of the critical appraisal of the included studies, assessed using the respective JBI checklists according to study design, are presented in Table 1.

Extracted data included study characteristics, study location and sample size, study design, population characteristics, exposure variables, methods used to assess dental caries or masticatory function, indicators of stunting or nutritional status, and findings regarding associations between the variables. The characteristics and main findings of the included studies are summarized in Table 1. The findings were presented descriptively and synthesized narratively according to similarities in exposure characteristics, outcomes, and study designs.

Table 1. Characteristics and main findings of studies

Author & Country	Study Objective	Geographic Setting	Study Design	Participants/Sample	Main Findings	Study Quality
(Abadi & Abral, 2020) (Indonesia)	To analyze patterns and risk factors for dental caries, including salivary pH, cariogenic diet, type of milk, toothbrushing practices, and debris index among stunted toddlers.	Semi-Rural (Pontianak)	Non-experimental cross-sectional study.	30 stunted toddlers aged 0–5 years in Pontianak, West Kalimantan.	Significant associations were found between salivary pH (p=0.013), cariogenic food intake (p=0.001), type of milk (p=0.003), toothbrushing practices (p=0.000), and debris (p=0.013) with the def-t index.	7/8 (87.5%) High
(Achmad et al., 2020)) (Indonesia)	To analyze the association between dental caries, gingivitis, and stunting among children.	Urban (Makassar)	Analytical observational cross-sectional study.	208 children aged 2.5 years, comprising 104 stunted children and 104 children with normal nutritional status in Makassar, South Sulawesi.	The mean caries score (def-t) was significantly higher among stunted children (7.37) than among children with normal nutritional status (5.37) (p=0.001).	7/8 (87.5%) High
(Anang et al., 2025) (Indonesia)	To determine the association between stunting, tooth eruption, and dental caries among toddlers.	Rural (Tasikmalaya)	Quantitative analytical cross-sectional study.	50 toddlers aged 24–60 months with stunting at Tamansari Public Health Center, Tasikmalaya.	Stunting was significantly associated with delayed tooth eruption (p=0.003) and increased occurrence of dental caries (p=0.003).	7/8 (87.5%) High
(Andriyani et al., 2023) (Indonesia)	To determine the association between stunting and dental caries (dmft/dmfs) among preschool children.	Coastal/Urban (Bandar Lampung)	Analytical survey with a cross-sectional design.	150 preschool children aged 3–5 years in Sukabumi Indah, Bandar Lampung.	The mean dmfs score was significantly higher among stunted children (14.03 ± 6.16) than among children with normal nutritional status (7.47 ± 3.74) (p=0.0001).	7/8 (87.5%) High
(Arsad et al., 2024) (Indonesia)	To analyze the association between the dental caries index and stunting among preschool children.	Rural (Sidrap)	Analytical observational cross-sectional study.	98 preschool children aged 3–6 years in Sidenreng Rappang Regency, South Sulawesi.	A significant association was found between the dental caries index and stunting among preschool children (p<0.05).	7/8 (87.5%) High
(I. Badruddin et al., 2021) (Indonesia)	To determine the prevalence of dental caries and stunting and examine the association between	National Survey (Indonesia)	Analytical observational cross-sectional study based on	410 children aged 5 years in Indonesia.	The prevalence of stunting was 25.4%, and 63.5% of children experienced severe early childhood caries (ECC). Stunting was significantly associated with parental	8/8 (100%) High

	oral health status and stunting among 5-year-old children.		national survey data.		education and socioeconomic status (p=0.001).	
(I. A. Badruddin et al., 2025) (Indonesia)	To analyze the association between the severity of stunting and dental caries among toddlers.	Rural (Klaten)	Cross-sectional study.	248 stunted children aged 0–3 years in Juwiring District, Klaten Regency, Central Java.	The proportion of caries was significantly higher among severely stunted children (75%) than among stunted children (53.9%) (p=0.001; OR=1.39). Parental income and feeding practices were also significantly associated with caries.	8/8 (100%) High
(Budiarti et al., 2024) (Indonesia)	To analyze the association between dental caries severity and stunting among preschool children.	Coastal/Rural (Pesawaran)	Observational cross-sectional study.	69 preschool children aged 24–60 months in the service area of Gedong Tataan Public Health Center, Pesawaran Regency.	A significant association was found between dental caries severity and stunting (p=0.000), with a mean caries score of 6.23 among stunted children.	7/8 (87.5%) High
(Mardiati et al., 2025) (Indonesia)	To examine the association of maternal knowledge and attitudes with dental caries and plaque index among stunted toddlers.	Coastal (North Jakarta)	Analytical survey with a cross-sectional design.	76 stunted toddlers aged 3–5 years and their mothers in Cilincing, Semper Barat, and Penjaringan, North Jakarta.	Maternal knowledge (p=0.011) and attitudes (p=0.011) were significantly associated with dental caries and plaque index (p=0.000) among stunted children.	7/8 (87.5%) High
(Mulsin et al., 2024) (Indonesia)	To compare the prevalence of Early Childhood Caries (ECC) between stunted and non-stunted children.	Urban (Bandung)	Analytical observational cross-sectional study.	60 children aged 3–5 years, comprising 30 stunted and 30 non-stunted children in Bandung, West Java.	ECC prevalence was significantly higher among stunted children (93.3%) than among non-stunted children (73.3%) (p=0.006), with mean def-t scores of 6.43 and 5.23, respectively.	8/8 (100%) High
(Ningsih et al., 2025) (Indonesia)	To analyze the association between dental caries and stunting among children in a rural area.	Rural (Aceh Besar)	Cross-sectional study.	44 children aged 0–5 years in Krueng Barona Jaya District, Aceh Besar Regency.	The number of carious teeth (p=0.006) and caries risk level (p=0.013) were significantly associated with stunting.	7/8 (87.5%) High
(Nurmawi et al., 2024) (Indonesia)	To analyze the association between a cariogenic dietary pattern and dental caries among Suku Anak Dalam toddlers at risk of stunting.	Remote/Indigenous (Muaro Jambi)	Analytical observational cross-sectional study.	40 Suku Anak Dalam toddlers aged 16–58 months in Muaro Jambi Regency, Jambi Province.	A cariogenic dietary pattern was significantly associated with increased dental caries (p=0.023; OR=6.4).	7/8 (87.5%) High

(Putri et al., 2023) (Indonesia)	To describe oral hygiene practices and caries increment among stunted children.	Urban (Bandung)	Descriptive analytical observational cross-sectional study.	113 stunted children aged 1–3 years in Bandung, West Java.	Most stunted children (70.8%) had poor oral hygiene practices and required intensive parental assistance.	8/8 (100%) High
(Rahmadi et al., 2023) (Indonesia)	To analyze pulp-involved dental caries as a risk factor for stunting among preschool children in a stunting-priority area.	Rural (Tulang Bawang Barat)	Correlational observational cross-sectional study.	151 preschool children aged 3–5 years in a stunting-priority village in West Tulang Bawang Regency, Lampung.	Caries prevalence was 77.5%, with 25.2% involving the pulp. Pulp-involved caries was a significant risk factor for stunting (p=0.02; OR=4.7).	8/8 (100%) High
(Salpiani & Nuraskin, 2025) (Indonesia)	To analyze the association between dental caries status (def-t) and stunting among preschool children.	Coastal (Banda Aceh)	Analytical observational cross-sectional study.	50 children attending PAUD Al-Jannati in Gampong Jawa, Kuta Raja District, Banda Aceh.	A significant association was found between dental caries status and stunting (p=0.003), with moderate caries being the most prevalent category (44%).	7/8 (87.5%) High
(Salsabilla et al., 2025) (Indonesia)	To analyze the association between maternal oral health behavior and dental caries among stunted toddlers.	Rural (Banyumas)	Analytical observational cross-sectional study.	101 stunted toddlers aged 30–59 months and their mothers in Cilongok District, Banyumas Regency.	Caries prevalence among stunted toddlers was 98%. Maternal knowledge (p=0.000), attitudes (p=0.000), and practices (p=0.010) were significantly associated with caries severity.	8/8 (100%) High
(Sari & Insana, 2024) (Indonesia)	To analyze the association between salivary pH and dental caries among stunted children.	Rural/Riverine (Hulu Sungai Utara)	Analytical survey with a cross-sectional design.	162 stunted children in Sungai Pandan District, Hulu Sungai Utara Regency, South Kalimantan.	Acidic salivary pH was significantly associated with the occurrence and severity of dental caries (p=0.000).	7/8 (87.5%) High
(Setiawan et al., 2025) (Indonesia)	To analyze the association between toothbrushing ability, caries burden (def-t), and oral health-related quality of life (OHRQoL) among stunted children.	Urban (Bandung)	Analytical observational cross-sectional study.	554 children aged 1–5 years, comprising 278 stunted and 276 non-stunted children in Bandung, West Java.	Nutritional status was associated with toothbrushing ability (p=0.034) and OHRQoL (p<0.001). Toothbrushing ability was correlated with caries burden (p<0.001).	8/8 (100%) High
(Yani et al., 2025) (Indonesia)	To compare dental caries severity between stunted and non-stunted toddlers.	Rural (Jember)	Analytical observational cross-sectional study.	Toddlers aged 25-60 months in Jember, East Java.	A significant difference in dental caries severity was observed between stunted and non-stunted toddlers (Mann–Whitney test, $p < 0.05$).	7/8 (87.5%) High

(Yohana et al., 2025) (Indonesia)	To analyze dental caries experience among children with a history of neonatal stunting.	Urban (Bandung)	Retrospective cohort study.	164 children aged 0-59 months in Bandung, West Java.	Children with a history of neonatal stunting and enamel hypoplasia experienced significantly greater dental caries severity over time	10/11 (90.9%) High
(Zulkifli et al., 2022) (Indonesia)	To examine the association between self-reported oral health problems and children's nutritional status.	National Survey (Indonesia)	National cross-sectional survey.	Preschool children aged 3-6 years across Indonesia.	Self-reported oral health problems were significantly associated with undernutrition and stunting among preschool children.	8/8 (100%) High

B. Discussion

The findings of this systematic review indicate a generally consistent association between dental caries and nutritional status among children in Indonesia. Across the included studies, children with stunting tended to have a higher prevalence or severity of dental caries, although the strength and specific indicators of the association varied between studies. Overall, the findings suggest that the relationship between dental caries and nutritional status is influenced by several interconnected factors, including caries severity, oral pain and masticatory function, dietary patterns, oral hygiene, biological conditions, and socioeconomic and environmental factors.

3.1 Association Between Dental Caries and Stunting

Children with stunting generally showed a higher prevalence of dental caries than children without stunting across various study settings in Indonesia, including rural subdistricts and coastal communities. Mulsin et al. (2024) reported that the prevalence of Early Childhood Caries (ECC) was 93.3% among stunted children, compared with 73.3% among non-stunted children ($p = 0.006$). Similarly, Badruddin et al. (2025) found in rural Klaten that dental caries was present in 75.0% of severely stunted children and 53.9% of stunted children ($p = 0.001$). These findings are consistent with those reported by Budiarti et al. (2024) in coastal Pesawaran and Yani et al. (2025) in rural Jember, which also identified significant differences in caries status according to nutritional status.

The association was also observed in quantitative measures of caries experience across both urban and rural/coastal settings. Achmad et al. (2020) reported a higher mean def-t score among stunted children than among children with normal nutritional status (7.37 vs. 5.37; $p = 0.001$). Similarly, Andriyani et al. (2023) found in coastal Bandar Lampung that the mean dmfs score was higher among stunted preschool children than among those with normal nutritional status (14.03 ± 6.16 vs. 7.47 ± 3.74; $p = 0.0001$). (Salpiani & Nuraskin, 2025) also reported a significant association between caries severity based on def-t and stunting in coastal Banda Aceh ($p = 0.003$). These findings suggest that the relationship between dental caries and stunting is not limited to the presence or absence of caries, but is also related to the overall cumulative burden and severity of carious lesions.

The severity and clinical stage of caries may also play an important role in this relationship. Rahmadi et al. (2023) demonstrated in rural Tulang Bawang Barat that caries involving the dental pulp was significantly associated with stunting, with an odds ratio of 4.7 (95% CI: 1.7–12.5; $p = 0.02$). Extensive pulp-involving lesions cause greater pain and reported chewing discomfort than early or non-cavitated lesions. Consequently, children with advanced carious breakdown may face a heightened risk of compromised dietary intake and nutritional faltering. However, because the included studies were predominantly cross-sectional and direct objective measurements of masticatory efficiency were rarely performed, these observational findings cannot confirm whether severe caries preceded stunting or occurred as a result of poor nutritional status.

3.2 Potential Biological Mechanisms

3.2.1 Oral Pain and Masticatory Function

One possible pathway linking severe dental caries with nutritional status is through oral pain and impaired masticatory function. Advanced caries, particularly when involving dentin or the dental pulp, may cause pain and discomfort during eating. This condition can make chewing more difficult and may reduce children's willingness to eat certain foods. Several studies included in this review reported findings related to caries severity, oral function, or factors that may affect eating behavior (Rahmadi et al., 2023; Yani et al., 2025). In this

context, masticatory function may represent an important intermediate factor in the relationship between dental caries and nutritional status.

However, evidence regarding masticatory function in the included studies is still limited. Most studies focused on the prevalence or severity of dental caries rather than directly measuring chewing ability. Therefore, the role of masticatory dysfunction should be considered a possible pathway that requires further investigation rather than an established mechanism.

3.2.1 Dietary Intake and Dietary Quality

Changes in dietary intake may also be involved in the relationship between dental caries and nutritional status. Children experiencing dental pain may have difficulty consuming foods that require more chewing and may change their food choices. Dietary factors were frequently identified in the included studies as being associated with dental caries. For example, Abadi & Abral (2020) reported a significant association between cariogenic food consumption and caries experience, while Nurmawi et al. (2024) found that a cariogenic diet was associated with dental caries among toddlers at risk of stunting (OR = 6.4; p = 0.023). Ningsih et al., 2025 also reported an association between the number of carious teeth, caries risk, and stunting.

These findings indicate that dietary patterns may have an important role in the relationship between oral health and nutritional status. However, the available evidence does not directly demonstrate that dietary changes caused by dental pain lead to inadequate nutrient intake or stunting. Dietary intake may also act as a common factor influencing both dental caries and nutritional status. Therefore, this pathway should be interpreted cautiously.

3.3 Potential Bidirectional Relationship Between Dental Caries and Stunting

The findings that the relationship between dental caries and stunting may not be explained by a simple one-way pathway from caries to stunting. Instead, a potential bidirectional relationship may exist, in which poor nutritional status may increase susceptibility to dental caries, while severe dental caries may further affect eating ability and nutritional status. This relationship likely occurs through several biological, behavioral, and environmental pathways (Anang et al., 2025; Yohana et al., 2023). However, this model should be considered as a plausible explanation of the observed association rather than a confirmed causal relationship, particularly because the included studies used a cross-sectional design.

One possible pathway is from stunting or undernutrition to increased susceptibility to dental caries. Poor nutritional status during early childhood may affect normal growth and development, including tooth development and the formation of dental hard tissues (Arsad et al., 2024). Nutritional deficiencies may also be associated with changes in salivary function, including reduced salivary flow and lower salivary pH, which reduces the protective role of saliva against tooth decay (Abadi & Abral, 2020; Sari & Insana, 2024). In addition, chronic nutritional deficits during early life have been linked to enamel hypoplasia and delayed primary tooth eruption, thereby heightening caries susceptibility (Anang et al., 2025; Putri et al., 2023). Yohana et al. (2023) also reported that a history of neonatal stunting combined with enamel hypoplasia was associated with greater caries severity later in childhood. These findings provide a plausible biological mechanism for the higher caries burden observed among stunted children.

The second possible pathway is from severe dental caries to impaired eating ability and poorer nutritional status. Advanced caries, particularly lesions involving the dental pulp, cause persistent odontogenic pain and discomfort during eating. These conditions interfere with children's willingness to chew and lead to shifts in food selection toward softer, less nutrient-dense foods (Ningsih et al., 2025; Rahmadi et al., 2023). Children with a greater caries burden may avoid foods requiring masticatory effort, thereby compromising overall dietary quality and caloric adequacy over time (Ningsih et al., 2025; Nurmawi et al., 2024). Nevertheless, because direct objective measurements of masticatory performance were rarely conducted and most studies relied on reported eating discomfort, the available literature does not provide sufficient longitudinal evidence to confirm this pathway as a direct cause of stunting.

Furthermore, this potential bidirectional relationship is mediated and moderated by shared behavioral, socioeconomic, and environmental factors. Dietary habits, oral hygiene practices, maternal health literacy, household income, and access to dental care concurrently influence both dental caries experience and nutritional status, particularly in underserved rural and coastal communities (Abadi & Abral, 2020; I. A. Badruddin et al., 2025; Zulkifli et al., 2022). Therefore, the association between caries and stunting involves an interconnected web of biological and social determinants rather than a single direct mechanism.

3.4 The Role of Behavioral and Dietary Factors

Behavioral and dietary factors may contribute to the high burden of dental caries observed among children with poor nutritional status. Abadi & Abral (2020) reported associations between cariogenic food consumption, toothbrushing practices, debris index, and caries experience in stunted toddlers. Nurmawi et al. (2024) also found an association between a cariogenic diet and dental caries. Oral hygiene practices were also highlighted in several studies. Wati (2024) reported that poor oral hygiene was strongly associated with dental caries among stunted toddlers (OR = 9.5; $p < 0.001$). More broadly, Putri et al. (2023) found that 70.8% of stunted children aged 1-3 years had poor oral health practices. These findings indicate that inadequate oral hygiene may contribute to persistent plaque accumulation and increased caries risk in this population.

Caregiver-related factors may further influence children's oral health during early childhood. Salsabilla et al. (2025) found significant associations between maternal knowledge, attitudes, and practices regarding oral health and dental caries among stunted toddlers. Similarly, Mardiati et al. (2025) reported associations between maternal knowledge and attitudes, dental caries status, and plaque index. Setiawan et al. (2025) further reported that nutritional status was associated with toothbrushing ability ($p = 0.034$), while toothbrushing ability was significantly correlated with caries burden ($p < 0.001$). This finding suggests that children's ability to perform oral hygiene may be related to both nutritional status and caries experience. These findings suggest that children's oral health is partly shaped by caregiver practices, particularly because young children depend heavily on parents or other caregivers for daily oral hygiene and dietary routines.

3.5 The Role of Biological Factors: Saliva and Dental Development

Biological factors may also contribute to the relationship between nutritional status and dental caries. Sari & Insana (2024) reported a significant association between acidic salivary pH and dental caries among stunted children ($p < 0.001$). Similarly, Abadi & Abral (2020) found that salivary pH was significantly associated with def-t scores ($r = -0.444$; $p = 0.013$). Changes in salivary conditions may reduce the protective function of saliva and create an oral environment that is more favorable for the development of dental caries (Abadi & Abral,

2020; Sari & Insana, 2024). However, because these studies were observational, the exact direction of the relationship between nutritional status, salivary characteristics, and caries cannot be clearly determined.

Nutritional status may also be related to dental development during early childhood. Anang et al. (2025) found a significant association between stunting and delayed primary tooth eruption ($p = 0.003$). In addition, Yohana et al. (2023) reported that children with a history of neonatal stunting and enamel hypoplasia had greater caries severity over time. These findings suggest that nutritional problems during critical periods of growth may be associated with changes in dental development and enamel quality, which may increase susceptibility to dental caries (Anang et al., 2025; Yohana et al., 2023). Overall, these findings provide a possible biological explanation for the higher caries burden observed among children with poor nutritional status.

3.6 Children in Rural and Coastal Indonesia

Several included studies were conducted in rural or remote areas where access to oral healthcare services, socioeconomic conditions, and dietary patterns differ significantly from urban centers. For instance, Ningsih et al. (2025) investigated children in rural subdistricts of Aceh Besar and found that both the number of carious teeth and caries risk levels were significantly associated with stunting. Similarly, Nurmawi et al. (2024) reported a high caries burden linked to cariogenic dietary patterns among toddlers from the indigenous Suku Anak Dalam community in rural Muaro Jambi, while Sari & Insana (2024) observed a significant correlation between acidic salivary pH and caries severity in rural riverine communities of Hulu Sungai Utara.

Equally important are the findings from coastal and fishing settlements, where unique socioeconomic vulnerabilities and dietary exposures prevail. Mardiati et al. (2025) evaluated stunted toddlers in coastal fishing communities of North Jakarta and demonstrated that poor maternal oral health literacy and high plaque indices were strongly correlated with caries severity. In coastal Banda Aceh, Salpiani & Nuraskin (2025) identified a significant association between def-t caries scores and stunting among preschool children ($p = 0.003$), mirroring observations by Budiarti et al. (2024) in coastal Pesawaran, Lampung. These studies collectively confirm that high caries burden and nutritional vulnerabilities coexist in both rural agricultural and coastal maritime environments.

Geographical remoteness directly influences children's access to both preventive and curative dental services. Children living in rural or isolated coastal areas often face severe barriers to routine dental examinations and early restorative care. Limited healthcare accessibility allows untreated carious lesions to progress to advanced stages involving the dental pulp, which frequently results in reported oral pain and chewing discomfort. Simultaneously, restricted geographic access to healthcare facilities hinders early growth monitoring and nutritional counseling. Consequently, geographic accessibility serves as a major shared environmental determinant influencing both oral disease progression and childhood growth faltering.

The local food environment further contributes to these regional health disparities. Dietary practices in rural and coastal communities are heavily conditioned by household income, seasonal food availability, local cultural practices, and increasing access to ultra-processed cariogenic snacks. Although the included literature does not establish a single uniform dietary pattern across all rural and coastal Indonesian children, multiple studies confirm that frequent cariogenic food consumption significantly correlates with caries severity (Abadi &

Abral, 2020; Nurmawi et al., 2024). Overall, while rural and coastal settings present a complex interplay of environmental, behavioral, and healthcare access constraints, these geographic communities are not homogeneous. The available cross-sectional evidence does not allow geographic setting itself to be regarded as a direct causal factor for caries or stunting. Further comparative studies using standardized measures of caries severity, objective masticatory performance, nutrient intake, and healthcare access are warranted to clarify the precise impact of geographic context on pediatric health outcomes.

3.7 The Role of Socioeconomic and Environmental Factors

The relationship between dental caries and stunting may also be affected by socioeconomic and environmental conditions. I. Badruddin et al. (2021) reported that parental education and socioeconomic status were significantly associated with stunting and oral health conditions among children. Similarly, I. A. Badruddin et al. (2025) found that parental income and feeding practices were associated with dental caries among stunted children ($p < 0.05$). Limited household resources may affect the ability of families to provide nutritious foods, maintain appropriate oral hygiene, and obtain preventive or curative dental care. At the same time, families with limited resources may rely more on inexpensive, energy-dense, and cariogenic foods (I. Badruddin et al., 2021; I. A. Badruddin et al., 2025).

At the population level, Zulkifli et al. (2022) also reported an association between socioeconomic and family-related factors, oral health problems, and nutritional status among Indonesian children. These findings suggest that socioeconomic conditions may influence both dental caries and nutritional status through several pathways, including dietary patterns, oral hygiene practices, and access to healthcare services. Therefore, socioeconomic conditions may act as common determinants or confounding factors in the observed relationship between oral health and nutritional status. This also indicates that the relationship between dental caries and stunting should be interpreted within the broader social and environmental context of childhood.

3.8 Limitations of the Current Evidence

Several methodological limitations should be considered when interpreting the findings of this review. First, the majority of the included studies employed a cross-sectional design, which inherently limits the ability to establish temporal sequence and causal inference between dental caries and growth stunting. Although observational associations were consistently reported, these cross-sectional datasets cannot determine whether severe dental caries preceded physical growth faltering or occurred as a physiological consequence of underlying chronic malnutrition (I. Badruddin et al., 2021; Setiawan et al., 2025).

Second, substantial methodological heterogeneity existed across the primary studies in terms of caries assessment criteria, anthropometric cutoff values, and sampling frameworks. Dental caries was evaluated using varying clinical indicators, including def-t, dmft, dmfs, and ICDAS criteria, which differ in their sensitivity to early non-cavitated lesions (Andriyani et al., 2023; Rahmadi et al., 2023). Furthermore, several studies specifically recruited pre-diagnosed stunted cohorts rather than representative population-based samples (Abadi & Abral, 2020; Salsabilla et al., 2025), which may constrain the external validity and generalizability of their findings to broader pediatric populations.

Third, empirical evidence directly evaluating the underlying biological mechanisms remains scarce. In particular, objective measurements of masticatory performance or chewing

efficiency were rarely conducted. Most primary studies relied on visual caries indices, oral hygiene scores, or self-reported eating discomfort rather than quantitative clinical tests of oral function (Ningsih et al., 2025; Nurmawi et al., 2024). Consequently, the precise extent to which impaired masticatory performance serves as a functional intermediate between severe pulp-involved caries and nutrient intake faltering remains unquantified.

Finally, while this review focused on rural and coastal populations in Indonesia, geographic context was insufficiently controlled or compared across the included primary literature. Although individual studies investigated specific rural subdistricts or coastal fishing settlements (Mardiati et al., 2025), few studies performed direct comparative analyses between rural, coastal, and urban cohorts using standardized methodology. This limits the ability to isolate geographic location itself from broader confounding variables such as socioeconomic status, household food insecurity, and local healthcare access.

3.9 Implications for Public Health Practice

The findings support the consideration of oral health within existing child health and nutrition services in Indonesia. In primary healthcare settings, assessment of dental caries and basic oral health practices could complement routine monitoring of children's nutritional status, particularly among children with a higher risk of growth problems. This approach may facilitate earlier identification of oral health problems that require preventive or curative care (Mardiati et al., 2025; Wati, 2024).

Health education for parents and caregivers can also address oral health alongside nutrition. Key messages may include regular toothbrushing with fluoride toothpaste, reducing frequent consumption of cariogenic foods and drinks, and recognizing dental pain or difficulty in eating (Salsabilla et al., 2025; Wati, 2024). Integration with existing maternal and child health activities at Puskesmas and Posyandu may be particularly useful in areas where access to dental services is limited (I. A. Badruddin et al., 2025; Zulkifli et al., 2022).

However, these findings should not be interpreted as evidence that dental caries is a direct cause of stunting or that dental treatment alone can prevent growth problems. Oral health should instead be considered as one component of the broader factors affecting child nutritional health.

3.10 Research Gaps and Future Research Directions

Future research should address the temporal relationship between dental caries and nutritional status through prospective longitudinal studies, particularly from pregnancy and the first 1,000 days of life through early childhood. Such designs could help distinguish whether poor nutritional status increases susceptibility to dental caries, whether severe caries contributes to nutritional problems, or whether both pathways occur.

More studies should also directly examine potential intermediate pathways. Objective, age-appropriate measures of masticatory function could clarify whether impaired chewing contributes to changes in food intake. Detailed dietary assessment, such as repeated 24-hour dietary recalls, could further determine whether caries-related changes in food consumption are associated with inadequate energy or nutrient intake.

In addition, future epidemiological studies should use standardized measures of dental caries and nutritional status and apply multivariable analysis to account for factors that may influence both outcomes, including socioeconomic status, parental education, dietary

patterns, oral hygiene practices, and access to healthcare services (I. Badruddin et al., 2021; Zulkifli et al., 2022). Research should also include children from diverse geographical and socioeconomic settings to improve the generalizability of the evidence.

Finally, community-based intervention studies are needed to evaluate whether comprehensive oral health interventions, including prevention and treatment of dental caries, can improve oral function, dietary intake, and nutritional outcomes. Evidence from such studies would help determine the potential contribution of oral health interventions to broader child health and nutrition programs.

IV. CONCLUSION

This systematic review demonstrates a consistent observational association between early childhood caries and growth stunting among young children aged 0-6 years, particularly within rural and coastal communities in Indonesia. Severe carious breakdown may impair eating ability and nutrient intake, suggesting that masticatory dysfunction represents a plausible biological pathway; however, direct objective measurements of chewing performance remain scarce in the primary literature. The observed association is further moderated by complex biological mechanisms (including salivary pH and enamel hypoplasia), maternal health behaviors, cariogenic dietary patterns, and broad socioeconomic disparities. Crucially, because the available evidence is predominantly cross-sectional, a definitive causal or bi-directional relationship cannot be confirmed. Future prospective longitudinal studies, objective assessments of masticatory performance, and community-based intervention trials are essential to clarify the temporal direction of this relationship and to evaluate the effectiveness of integrating early oral health screening into national pediatric nutrition programs in underserved rural and coastal regions.

ACKNOWLEDGEMENT

The authors would like to thank all individuals and institutions who contributed to the preparation of this systematic review.

REFERENCES

Abadi, M. T., & Abral, A. (2020). Pathogenesis of Dental Caries in Stunting. *Jurnal Kesehatan Gigi*, *7*(1), 1–4.

Achmad, H., Handayani, H., Singgih, M. F., Horax, S., Ramadhany, S., Setiawati, F., & Ramadhany, Y. F. (2020). Analysis of Dental Caries & Gingivitis with the Occurrence of Stunting in Children in Makassar City (Tamalanrea Subdistrict). *Systematic Review Pharmacy*, *11*(4), 371–376. https://doi.org/10.31838/srp.2020.4.55

Anang, Triyanto, R., & Suharja, E. (2025). Status gizi kurang (stunting) dengan erupsi dan kejadian karies gigi pada balita usia 24-60 bulan. *Journal of Dental Hygiene and Therapy*, *6*(1), 25–28. https://doi.org/10.36082/jdht.v6i1.2081

Andriyani, D., Arianto, & Chandra, R. (2023). Status gizi pendek (stunting) dengan karies gigi pada anak prasekolah di Kelurahan Sukabumi Indah Kota Bandar Lampung. *Journal of Dental Hygiene and Therapy*, *4*(1), 8–12. https://doi.org/10.36082/jdht.v4i1.903

Arsad, A., Tahir, M., Hidayah, A., & Fadli, F. (2024). Analysis of relationship between caries index and stunting in preschool children in Indonesia. *Multidisciplinary Science Journal*, *6*(e2024148), 1–4. https://doi.org/https://doi.org/10.31893/multiscience.2024148 Analysis

Aulia, R., Indriyanti, R., & Setiawan, A. (2023). The bi-directional relationship between growth stunting and early childhood caries : a rapid review. *Front. Public Health*,

11(December 2023). https://doi.org/10.3389/fpubh.2023.1234893

Badruddin, I. A., Andarini, L., Adiatman, M., & Bahar, A. (2025). Hubungan Stunting dan Kejadian Karies Gigi pada Anak Stunting di. *Jurnal Ilmiah dan Teknologi*, *21*(2), 116–125. https://doi.org/https://doi.org/10.32509/jitekgi.v21i2.5868

Badruddin, I., Khairissa, M., Darwita, R., Setiawati, F., Adiatman, M., Maharani, D., & Rahardjo, A. (2021). Relationship beetween oral health status and stunting in 5-year-old children in Indonesia. *Journal of International Dental and Medical Research*, *14*(3), 1039.

Berat, P., Andrade, V., Regnault, N., Tenenbaum, A., & Levy, S. (2025). Oral Health Conditions of Preschool Children Among Birth Cohort Studies : A Scoping Review. *Oral Health and Preventive Dentistry*, *23*, 315–328. https://doi.org/10.3290/j.ohpd.c

Budiarti, I., Andriyani, D., & Murwaningsih, S. (2024). Hubungan tingkat karies gigi pada anak pra sekolah terhadap stunting di Kecamatan Gedong Tataan Kabupaten Pesawaran. *PREPOTIF: Jurnal Kesehatan Masyarakat*, *8*(1), 810–815. https://doi.org/https://doi.org/10.31004/prepotif.v8i1.26265

Folayan, M. O., Tantawi, M. El, Schroth, R. J., Vukovic, A., Kemoli, A., Gaffar, B., Obiyan, M., Childhood, E., & Advocacy, C. (2020). Associations between early childhood caries , malnutrition and anemia : a global perspective. *BMC Nutrition*, *6*(16), 1–8. https://doi.org/https://doi.org/10.1186/s40795-020-00340-z

Huang, T., Liang, J., Li, C., & Wang, Z. (2025). Effects of dental treatment under general anesthesia on the oral health quality of life and dental fear of preschool children : a systematic review and meta-analysis. *BMC Oral Health*, *25*(774). https://doi.org/https://doi.org/10.1186/s12903-025-06168-y

Kemenkes RI. (2023). *Survei Kesehatan Indonesia (SKI)*.

Kementrian Kesehatan. (2018). Kesehatan Gigi dan Mulut di Indonesia. *Kemenkes*, 2–3.

Mardiati, E., Pribawanti, D., Wiradona, I., & Sulistiani, S. (2025). Stunting dan kesehatan gigi anak: analisis pengaruh pengetahuan dan sikap ibu terhadap karies dan plak indeks. *Journal of Dental Hygiene and Therapy*, *6*(1), 7–12. https://doi.org/10.36082/jdht.v6i1.1967

Mulsin, J. I., Setiawan, A. S., Suzy, A., & Pertiwi, P. (2024). Differences In Prevalence Of Early Childhood Caries (Ecc) In Stunted And Non-Stunted Children In Bandung. *Odonto: Dental Journal*, *11*(2), 251–258. https://doi.org/http://dx.doi.org/10.30659/odj.11.2.251-258

Ningsih, D. S., Safuni, N., & Annisa, R. (2025). The relationship between dental caries and stunting among children in a rural Indonesian Subdistrict : Evidence from Krueng Barona Jaya , Aceh Besar Hubungan antara karies gigi dan stunting pada anak di wilayah pedesaan Indonesia : Studi kasus di Kecamata. *Aceh Nutrition Journal*, *10*(3), 743–749. https://doi.org/http://dx.doi.org/10.30867/action.v10i3.2395 Pages:

Nurmawi, Y., Surayah, & Primalasari. (2024). Incidents of dental caries in SAD toddlers at risk of stunting in Muaro Jambi. *Riset Informasi Kesehatan*, *13*(2), 189–194. https://doi.org/10.30644/rik.v13i2.888

Putri, T. N., Indriyanti, R., & Setiawan, A. S. (2023). A descriptive study on oral hygiene practice and caries increment in children with growth stunting. *Frontiers in Oral Health*, *4*(November), 1–7. https://doi.org/10.3389/froh.2023.1236228

Rahmadi, A., Dyah, R., Elina, L., & Musyabiq, S. (2023). Karies Mencapai Pulpa Merupakan Faktor Risiko Stunting Pada Anak Prasekolah di Daerah Lokus. *Journal of Oral Health Care*, *11*(2), 101–109. https://doi.org/10.29238/ohc.v11i2.2045

Salpiani, & Nuraskin, C. (2025). Hubungan Status Karies Gigi Dengan Kejadian Stunting Di Paud Al-Jannati Gampong Jawa Kecamatan Kuta Raja Kota Banda Aceh The Relationship Of Dental Caries Status And Stunting Incidents In Paud Al-Jannati Gampong Jawa , Kuta Raja District , Banda Aceh City. *Jurnal Kesehatan Ilmiah*, *19*(1), 57–62. https://doi.org/https://doi.org/10.30867/nasuwakes.v18i1.673

Salsabilla, A., Hidayah, R. A., Oktadewi, F. D., Taqwim, A., & Widodo, A. H. B. (2025). Hubungan Perilaku Ibu dalam Kesehatan Gigi dan Mulut dengan Kejadian Karies pada Anak Stunting Usia 30-59 Bulan di Kecamatan Cilongok , Banyumas district , Banyumas. *Journal of Dental and Biosciences*, *02*(02), 9–17. https://doi.org/10.20884/1.jdentbios.2025.2.02.12612

Sari, E., & Insana, A. (2024). Hubungan pH saliva dengan karies gigi pada anak stunting di Kecamatan Sungai Pandan Kabupaten Hulu Sungai Utara Provinsi Kalimantan Tengah. *An-Nadaa: Jurnal Kesehatan Masyarakat*, *11*(2), 110–113. https://doi.org/http://dx.doi.org/ 10.31602/ann.v11i2.16273

Setiawan, A. S., Atmadja, I. T., Andisetyanto, P., Indriyanti, R., & Suryanti, N. (2025). Toothbrushing ability , caries burden , and oral health – related quality of life among stunted preschool children in Bandung-Indonesia. *BMC Oral Health*, *25*(1958), 1–11. https://doi.org/https://doi.org/10.1186/s12903-025-07307-1

Setiawan, A. S., Indriyanti, R., & Suryanti, N. (2022). Neonatal stunting and early childhood caries : A mini-review. *Frontiers in Pediatrics*, *10*(4). https://doi.org/10.3389/fped.2022.871862

Wati, D. F. (2024). Determinan yang mempengaruhi kejadian karies gigi pada anak balita stunting di wilayah kerja puskesmas Kecamatan Ciracas Jakarta Timur. *Jurnal Ilmiah Kesehatan BPI*, *8*(1), 1–16. https://doi.org/https://doi.org/10.58813/stikesbpi.v8i1.191

Yani, R., Handayani, A., Hadnyanawati, H., Kiswaluyo, Dwiatmoko, S., & Misrohmasari, E. (2025). The comparison of dental caries severity on stunting and non-stunting toddlers in Kalisat, Jember, Indonesia. *Acta Medica Philippina*, *59*(7), 92–96. https://doi.org/https://doi.org/10.47895/amp.vi0.4444

Yohana, S., Indriyanti, R., Setiawan, A. S., & Suryanti, N. (2023). Caries Experience among Children with History of Neonatal Stunting. *European Journal of Dentistry*, *17*(3), 687–692. https://doi.org/https://doi.org/ 10.1055/s-0042-1750775

Zulkifli, N., Rahardjo, A., Darwita, R., & Adiatman, M. (2022). Self-reported oral health problems and risk factors associated with 3-6 year old children nutritional status in Indonesia. *Journal od International Dental and Medical Research*, *15*(1), 190–198.