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Association between Malnutrition and Tooth Eruption in Children: A Systematic Review

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ABSTRACT

Background: Tooth eruption is an important aspect of child development that may be influenced by nutritional status. Undernutrition can impair growth and development, potentially affecting the timing and process of tooth eruption. However, findings regarding the association between undernutrition and tooth eruption remain inconsistent. ***Objective:*** To analyze the association between malnutrition and tooth eruption in children. ***Methods:*** This systematic review was conducted in accordance with the PRISMA 2020 guidelines. Literature searches were performed in PubMed/MEDLINE, Scopus, ScienceDirect, Cochrane, and Consensus. Observational studies involving children that assessed malnutrition and its association with the eruption of primary and/or permanent teeth were included. Methodological quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools according to each study design. ***Results:*** A total of seven studies met the inclusion criteria. Overall, several studies indicated that malnutrition, particularly stunting, was associated with delayed tooth eruption in children. ***Conclusion:*** Malnutrition, particularly undernutrition, may be associated with delayed tooth eruption in children.

Keywords: malnutrition; nutritional status; delayed tooth eruption; good health and well-being; systematic review

INTRODUCTION

Malnutrition refers to deficiencies or excesses in nutrient intake, imbalances in essential nutrients, or impaired nutrient utilization by the body. It is broadly classified into three major groups: undernutrition, micronutrient-related malnutrition, and overnutrition [1]. In Indonesia, stunting is one of the most prevalent forms of malnutrition. It is a chronic condition in children characterized by a height that is lower than that of children of the same age. The Indonesian Ministry of Health reported a national stunting prevalence of 19.8% in 2024. Although this figure decreased from 2023, addressing stunting remains a substantial challenge [2]. The consequences of stunting extend beyond impaired linear growth and may affect the health of other tissues.

Clinical manifestations of stunting commonly involve motor and mental development. In addition, stunting may increase the risk of dental caries because reduced salivary flow can impair the protective buffering function of saliva in the oral cavity [3]. The age at which teeth erupt is also significantly related to a child's age and development. Estimating tooth eruption in children is important for treatment planning, disease diagnosis, prevention, and subsequent therapeutic decisions. However, this process may be affected by stunting, as nutritional deficiencies can interfere with tooth growth and development [4].

Several studies have evaluated the association between children's nutritional status and tooth eruption, but their findings remain variable. Some studies have reported delayed tooth eruption in malnourished children compared with children with normal nutritional status, whereas others have found no significant association across the age groups and tooth types examined. Differences in study populations, measurement methods, and approaches to assessing eruption timing may contribute to these inconsistent findings. Therefore, a systematic evaluation of the available evidence is needed to provide a clearer understanding of the association between malnutrition and tooth eruption in children.

METHODS

Study design

This study was a systematic review designed to identify, evaluate, and synthesize scientific evidence regarding the association between malnutrition and tooth eruption in children. Relevant primary observational studies were considered, and study selection was based on predefined inclusion and exclusion criteria. The research question was: "Among children, what is the association between malnutrition and tooth eruption?" The question was structured using the Population, Exposure, Comparison, and Outcome (PECO) framework: Population, children, including infants, toddlers, preschool-aged children, and school-aged children; Exposure, malnutrition or poor nutritional status, including stunting, underweight, low body mass index (BMI), growth retardation, and nutritional deficiencies; Comparison, healthy children with good nutritional status; and Outcome, tooth eruption, including delayed eruption, eruption status, eruption timing, and the number of erupted teeth.

Eligibility criteria

- *Inclusion criteria*

Studies were eligible if they involved children or a pediatric population and evaluated malnutrition or undernutrition as an exposure. Malnutrition could include stunting, wasting, being underweight, or protein-energy malnutrition. Studies were required to assess tooth eruption as an outcome in either primary or permanent dentition, including eruption timing, delayed tooth eruption, eruption sequence, the number of erupted teeth, or deviations from normal developmental eruption standards. Studies had to allow an assessment of the association between nutritional status or malnutrition and tooth eruption, either through comparisons between malnourished and normally nourished children or through other association analyses. Eligible designs included cross-sectional, cohort, case-control, and other relevant primary observational studies. Studies had to be conducted in humans and provide data that could be extracted in relation to the research question.

- *Exclusion criteria*

Studies involving adults or populations whose pediatric data could not be separated were excluded. Animal, in vitro, and in silico studies were also excluded because they do not directly evaluate the association between malnutrition and tooth eruption in children. Studies that did not assess malnutrition or undernutrition as an exposure, or did not report tooth eruption as an outcome, were excluded. Studies addressing only dental caries, enamel hypoplasia, dentin defects, craniofacial growth, maxillary development, or alveolar bone without reporting tooth eruption data were not included. Studies that mentioned malnutrition only as a sample characteristic without evaluating its association with tooth eruption were excluded. Studies focusing exclusively on overweight or obesity without an undernutrition component were also excluded. Case reports, case series, editorials, letters, commentaries, opinion articles, conference abstracts without sufficient data, narrative reviews, systematic reviews, scoping reviews, and meta-analyses were excluded from the main synthesis because they were not primary studies suitable for the review. Duplicate articles and articles without extractable data for assessing the association between malnutrition and tooth eruption were also excluded.

Information sources and search strategy

The literature search was conducted in PubMed, Scopus, ScienceDirect, Cochrane, and Consensus, and was supplemented by screening the reference lists of relevant studies. The search strategy was developed from the PECO components using relevant synonyms and subject terms. Concepts were combined using the Boolean operators OR and AND. The final search strategy used Medical Subject Headings (MeSH) terms and related terms for children, malnutrition, and tooth eruption, structured as follows: (Child OR Adolescent OR Pediatric) AND (Malnutrition OR Protein-Energy Malnutrition OR Nutritional Deficiencies OR Nutritional Status) AND (Nutritional Status OR Healthy People) AND (Tooth Eruption OR Tooth Deciduous).

Study selection

Study selection was conducted in stages according to the predefined inclusion and exclusion criteria. All records retrieved from the databases were compiled and screened for duplicates, which were removed. The remaining records were screened by title and abstract to identify studies potentially relevant to the research question. At this stage, articles were assessed against the predefined PECO criteria: pediatric population, malnutrition, and tooth eruption. Potentially relevant articles proceeded to full-text assessment to determine eligibility. Full texts were evaluated for the involvement of a pediatric population, assessment of malnutrition as an exposure, and assessment of tooth eruption in primary and/or permanent teeth as an outcome. Articles that did not meet the inclusion criteria or met any exclusion criterion were excluded. The number of records at each stage, identification, screening, eligibility assessment, and final inclusion, was recorded and reported using a PRISMA 2020 flow diagram.

Data extraction

Data from all studies meeting the eligibility criteria were systematically extracted using a standardized data extraction form developed according to the research question and PECO framework. The form was designed to ensure consistent collection of relevant information from all included studies. Extracted data included study characteristics, population characteristics, exposure, outcome measurements, and study findings. Study characteristics included the first author's name, publication year, country or study location, study design, and study period when available. Population characteristics included sample size, age or age range, sex, and other relevant population characteristics.

Exposure-related data included the type of undernutrition, such as stunting, wasting, underweight, or protein-energy malnutrition, as well as the definitions and criteria used to determine nutritional status, assessment methods, anthropometric indicators, and reference standards. The number of participants in each nutritional-status category was also recorded when reported. Outcome-related data included the timing or age of tooth eruption, delayed tooth eruption, eruption sequence, the number of erupted teeth, and deviations from the expected eruption pattern. The type of dentition assessed (primary and/or permanent), specific teeth evaluated, methods used to assess tooth eruption, and reference standards were also recorded when available.

Data on the association between undernutrition and tooth eruption included comparison groups, participant numbers, effect measures, effect estimates, 95% confidence intervals (CIs), and p-values. Effect measures could include odds ratios (ORs), risk ratios (RRs), prevalence ratios (PRs), mean differences (MDs), or other measures reported by each study. Adjusted effect estimates and confounding variables included in multivariable analyses were extracted when available. Additional information, including potential confounders, funding sources, conflicts of interest, and study limitations, was recorded to support interpretation and critical appraisal. Data were extracted from full-text articles. Information that was not reported or could not be determined was recorded as "not reported" or "unclear" and was not assumed. Study authors could be contacted for clarification if necessary. The extraction form was piloted on several included studies before the main extraction process to ensure that variables could be interpreted and recorded consistently. Extracted data were recorded electronically and used to prepare the study characteristics table and support data synthesis.

Risk of bias

The risk of bias of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools appropriate to each study design. The JBI Critical Appraisal Tool for Analytical Cross-sectional Studies was used for six cross-sectional studies, whereas the JBI Critical Appraisal Checklist for Case Control Studies was used for one case-control study. Each study was assessed across relevant domains, including subject selection, exposure and outcome measurement, confounding factors, statistical analysis, and completeness of reporting. Each item was rated as "Yes," "No," "Unclear," or "Not applicable," with justification provided for each assessment.

RESULTS

The searches of PubMed, Scopus, ScienceDirect, Cochrane, and Consensus were conducted on August 29, 2026. A total of 52 studies were identified, of which 26 were excluded during the initial screening. The full texts of the remaining 26 records were sought and assessed for eligibility. Following full-text assessment, 19 studies were excluded for the following reasons: absence of a pediatric population (6 records), lack of relevance to malnutrition (7 records), absence of the tooth eruption outcome (5 studies), and non-primary study design (1 record). Ultimately, seven studies were included in this systematic review (Figure 1).

Study characteristics

Seven studies published between 2021 and 2025 were included and are presented in Table 1. The studies involved children aged 24 months to 12 years from Brazil, Indonesia, Iraq, and Bulgaria, with sample sizes ranging from 42 to 709 participants. Nutritional status was assessed using various indicators, including body mass index (BMI), height-for-age, stunting status, and phosphorus intake. Tooth eruption was evaluated in different types of primary and permanent teeth. Overall, five studies indicated an association between poorer nutritional status and delayed tooth eruption, whereas two studies did not show a statistically significant association.

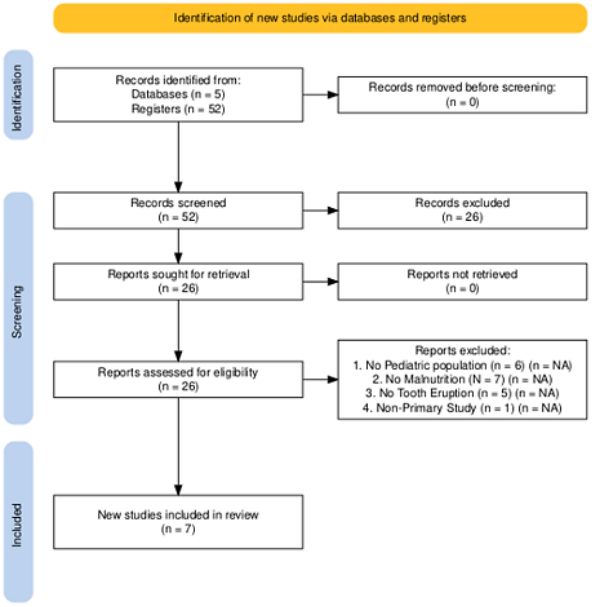


FIGURE 1: PRISMA 2020 flow diagram: 52 records identified; 26 excluded during initial screening; 26 full-text reports assessed; 19 excluded (6 without a pediatric population, 7 not relevant to malnutrition, 5 without a tooth-eruption outcome, and 1 non-primary study); 7 studies included.

TABLE 1: Characteristics and main findings of the included studies.

Study	Population	Nutritional exposure	Outcome	Main findings	Interpretation
Reis et al., 2021	353 Brazilian children 8–11 years	BMI z-score	Delayed permanent tooth eruption	Underweight; adjusted OR 4.21 (95% CI 1.42–12.43); p=0.009	Supports an association
Fadilla et al., 2022	42 stunted children, 6–7 years	Height-for-age	Permanent first molar eruption	No significant correlation (r=0.185; p=0.242)	Not significant
Mahata et al., 2024	68 children, 6–7 years; 34 stunted and 34 normal	Height-for-age	Permanent mandibular central incisor	Not erupted in 64.7% of stunted children vs 17.6% of normal children	Supports delayed eruption
Khalaf et al., 2024	330 Iraqi children 6–9 years	BMI/WHO nutritional status	Permanent first molar	Weak positive correlation; underweight children showed slower eruption	Supports an association
Wulandari et al., 2024	50 children, 10–12 years	Phosphorus intake	Permanent canine eruption	Median phosphorus intake: 597.30 mg in normal eruption group vs 440.00 mg in delayed eruption group (p<0.001)	Supports an association
Anang et al., 2025	50 stunted toddlers, 24–60 months	Height/stunting	Tooth eruption	Significant association between height and tooth eruption (p=0.003)	Supports an association
Kirilov et al., 2025	709 Bulgarian children, 5–12 years	BMI categories	Number of erupted permanent teeth	Overall association was not significant (p=0.093)	Inconsistent evidence

Risk of bias

The risk of bias of the included studies was assessed using the JBI Critical Appraisal Tools. Because the included studies had different observational designs, risk-of-bias assessments were divided into two categories. The assessments for cross-sectional studies are presented in Table 2, while the case-control study assessment is presented in Table 3. Using JBI instruments appropriate to each study design enabled methodological quality and potential sources of bias to be evaluated according to the characteristics of each design.

TABLE 2: Risk of bias assessment of cross-sectional studies.

JBI item	Reis 2021	Fadilla 2022	Khalaf 2024	Wulandari 2024	Anang 2025	Kirilov 2025
Inclusion criteria clearly defined	Yes	Yes	Unclear	Yes	Unclear	Unclear
Subjects and settings described in detail	Yes	Yes	Yes	Yes	Yes	Yes
Exposure measured in a valid and reliable way	Yes	Yes	Yes	Yes	Yes	Yes
Objective/standard criteria used for condition measurement	Yes	Yes	Yes	Yes	Yes	Yes
Confounding factors identified	Yes	No	No	Yes	No	Yes
Strategies to deal with confounding stated	Yes	No	No	No	No	No
Outcomes measured in a valid and reliable way	Yes	Yes	Yes	Yes	Unclear	Yes
Appropriate statistical analysis	Yes	Yes	Yes	Yes	Yes	Yes
Total Yes	8/8	6/8	5/8	6/8	4/8	6/8
Overall judgement	Low	Moderate	Moderate	Moderate	Moderate–High	Moderate

TABLE 3: Risk of bias assessment of the case-control study.

JBI case-control item	Mahata et al., 2024
Groups comparable other than exposure/condition?	Yes
Cases and controls matched appropriately?	Yes
Same criteria used for identification of cases and controls?	Yes
Same criteria used for identification of cases and controls?	Yes
Exposure measured in a standard, valid, and reliable way?	Yes
Exposure measured in the same way for cases and controls?	Yes
Confounding factors identified?	No
Strategies to deal with confounding stated?	No
Outcomes assessed in a standard, valid, and reliable way?	Yes
Exposure period long enough to be meaningful?	Unclear
Appropriate statistical analysis?	Yes
Total Yes	7/10
Overall judgement	Moderate

Synthesis of findings

• *Underweight and delayed tooth eruption*

Reis et al. (2021) provided the strongest quantitative evidence among the included studies. Of 353 children aged 8–11 years, 16 were classified as underweight. Underweight was associated with delayed permanent tooth eruption in the bivariate analysis (OR 3.5; 95% CI 1.3–9.8; p=0.014) and remained a risk factor after adjustment for age and sex (OR 4.21; 95% CI 1.42–12.43; p=0.009).

• *Stunting and permanent tooth eruption*

Mahata et al. (2024) included 68 children aged 6–7 years, comprising 34 stunted children and 34 children with normal nutritional status. A total of 22 stunted children (64.7%) had not yet experienced eruption of the permanent mandibular central incisors, compared with only six children (17.6%) in the normal group. In contrast, Fadilla et al. (2022) reported no significant association between nutritional status and permanent first molar eruption among stunted children aged 6–7 years (r=0.185; p=0.242).

• *BMI status and permanent first molar eruption*

Khalaf et al. (2024) studied 330 children aged 6–9 years in Iraq. Nutritional status was assessed using height, weight, and BMI based on the WHO 2007 guidelines. The study found a weak positive correlation between eruption stage and nutritional status (p=0.002), while underweight children showed slower eruption of the first molars. An association was also reported between height-for-age z-score and eruption stage (r=0.4; p<0.001).

• *BMI status in Bulgarian children*

Kirilov et al. (2025) studied 709 children aged 5–12 years in Bulgaria. The children were classified as underweight, normal weight, overweight, or obese according to the IOTF cut-offs. The study reported that the highest percentage of unerupted teeth occurred in the underweight category. However, the overall association between BMI category and eruption was not statistically significant. These findings suggest a pattern indicating delayed eruption among underweight children, although the overall statistical evidence was not strong.

• *Stunting and tooth eruption in toddlers*

Anang et al. (2025) studied 50 children aged 24–60 months, all of whom were stunted. The analysis showed an association between height and tooth eruption (p=0.003). The authors concluded that malnutrition status (stunting) was associated with tooth eruption and dental caries in toddlers. Because all participants were stunted, these findings are more appropriately interpreted as an association between variation in height and tooth eruption within a stunted group, rather than as a direct comparison between stunted and normally nourished children.

Phosphorus intake and permanent canine eruption

Wulandari et al. (2024) studied 50 children aged 10–12 years according to the eruption status of their permanent canines. Median phosphorus intake was 597.30 mg in the normal eruption group and 440.00 mg in the delayed eruption group; the difference was statistically significant (p<0.001). This finding extends the concept of malnutrition beyond anthropometric indicators to include deficiencies in specific nutrients.

DISCUSSION

Summary of findings

Overall, the seven relevant studies indicate a tendency for poorer nutritional status to be associated with tooth eruption, although the strength of the association varied between studies. The strongest evidence came from Reis et al. (2021), while other studies, Mahata et al. (2024), Khalaf et al. (2024), Anang et al. (2025), and Wulandari et al. (2024), reported significant associations for particular outcomes. Inconsistency was particularly evident in Fadilla et al. (2022) and Kirilov et al. (2025). These differences may be related to variations in age, tooth type, definitions of nutritional status, sample size, study design, and other factors. Fadilla et al. (2022) specifically noted that genetic

factors, prematurity, socioeconomic conditions, hormonal factors, and systemic disorders were not measured in their study.

Nutritional exposures should also be distinguished. Stunting reflects chronic growth impairment, BMI describes body-size status, whereas phosphorus intake represents an indicator of a specific nutrient. These indicators should not be considered equivalent in a quantitative synthesis. Age and tooth type are important sources of heterogeneity. Mahata et al. (2024) assessed mandibular central incisors in children aged 6–7 years; Fadilla et al. (2022) assessed permanent first molars at the same age; Khalaf et al. (2024) assessed first molars in children aged 6–9 years; and Wulandari et al. (2024) assessed permanent canines in children aged 10–12 years. Because tooth eruption is strongly age-dependent, future studies should use eruption standards specific to age and tooth type.

Biologically, an association between nutrition and tooth eruption is plausible because tooth and bone development require adequate energy, protein, minerals, and vitamins. Mahata et al. (2024) linked stunting to impaired periodontal bone growth, while Wulandari et al. (2024) described the importance of phosphorus in bone and tooth mineralization. These findings support the importance of nutritional status for dental growth and development.

Clinical implications

Delayed tooth eruption may be one of the signs that warrants attention in children with malnutrition. In pediatric dentistry, assessment of delayed eruption should not focus solely on local factors but should also consider the child's growth and nutritional history. Reis et al. (2021) emphasized that eruption disturbances may be related to occlusal development, preventive interventions, and orthodontic treatment. However, dentists cannot diagnose malnutrition in a child solely on the basis of delayed tooth eruption. Other factors, including genetic, endocrine, systemic, and local conditions, as well as age, sex, and socioeconomic status, must also be considered.

Strengths and limitations of the systematic review

Based on data extraction and critical appraisal of the studies meeting the inclusion criteria, this systematic review has several methodological strengths and limitations. One strength is that the included studies evaluated nutritional status in children and measured tooth eruption as an outcome, making them relevant to the research question. Several studies also used structured indicators and criteria for nutritional status, allowing more systematic classification. In addition, studies comparing groups of children with different nutritional statuses provide relevant information for evaluating a possible association between malnutrition and tooth eruption.

Nevertheless, several limitations should be considered when interpreting the findings. Differences in population characteristics, age ranges, definitions and classifications of malnutrition, nutritional assessment methods, and parameters and methods used to assess tooth eruption may have resulted in heterogeneity between studies. These differences may affect comparability and limit the possibility of direct quantitative synthesis. Furthermore, when most studies use a cross-sectional design, the temporal relationship between malnutrition and the timing of tooth eruption cannot be established with certainty.

Another limitation concerns confounding factors that may influence the association. Factors such as age, sex, health conditions, socioeconomic status, dietary patterns, and other variables reported in individual studies should be considered when interpreting the results. If these factors are not controlled, the association between malnutrition and tooth eruption may be affected by confounding. Differences in statistical analysis methods and reporting of measures of association may also limit direct comparisons between studies.

CONCLUSION AND RECOMMENDATIONS

Underweight and stunting were associated with an increased risk of delayed permanent tooth eruption in several studies. In addition to anthropometric status, lower phosphorus intake was also associated with delayed tooth eruption. Overall, the findings indicate an association between poorer nutritional status and delayed tooth eruption in children. Further primary studies using more consistent methods and definitions are needed to strengthen the evidence regarding the association between nutritional status and tooth eruption.

REFERENCES

[1] World Health Organization. Malnutrition [Internet]. 2024 [cited 2026 May 11]. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition.

[2] Ministry of Health of the Republic of Indonesia. Mengenal Stunting [Internet]. 2025 [cited 2026 May 6]. Available from: https://keslan.kemkes.go.id/view_artikel/3959/mengenal-stunting.

[3] Sadida ZJ, Indriyanti R, Setiawan AS. Does growth stunting correlate with oral health in children?: A systematic review. Eur J Dent. 2022;16(1):32–40.

[4] Setiawan AS, Abhista N, Andisetyanto P, Indriyanti R, Suryanti N. Growth stunting implication in children: A review on primary tooth eruption. Eur J Gen Dent. 2022;11(1):7–16.

[5] Reis CLB, Barbosa MCF, Henklein S, Madalena IR, de Lima DC, Oliveira MAHM, et al. Nutritional status is associated with permanent tooth eruption in a group of Brazilian school children. Glob Pediatr Health. 2021;8.

[6] Mahata IBE, Utami SP, Trisa A. Description of eruption of permanent lower central incisors in stunted children at Koto Balingka West Pasaman Elementary School. J Dentomaxillofac Sci. 2024; 9(1):37–41.

[6] Fadilla ND, Wardani R, Putri FM. Correlation between stunting in children aged 6–7 years in terms of nutritional status and the eruption of permanent first molar. Padjadjaran J Dent. 2022;34(2):140.

[7] Khalaf MS, Abdul-Wadood MO, Khammas AM. Eruption of first permanent molar among a group of Iraqi children in relation to nutritional status. Scr Medica (Banja Luka). 2024;55(2) :165–71.

[8] Kirilov B, Ivanova-Pandourska I, Zhecheva Y. Nutritional status and permanent tooth eruption in Bulgarian children aged 5–12 years. Comptes Rendus L'Academie Bulg des Sci. 2025;78(11):1739–46.

[9] Anang A, Triyanto R, Suharja ES. Malnutrition status (stunting) with eruptions and incidence of dental caries in toddlers aged 24–60 months. JDHT J Dent Hyg Ther. 2025;6(1):25–8.

[10] Wulandari RW, Kasuma N, Syafitri FU, Effendi MDS, Wirza TR. Nutritional deficiency and dental health: The role of phosphorus in permanent [teeth]. Open Access Indones J Med Rev. 2024:834–47.