

SYSTEMATIC REVIEW

Primary tooth eruption in preterm low birth weight children

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ABSTRACT

Primary teeth play a vital role as masticatory organs that support the digestive process in children. Preterm low birth weight (PTLBW) is a significant public health concern in many countries and may adversely affect children's overall health. Understanding the patterns and timing of primary tooth eruption in PTLBW children is important, as it can provide valuable insights for clinical management, including the monitoring of dental development and the implementation of early interventions. This study presents a comprehensive scoping review of the literature on PTLBW and primary tooth eruption. The review followed the framework proposed by Arksey and O'Malley and was further refined using the Joanna Briggs Institute (JBI) methodology for scoping reviews. Literature searches were conducted in electronic databases, including Scopus and PubMed, covering publications from the past 10 years. Eight studies met the inclusion criteria and were analyzed in this review. The findings indicate that PTLBW children experience delayed eruption of primary teeth. Future prospective studies are needed to identify potential biomarkers or predictive indicators for delayed eruption, as well as to evaluate the effectiveness of early treatment interventions on dental development and oral health outcomes in this population.

Keywords: low birth weight; preterm birth; primary teeth

INTRODUCTION

Primary teeth are essential in early childhood development. They serve as masticatory organs that aid in digestion and play an important role in the development of facial muscles and speech. The eruption of primary teeth marks a key stage in dental development.¹

Dentition is a vital component of the oral cavity, contributing to various orofacial functions. Its development begins in mid-gestation, and following crown formation, teeth begin to erupt and eventually establish functional occlusion through contact with their opposing counterparts. Tooth eruption refers to the movement of tooth buds from a non-functional position within the alveolar process to their final functional position in the oral cavity. This process is regulated by anatomical structures and molecular mediators that promote alveolar bone resorption above the developing teeth, facilitating their progression along the eruption pathway.^{2,3}

In neonates, gestational age, prematurity, serious neonatal illnesses, and low birth weight are significantly correlated with delayed eruption of primary teeth. Maternal factors, including smoking during pregnancy, gestational age, and vitamin D levels, may influence the timing of primary tooth eruption. Several perinatal factors, such as birth weight and ethnicity, are strongly associated with eruption timing, whereas birth length and sex appear to have minimal effect. Moreover, the timing of primary tooth eruption is closely related to overall physical growth indicators, such as weight, height, and head circumference.^{4,5} Moreover, the timing of primary tooth eruption is closely related to overall physical growth indicators, such as weight, height, and head circumference.⁶

Preterm low birth weight (PTLBW) is a significant health issue in many countries. Globally, approximately 1484 million babies are born prematurely, and it is estimated that over 20 million babies are born with low birth weight.

Preterm low birth weight becomes a prolonged and potentially life-threatening problem for children under 5 years old.^{7,8}

Although numerous studies have examined tooth eruption in children generally, research specifically focusing on PTLBW children remains limited. Premature infants often face additional risk factors that may influence the eruption process of their primary teeth, including environmental factors associated with neonatal intensive care unit (NICU) treatment and underlying medical conditions.⁹

Understanding the patterns and timing of primary tooth eruption in PTLBW children is

essential, as it can offer valuable insights into their health management, particularly in monitoring dental development and initiating appropriate interventions. Furthermore, identifying factors that affect tooth eruption in this population can help in planning more precise and effective care strategies.

Considering the current research limitations and the significance of this issue in clinical practice, researchers conducted a scoping review to investigate recent literature on primary tooth eruption in PTLBW children. This review aims to provide a comprehensive overview of PTLBW and primary tooth eruption timing, identify existing

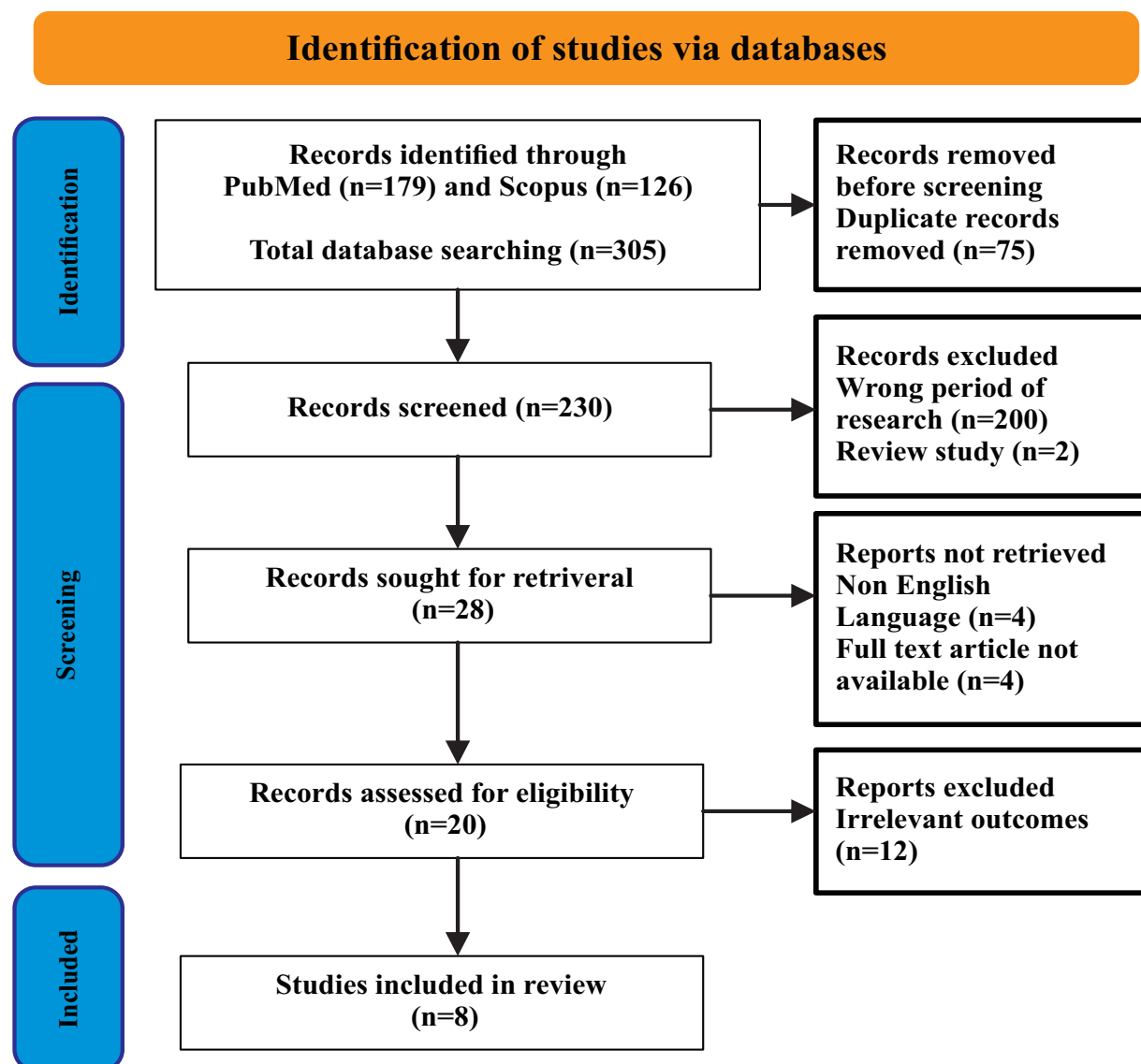


Figure 1. PRISMA flow diagram, illustrating the process of study identification, screening, inclusion, and exclusion

research gaps, and establish a strong foundation for further studies in this field.

MATERIALS AND METHODS

This scoping review was conducted following the framework proposed by Arksey and O'Malley and further refined using the Joanna Briggs Institute (JBI) methodology for scoping reviews. The guiding research questions were: "How does primary tooth eruption occur in PTLBW infants?" and "What are the differences compared to infants with normal birth weight?". The review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines.

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. Literature was obtained from two electronic databases, Scopus and PubMed, using a defined search strategy.

For Scopus, the search used the terms: (TITLE-ABS-KEY (tooth AND deciduous) OR TITLE-ABS-KEY (tooth AND eruption)) AND (TITLE-ABS-KEY (premature AND infant) OR TITLE-ABS-KEY (premature AND birth) OR TITLE-ABS-KEY (low AND birth AND weight AND infant) AND TITLE-ABS-KEY (birth AND weight)). For PubMed, the search used: ("tooth, deciduous"[MeSH Terms] OR ("tooth eruption"[MeSH Terms] OR Tooth Eruption[Text Word])) AND ("infant, premature"[MeSH Terms] OR "premature birth"[MeSH Terms] OR "infant, low birth weight"[MeSH Terms] OR "birth weight"[MeSH Terms]).

The inclusion criteria for the selected literature were as follows: the articles had to be published in English, involve infants with a history of PTLBW as research subjects, and be published within the last ten years. Articles were excluded if they were not available in full text or were review studies.

A total of 305 articles were initially identified. After removing duplicates, 230 articles remained. Of these, 28 articles were screened following

the exclusion of studies published more than 10 years ago ($n = 200$) and review articles ($n = 2$). An additional 8 articles were excluded—4 for being non-English and 4 for lack of full-text availability. Ultimately, 20 articles were assessed for eligibility, and 12 were excluded due to irrelevant outcomes. Thus, 8 articles were included in the final review.

RESULTS

This scoping review identified eight studies that examined the correlation between preterm low birth weight (PTLBW) and primary tooth eruption. The studies were conducted in 6 Asian countries, one study in Brazil and one study in Croatia. The types of studies used were cohort ($n = 2$),^{10,11} cross-sectional ($n = 3$),¹²⁻¹⁴ observational ($n = 2$)^{15,16} and longitudinal ($n = 1$).¹⁷

Most of the findings indicated that PTLBW is associated with delayed eruption of primary teeth. In studies involving preterm infants, corrected age was considered before drawing conclusions about the relationship between preterm birth and primary tooth eruption. However, Dodo (2023) reported that primary tooth eruption occurred earlier in preterm infants, while Prokocimer (2015) found no significant difference in the number of teeth between children with low birth weight and those with normal birth weight. An overview and summary of the articles included in this review are presented in Table 1.

DISCUSSION

Delayed primary tooth eruption in PTLBW children is a critical issue, as it may signal underlying neonatal complications and inform the need for early interventions.^{11,14,18} Research suggests that prematurity and low birth weight are significant determinants of tooth eruption timing, with preterm infants frequently exhibiting delays when compared to their full-term counterparts.¹⁰⁻¹⁴ Primary teeth play a key role in mastication, speech development, aesthetics, and maintaining space for permanent dentition. Therefore, delayed eruption may lead to long-term consequences such as malocclusion, orthodontic abnormalities,

Table 1. Summary of primary tooth eruption on PTLBW

Author	Location	Study Design	Sample	Ages	Instrument for PT/LBW	Instrument for Tooth Eruption	Result
Takahashi et al. (2023)	Japan	Observational Cohort Study	27.454	18 months	Secondary survey data (LBW) from infants 18 month old health examination	Secondary data from health examination.	Low birth weight was associated with a lower likelihood of having 16 or more erupted primary teeth at 18 months. The odds were approximately 0.75 (95% CI: 0.68–0.84) in boys and 0.72 (95% CI: 0.65–0.80) in girls, indicating a 25–28% reduction in likelihood compared to children with normal birth weight.
Dodo et al. (2023)	Japan	Cohort Study	1.695	1.5 years old and 3.5 years old	Secondary Data	Intraoral observations by parents	In preterm children, the average eruption age of the mandibular primary central incisors was 7.2 ± 2.6 months in males and 8.0 ± 3.2 months in females. However, when corrected age was considered, the eruption occurred earlier, indicating that preterm infants experience tooth eruption at an earlier developmental stage compared to term infants.
Garg et al. (2021)	India	Cross-sectional study	110	6 months.	Clinical examination at birth	Intraoral examination at birth	The study found children with Prematurity and low birth weight can be considered as risk factor for delayed eruption. The mean first evidence of tooth eruption was 12.88 ± 1.16 and median was 12.80 months with statistically significant difference.
Wu et al. (2019)	China	Observational study	1.296	6,9, and 12 months.	Hospital laboratory records	Oral examination	LBW was significantly associated with a delayed eruption of the first primary tooth, with a beta coefficient of 0.98 (95% CI: 0.20–1.76), indicating that LBW infants experienced a delay of approximately 0.98 months in the eruption timing compared to those with normal birth weight. Additionally, the average eruption age for infants with low birth weight was 8.23 months, suggesting a delayed eruption compared to their peers. On the other hand, macrosomia was associated with earlier eruption ($\beta = -0.79$, 95% CI: -1.30 to -0.28). Birth weight was significantly associated with delayed eruption timing of the first primary tooth.

Author	Location	Study Design	Sample	Ages	Instrument for PT/LBW	Instrument for Tooth Eruption	Result
Prokocimer et al. (2015)	Israel	Cross-sectional study	300	2-17 years old	Medical File	Medical file	The study demonstrated that preterm birth may predict an abnormal number of teeth. The highest prevalence of children with delayed tooth eruption were found on they who were born with prematurity, 95.7%. No significant differences were found in the abnormal number of teeth of children with LBW compared with children of normal weight.
Wang et al. (2019)	China	Obervational study	2.230	3-36 months	Birth records and questionnaire	Clinical examination	Premature delivery and birth weight were the influencing factors for the timing of primary tooth eruption. The eruption time of the first primary tooth was later in the LBW group (8.4 ± 1.9 months).
Pavicin et al. (2015)	Croatia	Cross-sectional study	592	6 months	Electronic Questionnaire	Electronic Questionnaire	Short gestational age and very LBW are known predictors of delayed eruption of primary teeth. Generally, the greater the child's birth weight, the earlier the eruption of the first tooth. On average, children with normal birth weight experience tooth eruption at around 6.6 months of age, whereas those with low birth weight LBW tend to have their first tooth erupt at approximately 7.76 months
Neto et al. (2014)	Brasil	Longitudinal study	40	5 months	Medical Records	Clinical examination	Reports have shown that preterm and very LBW children had a significant delay in dental eruption. The average eruption age of the first teeth was 9.6 ± 1.9 months.

and alterations in jaw structure.¹⁹ Moreover, delayed eruption may serve as an early marker for other health concerns, including malnutrition and systemic diseases. Consequently, children affected by delayed tooth eruption require thorough monitoring and tailored health care strategies.¹⁸

Tooth eruption can be influenced by systemic, genetic, and environmental factors. Systemic factors include genetics, sex, and overall

health status.²⁰⁻²³ Genetics plays a substantial role, as inherited traits from parents largely determine the timing and pattern of tooth development.^{19,22} Sex also influences tooth eruption, with several studies showing that girls tend to experience earlier eruption than boys.²³⁻²⁶ Furthermore, children with Down syndrome exhibit significantly delayed eruption of primary teeth compared to typically developing children.²⁷

Prematurity and low birth weight have been identified as contributing factors to delayed child growth and dental development, including primary tooth eruption.^{13–16} Hormonal factors are also involved in regulating tooth development and eruption timing.²⁸ Furthermore, the eruption time of an individual's deciduous teeth may vary between racial groups.²⁹ Environmental factors influencing the eruption time of primary teeth include nutritional status, socio-economic conditions, and ethnicity.^{12,16,25,29}

A recent observational study reported a significant association between delayed eruption of deciduous teeth and birth weight.¹⁵ A group sample of Low Birth Weight (LBW)^{11,12} and very LBW children^{13,17} had a lower total number of deciduous teeth compared to children with normal birth weight. An observational study conducted in China with 2,230 participants further confirmed that preterm birth or short gestational age is an influential factor.¹⁶ Therefore, a positive correlation can be drawn between deciduous delayed eruption and PTLBW¹² and preterm very LBW children.^{13,16,17} This delay has been observed in both sexes.¹¹ Collectively, PTLBW and preterm VLBW have been identified as risk factors for delayed eruption of primary teeth.^{15–17}

However, contrasting findings were reported in a cohort study conducted in Japan, which compared eruption timing between preterm and full-term infants. The study noted that when corrected or adjusted age was considered, preterm infants experienced earlier eruption of deciduous teeth than full-term infants.¹⁰ Similarly, a cross-sectional study conducted in Israel found no significant difference in the number of teeth between LBW and normal birth weight children.¹⁴

The occurrence of delayed eruption of primary teeth in children with PTLBW may be caused by certain health problems not experienced by normally born children. PTLBW is a special condition where a child already has health problems since being in the womb. Prenatal factors that cause premature birth and low birth weight may potentially also affect a child's growth, including tooth eruption.^{11–13,21}

Maternal nutrition plays a critical role in this context. Pregnant women with nutrient deficiencies are at higher risk of delivering preterm and low birth weight infants. Protein deficiency, in particular, has been shown to affect tooth development, leading to delayed eruption, reduced tooth size, altered enamel solubility, and salivary gland dysfunction.³⁰ In addition to macronutrient deficiencies, deficiencies in calcium and vitamins D can also contribute to delayed tooth eruption.³¹ The nutritional status of mothers had a significant impact on the initial timing and duration of the primary dentition eruption process ($p < 0.05$). Children whose mothers had poor nutritional status during pregnancy experienced a delayed start and prolonged duration in the eruption of their primary teeth.³²

These nutrient deficiencies can persist after the baby is born. PTLBW had been identified as a predisposing factor for stunting. Compared to full-term infants, preterm infants were twice as likely to experience stunting and be underweight.³³ Infants born with LBW had a 1.74 times higher likelihood of stunting compared to those born with normal weight.³⁴ The results of the study may correlate with numerous studies indicating that socio-economic factors can influence maternal nutritional status, leading to PTLBW and subsequently resulting in stunting. Children who experience stunting have delayed tooth eruption for both primary and permanent teeth.^{33–35}

The assessment of study quality of this study was beyond the parameters of this scoping review; therefore, we were unable to evaluate the quality of each study included in this review. However, the present review provides a comprehensive overview of studies regarding the eruption time of primary teeth in children with PTLBW. The significant delays in the eruption of primary teeth among PTLBW children highlight the potential role of systemic factors, such as birth weight and gestational age, in dental development. Identifying these delays may aid in early intervention strategies to promote proper dental development in at-risk populations.

CONCLUSION

PTLBW children tend to experience delayed eruption of primary teeth. Systemic factors such as birth weight and gestational age play a crucial role in dental development among PTLBW children. This delay can impact their oral health and necessitate timely care interventions. Future research should focus on understanding the underlying mechanisms of delayed tooth eruption in PTLBW children, exploring the relationship between systemic factors like maternal nutrition, maternal health conditions, and environmental factors with the eruption time of primary teeth in PTLBW children. Prospective studies are needed to identify potential biomarkers or other indicators to predict or measure the risk of delayed tooth eruption in PTLBW children and evaluate the impact of early treatment interventions on dental development and oral health in this population.

CONFLICT OF INTEREST

The authors declare no conflict of interest with the data contained in the manuscript.

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