AMJ Australasian Medical Journal [AMJ 2021;14(4):96-107]

The timing of tooth eruption in preterm children: A systematic review

Neringa Sadauskaite, Ruta Almonaitiene, and Vilma Brukiene

Institute of Odontology, Faculty of Medicine, Vilnius university, Vilnius, Lithuania

REVIEW

Please cite this paper as: Sadauskaite N, Almonaitiene R, Brukiene V. The timing of tooth eruption in preterm children: a systematic review. AMJ 2021;14(4):96–107.
https://doi.org/10.35841/1836-1935.14.4.96-107

Corresponding Author:
Neringa Sadauskaite
M. K. Ciurlionio str. 21, Vilnius 03101, Lithuania
Email: sadauskaite.neringa@gmail.com

ABSTRACT

Background

Preterm birth has been reported to affect normal physiological growth and development of preterm-delivered children. Whether preterm birth affects primary and permanent tooth eruption, is not yet determined.

Aims

To identify whether preterm birth affects tooth eruption by reviewing scientific literature.

Methods

MEDLINE, EMBASE, Cochrane library and reference lists of included studies were screened from January 1980 to November 2020. The study designs included both interventional and observational studies analysing peculiarities of tooth eruption in premature infants with no congenital syndromes. Risk of bias was assessed using NIH Quality Assessment tool for cohort, cross-sectional studies.

Results

Twelve articles were selected for data extraction after exclusion of 1709 irrelevant studies. Primary teeth eruption time in preterm children was delayed up to two months taking account of chronological age only. In most studies, after changing the age from chronological to corrected, the eruption of primary teeth was still delayed, but the difference was negligible. Catch-up growth occurs in 18 months and the difference in primary teeth eruption time remains insignificant. Very low birth weight and non-breastfeeding were associated with delayed primary teeth eruption. One study found earlier eruption of first permanent molars and incisors, while other two stated lagging maturation of permanent teeth up to the age of nine years. The quality of evidence provided by the studies was low.

Conclusion

Considering chronological age, primary teeth eruption time in preterm children was delayed and related to very low birth weight and non-breastfeeding. Data on eruption of permanent teeth were inconsistent; more detailed research is need.

Key Words

Tooth eruption, preterm birth, primary teeth, milk teeth, permanent teeth

What this review adds:

1. What is known about this subject?

Preterm birth is associated with various complications, including changed development of oral tissues and tooth eruption.

2. What new information is offered in this review?

This article will review scientific articles on the timing of teeth eruption in preterm children and will summarize the evidence concerning the peculiarities of primary and permanent teeth eruption in preterm and low birth weight children.

3. What are the implications for research, policy, or practice?

In premature children anamnesis of preterm birth should be included in patient's questionnaire because of the abnormal teeth eruption time. Also, corrected age ought to be used in order to predict primary teeth eruption age.

Introduction

According to the World Health Organization, preterm birth is defined as birth before 37 completed weeks of gestation. [1] Premature infants can be also defined as low birth weight (<2.5kg) or very low birth weight (<1.5kg) infants, depending on prematurity.[2]

Preterm birth is a multifactorial process and is the second most frequent cause of early childhood death after pneumonia.[3] Prematurity is associated with psychosocial, sociodemographic, medical, genetic, environmental risk factors such as stress, spontaneous preterm labour, maternal or foetal infections, pregnancies after in vitro fertilization.[1-7] The survival rate of newborns depends on the country's economic situation: in low-income countries, 90 per cent of newborns with birth age less than 23 weeks die in the first days of their life, while in high-income countries due to the progress of perinatal care, death rate is 10 per cent.[4] Modern medical technologies help preterm infants to survive, but depending on the time preterm infants were born, they may be faced with serious complications, such as respiratory distress syndrome, brain haemorrhage, infections, chronic lung disease and many other.[8-10] Some developmental changes can be irreversible and have a lasting impact on the child's future growth. Studies have shown that catch up growth may occur for very low birth weight children as they can reach the weight of full-term children by the age of eight years[11], but those children may still have neurodevelopmental disabilities, learning difficulties, lower IQ, executive functioning and other complications later in life.[9]

The development of oral tissues can also be affected by preterm birth. The change of tooth crown structure (enamel hypomineralisation and/or hypoplasia), retardation of dental crown development, palatal or dental arch distortions and delay in tooth eruption are the most documented consequences of prematurity.[12-26] Preterm and malnourished children can have 7.8 times more defects in dental enamel, such as palatal groove compared to full term infants, however they are not highly prevalent.[27] Also, children born preterm tend to have malocclusion and therefore a potential increased need for orthodontic treatment.[27]

Due to the various age calculating methods (chronological, corrected or conceptional), birth weight, nutritional intake, infections and even gender, preterm children may show abnormal and individual teeth eruption time. As so many factors should be taken into consideration when managing both primary and permanent teeth eruption times and patterns in prematurely born children, the clinicians (paediatricians, dentists, orthodontists) should be educated on what teeth eruption time deviations should be expected, if there are any measures to prevent delay in teeth eruption and if the same catch-up growth for dental development as for the whole body is to be expected. This article will review scientific articles on the timing of teeth eruption in preterm children and will summarize the evidence concerning the peculiarities of primary and permanent teeth eruption in preterm and low birth weight children.

Materials and methods

Protocol and registration

This systematic review was conducted in accordance with the guidelines of the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement (28). The protocol of the review was not registered.

Eligibility criteria

The following selection criteria were used to identify potential studies:

1. Papers written in English.
2. Human studies.
3. Systematic reviews, reviews, case reports, abstracts and letters to the editor were excluded.
4. Premature birth was defined as birth before the 37th weeks of gestational age or newborn weight less than 2.5kg.
5. Primary and permanent teeth eruption time.
6. Preterm children had no congenital syndromes (mentioned in protocols of the selected studies).

Information sources, search strategy, and study selection:

The systematic search and selection of scientific literature were conducted from January 1980 to November 2020. The search was restricted to studies published in English. The following databases were searched: MEDLINE (through PubMed), Cochrane library including CENTRAL, CDSR, DARE, and EMBASE database via OVID by using the Boolean operators "AND" and "OR" for combinations of relevant keywords: "premature birth", "low birth weight infant", "very low birth weight infant", "prematurely born", "preterm birth", "gestational age", "tooth eruption", "tooth emergence", "dental eruption", "teeth maturation". Hand searches of the studies' reference lists were assessed to identify other primary studies. Two authors (N.S. and R.A.) applied the eligibility criteria, extracted the data and assessed the risk of bias independently, and in duplicate. Disagreements between reviewers were resolved by consensus discussions.

Data collection process and data items

Study selection was performed independently and in duplicate by the first two authors (N.A. and R.A.) of the review, who were not blinded to the identity of the authors of the studies, their institutions, or the results of their research. Study selection procedures comprised of title-reading, abstract-reading, and full-text-reading stages. Disagreements were resolved by discussion and consultation with the last author (V.B.).

A data extraction form of included studies was used by two authors (N.S. and R.A.) to record the study design (cohort or cross-sectional), setting, number of patients analysed, their gender, type of dentition, method of eruption measurement, estimation of prematurity and eruption age, statistical analysis and outcome (Tables I-III).

Risk of bias in individual studies

The checklists published by the US National Heart, Lung and Blood Institute (NIH) for observational cohort and cross-sectional studies were used to evaluate the observational and cohort studies.[29] The questions were answered either 'yes', 'no', 'unclear' or 'not applicable'. Each study was judged as having low, unclear or high risk of bias.

A bias judgment of low, high, or presenting with some concerns was rendered, based on the following: low risk of bias (for cohort and cross-sectional studies checked all as "yes" or one "no/unclear"), high risk of bias (more than three checked as "no" or "unclear"), and unclear (less than four "no" or "unclear").

Risk of bias across studies

The biases of publications were planned to be detected using contour-enhanced funnel plots[31] and Begg's rank correlation test[32] if at least 20 studies could be included in a meta-analysis. Also, the assessment for the general quality of evidence for every primary outcome to be performed according to the Grades of Recommendation, Assessment, Development and Evaluation (GRADE),[33] based on interpretations: 'high quality': highly confident that the true effect is close to that the estimate of the effect, 'moderate quality': effect estimate is generated moderately confident – possible that it is substantially different, 'low quality': low confidence in the estimated effect – the true effect may be substantially different.

Results

Study selection

The search strategy resulted in 4275 articles. 1721 articles remained after irrelevant study types, articles in language other than English and duplicates were excluded. Full-text was obtained, if the title and abstract met the inclusion criteria. 12 articles were included for the final analysis and systematic review (Figure 1).

Study characteristics

Summarized data of the studies are listed in the Tables I-III. Of the 12 studies, two were performed in the USA,[15,17] Australia,[16,25] Finland[24,26] and Brazil;[18,19] one in Egypt,[20] Jordan,[21] Croatia[22] and China.[23] Cohort[15,17-21,23-25] and cross-sectional studies[16,22,26] were performed. Most studies were carried out in hospitals,[16-18,20,21,24,25] some in medical centres/clinics/departments,[19,23,26] nursery school[15] or parent organizations.[22] Nine studies analysed the peculiarities and deviation of deciduous teeth eruption,[15-23] two studies – of permanent teeth eruption[25,26] and one study of both primary and permanent teeth eruption.[24] The results of the studies were assessed in different age calculation methods:

- Chronological age (postnatal age) – the time passed after the birth, was measured in 11 studies.[15-25]
- Corrected age (adjusted age) – the chronological age of the child minus weeks of prematurity – seven studies.[16-21,24]
- Conceptional age – the time elapsed between the day of conception and the day of delivery - one study.[26]
- Postmenstrual age – the time passed between the first day of the last menstrual period and birth plus chronological age – one study.[22]
- Post conceptual age – the time passed after conception – one study.[15]

Results of individual studies

Primary tooth eruption

The eruption of primary teeth in preterm children according to chronological age was statistically significantly delayed compared to children born at term.[15-25] The eruption of the first primary tooth was delayed up to two months mostly in preterm children compared to the full term.[15,18-20,22,23,25] In the Viscardi et al.[17] study, 40 per cent of premature infants had primary teeth erupted on time and 60 per cent had delayed eruption – they tended to have their first primary tooth erupt approximately four months later. Comparing these groups, the delay was significant in both chronological (16.4 weeks) and corrected (14.7 weeks) ages.[17]

However, in most of the studies, after changing the ages of premature children from chronological to corrected, postmenstrual, conceptional or postconceptional ages, the eruption of primary teeth was still delayed, but the difference was negligible.[15,16,18,20-22,24]

The association between birth weight of premature children and primary tooth eruption time has been observed. It was found that the smaller the birth weight of the child was, the more delayed eruption of primary teeth was observed.[16,18-21,23] Infants with birth weight less than 1.5kg had their first deciduous tooth erupted at the age of 8.4–9.8 months on average, while those children with birth weight over 1.5kg – at 7.3–8 months on average.[18,20,23] The Seow et al.[16] study, considered as having "low" risk of bias, compared the number of erupted primary teeth in preterm and very low birth weight children with normal birth weight children according to chronological age. It was found that very low birth weight children had significantly fewer erupted deciduous teeth compared to normal weight ones. The difference remained significant until the age of 18 months while the number of erupted teeth equalled later.

The eruption time of primary teeth in preterm children could also be affected by nutrition, feeding methods and postnatal weight gain.[17,20-22] According to Pavičin et al.[22] study, the emergence of the first tooth in breastfed premature newborns was significantly earlier than in those, fed from the bottle or breastfeeding and bottle combination. Findings of other studies[20,21] also confirmed that the preterm infants, fed with mother's milk rather than combination of breastfeeding plus formula or substitutes, had significantly earlier primary teeth eruption. In the Draidi et al.[21] study, it was noted that type of preterm formula also has an impact on the first tooth eruption. Preterm infants, who received the preterm formula or Total Parenteral Nutrition, had more equal first tooth eruption age with full terms, than those infants, who had taken full term formula. They also found that vitamins and iron had no effect on the deciduous teeth eruption time in preterm children.[21]

Studies show that child's prematurity and prolonged endotracheal intubation affect the mineralization and eruption of primary teeth, often the maxillary anterior teeth.[20,25,35,36] However, Draidi et al.[21] study, which was considered as having "low" risk of bias, shows opposite results. No statistically significant difference was found comparing the primary teeth eruption time of intubated and non-intubated premature children.

Viscardi et al.[17] study showed that even some type of bacteria could have impact on teeth eruption: children who were infected with Staphylococcus epidermidis had their first tooth erupted delayed significantly more than uninfected ones.

Permanent tooth eruption

Unlike deciduous teeth, inconsistent results were presented in the studies that analysed permanent teeth eruption time in prematurely born children. In the Backström et al.[24] study, no significant difference was observed in permanent teeth eruption time between preterm and full-term children of both chronological and corrected ages. However, if the primary teeth eruption at the one-year-olds was delayed, a tendency of delayed permanent teeth eruption at the 9–11 years of age was also seen. In the Seow[24] study, the preterm and very low birth weight children permanent teeth eruption time was delayed up to 0.57 years at the age of six years and younger, compared to full term and normal birth weight children, on chronological age. However, the teeth eruption time almost equalled in both groups and became insignificant in children older than nine years of age. Vice versa, the Harila-Kaera et al.[26] study results showed that the eruption of permanent teeth was even earlier on preterm children when the number of erupted teeth were compared. The first molars and incisors emerged significantly earlier in preterm than the full-term children. Upper first right molar, upper central and lateral incisors were the first teeth to erupt in preterm black children and upper and lower central left incisors, upper lateral incisor for the white children. White children had significantly less early erupted permanent teeth compared to black children.[26]

Gender differences in tooth eruption

In most of the studies, there was no significant difference in the deciduous teeth eruption time between boys and girls of chronological and corrected ages.[16,18-20,22] Four studies did not distinguish gender.[15,17,23,26] Three studies have found the difference in teeth eruption between sexes.[21,24,25] In the Backström et al.[24] and the Draidi et al.[21] studies, prematurely born girls had their primary teeth erupted statistically significantly delayed in comparison to full term girls on chronological and corrected ages. In the corrected age, the delay was two months in preterm girls compared to full term girls. The eruption of primary teeth did not differ significantly between preterm and full-term boys. Comparing preterm boys with preterm girls, the eruption of first primary tooth was delayed by three months in preterm girls.[24] Backström et al.[24] found no difference in the first permanent teeth eruption age between sexes, however, in Kim Seow[25] study, very low birth weight girls showed a delay in permanent teeth eruption time, which was less than in very low birth weight boys.

Risk of Bias within Studies

The quality of the included studies is shown in Table IV.

There were no Randomised controlled trials that included eligibility criteria. All selected studies were cohort and cross-sectional studies. According to the NIH Quality Assessment Tool,[28] three studies were considered as having "low" risk of bias,[17,24,25] one – high risk of bias[15] and others – mainly unclear.[16,18-21,22,23,26]

Risk of bias across studies

Due to inadequate number of eligible studies, an evaluation for the existence of reporting biases was not possible to be performed. For the same reasons, the general quality of evidence outcomes could not be rated using the GRADE approach.

Discussion

The results of this systematic review show that primary teeth eruption time in preterm children was delayed according to chronological age, but not if corrected age was considered.[16,18,20,21]

Although several studies[19,17] suggest some delay in primary teeth eruption in preterm and very low birth weight children even if corrected age is used, the mean delay is very small and clinically not significant. Moreover, due to high risk of bias, conclusions of one study[19] cannot be considered as reliable and the different results of the other[17] could be explained by the fact that tooth eruption time was related not only with the degree of subjects' prematurity but with neonatal complications and nutritional intake. The study had a small sample size and tooth eruption dates were recorded by parents, which might also give results inaccurately. Some authors also note that delayed teeth eruption may be caused by the age counting method, but not by the delayed tooth formation.[16] When taking sex into account, preterm girls are more likely to have delayed primary teeth eruption.[21,24,25]

The second important finding is that inequalities in primary teeth eruption seems to disappear after the age of 18 months[16,23,34] and this may indicate that catch up growth occurs – because of the accelerated early growth of the entire body, growth of the jaws and teeth also speeds up, which may have accelerated the eruption of teeth too.[16,23,34] Following this assumption that catch up growth occurs in preterm children so early, the eruption time of permanent teeth should not be affected since they start to erupt from the age of 6 on average.

Only several studies[24-26] analysed permanent teeth eruption and maturation time in prematurely born children and unlike with primary teeth the results are not straightforward. Only one study[26] evaluated actual emergence time of permanent teeth while other two studies analysed maturation of the permanent teeth from panoramic X-rays[24,25] and therefore the results seem to be confusing. Actually, they tell us that although maturation of permanent teeth in preterm children is delayed more until the age of six, less between six to nine years and is normal from the age of nine, as compared to full term children, the emergence time of permanent teeth is earlier at least for first permanent molars and incisors. The exception from that would be slowly maturing children: the ones that have small number of primary teeth at the age of one year. These children are likely to have delayed eruption of permanent teeth. However, more research is needed in order to understand the underlying mechanisms and to get more reliable data.

Even though the prematurity itself is the most important association with tooth eruption, some studies suggest that a type of food intake, bacterial infections and a long-term orotracheal intubation which is needed in neonatal intensive care due to neonatal infections or respiratory illnesses, may have effect on teeth eruption of preterm children.[20,21,35] Breastfed with mother's milk preterm infants had significantly earlier first deciduous tooth eruption compared to other feeding methods. The authors explain that different mechanisms are involved in air-facial muscle activation when children are breastfed or bottle-fed. Jaws can grow differently when children are bottle-fed, therefore, the dimensions of the dental arches and even the time of teeth eruption can change. On the other hand, not all preterm children can be breastfed for the several of reasons. The results of some studies suggest that in such cases mother's milk or preterm formula have more positive effect on primary teeth eruption.[21] A long-term orotracheal intubation could have mechanical influence on infant's oral tissue development[20,35] but the constant conclusions on deciduous teeth eruption could not be drawn. As more severe neonatal illnesses need longer intubation time and so delayed tooth eruption could be a complication of severe illness rather than effect of intubation.[17,21]

To our knowledge, this is the first systematic review, summarizing results on primary and permanent teeth eruption in preterm children and its relation to children feeding methods, intubation and gender. However, the main limitation of this review was that no RCT's were found and therefore not included in the analysis. Even though RCT's are considered to be at the top of the hierarchy of research design, we included cohort and cross-sectional studies in order to cover all available information regarding teeth eruption in preterm children due to limited related topic studies. Most of the evidence in this research was judged as having unclear risk of bias, though the quality assessment of some of the included studies could have been regarded as low risk of bias if the authors could have been contacted. Regarding the risk of bias, only three studies have been classified as low risk, so the priority of their statements was considered when conclusions were drawn.[17,24,25]

The biological age of the child does not always coincide with the chronological one, and this is especially true for preterm children, therefore, we recommend to include anamnesis of preterm birth in patient's questionnaire and to use corrected age when evaluating teeth eruption patterns.

Conclusions

Considering chronological age, primary teeth eruption time in preterm children was delayed and related to very low birth weight and non-breastfeeding. Data on eruption of permanent teeth were inconsistent; more detailed research is need.

References

1. World Health Organization. Preterm birth fact sheet No363.
2. WHA Global Nutrition Targets 2025: Low Birth Weight Policy Brief. Retrieved from: https://www.who.int/nutrition/topics/globaltargets_lowbirthweight_policybrief.pdf (accessed 20th January, 2021).
3. Liu L, Johnson HL, Cousens S, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet. 2012;9;379(9832):2151–61.
4. Goldenberg RL, Culhane JF, Iams JD, et al. Epidemiology and causes of preterm birth. Lancet 2008;371:75–84.
5. Jackson RA, Gibson KA, Wu YW, et al. Perinatal outcomes in singletons following in vitro fertilization: a meta–analysis. Obstet Gynecol 2004;103:551–563.
6. Conde-Agudelo A, Rosas-Bermudez A, Kafury-Goeta AC. Birth spacing and risk of adverse perinatal outcomes: a metaanalysis. JAMA. 2006;295:1809–1823.
7. Iannucci TA, Tomich PG, Gianopoulos JG. Etiology and outcome of extremely low-birth-weight infants. Am J Obstet Gynecol. 1996;174:1896–1902.
8. Lista G, Castoldi F, Bianchi S et al. Lung function and respiratory health at school age in ventilated very low birth weight infants. Indian J Pediatr. 2014;81: 275–278.
9. Ream MA, Lehwald L. Neurologic Consequences of Preterm Birth. Curr Neurol Neurosci Rep. 2018;18(8):48.
10. Myers E, Ment LR. Long-term outcome of preterm infants and the role of neuroimaging. Clin Perinatol. 2009;36(4):773–vi. doi:10.1016/j.clp.2009.07.008
11. Hack M, Schluchter M, Cartar L, et al. Growth of very low birth weight infants to age 20 years. Pediatrics. 2003;112(1 Pt 1):e30–e38.
12. Seow WK. Effects of preterm birth on oral growth and development. Aust Dent J. 1997;42(2):85–91.
13. Takaoka LA, Goulart AL, Kopelman BI, et al. Enamel defects in the complete primary dentition of children born at term and preterm. Pediatr Dent. 2011;33(2):171–6.
14. Cortines AAO, Costa LR. Associated factors and persistence of palatal groove in preterm infants: a cohort study. BMC Pediatr. 2016;16(1):143.
15. Golden NL, Takieddine F, Hirsch VJ. Teething Age in Prematurely Born Infants. Am J Dis Child. 1981;135(10):903–904.
16. Seow WK, Humphrys C, Mahanonda R, et al. Dental eruption in low birth-weight prematurely born children: a controlled study. Pediatr Dent. 1988;10(1):39–42.
17. Viscardi RM, Romberg E, Abrams RG. Delayed primary tooth eruption in premature infants: relationship to neonatal factors. Pediatr Dent. 1994;16(1):23–8.
18. Ramos SR, Gugisch RC, Fraiz FC. The influence of gestational age and birth weight of the newborn on tooth eruption. J Appl Oral Sci. 2006;14(4):228–32.
19. Neto PG, Falcão MC. Eruption chronology of the first deciduous teeth in children born prematurely with birth weight less than 1500g. Rev Paul Pediatr. 2014;32(1):17–23.
20. Khalifa AM, El Gendy RA, El-Mohsen MMA, et al. Relationship between gestational age, birth weight and deciduous tooth eruption. Egypt Pediatr Assoc Gazette. 2014;62(2):41–5.
21. Draidi Y, Salama G, Sonna N, et al. Chronological age versus corrected age of first tooth eruption in Jordanian premature infants. J Roy Med Serv. 2015;22(3):30–9.
22. Pavičin IS, Dumančić J, Badel T, et al. Timing of emergence of the first primary tooth in preterm and full-term infants. Ann Anat. 2016;203:19–23.
23. Wang XZ, Sun XY, Quan JK, et al. Effects of Premature Delivery and Birth Weight on Eruption Pattern of Primary Dentition among Beijing Children. Chin J Dent Res. 2019;22(2):131–137.
24. Backström MC, Aine L, Mäki R, et al. Maturation of primary and permanent teeth in preterm infants. Arch Dis Child Fetal Neonatal Ed. 2000;83(2):F104–F108. doi:10.1136/fn.83.2.f104
25. Seow WK. A study of the development of the permanent dentition in very low birthweight children. Pediatr Dent.

1996;18(5):379–84.
26. Harila-Kaera V, Heikkinen T, Alvesalo L. The eruption of permanent incisors and first molars in prematurely born children. Eur J Orthod. 2003;25(3):293–9.
27. Paulsson L. Premature birth--Studies on orthodontic treatment need, craniofacial morphology and function. Swed Dent J Suppl. 2009;(199):9–66.
28. Moher D, Liberati A, Tetzlaff J, et al. PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Medicine. 2009;6, e1000097.
29. Study Quality Assessment Tools. Retrieved from https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools (accessed 24th March, 2020).
30. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:l4898.
31. Peters JL, Sutton AJ, Jones DR, et al. Contour-enhanced meta-analysis funnel plots help distinguish publication bias from other causes of asymmetry. J Clin Epidemiol. 2008;6:991–996.
32. Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. Biometrics. 1994;50:1088–1101.
33. Guyatt GH, Oxman AD, Schünemann HJ, et al. GRADE guidelines: a new series of articles in the Journal of Clinical Epidemiology. J Clin Epidemiol. 2011;64:380–382.
34. Olbertz DM, Mumm R, Wittwer-Backofen U, et al. Identification of growth patterns of preterm and small-for-gestational age children from birth to 4 years – do they catch up? J Perinat Med. 2019;47(4):448–454.
35. Alves PV, Luiz RR. The influence of orotracheal intubation on the oral tissue development in preterm infants. Oral Health Prev Dent. 2012;10(2):141–7.
36. Seow WK, Brown JP, Tudehope DI, et al. Developmental defects in the primary dentition of low birth-weight infants: adverse effects of laryngoscopy and prolonged endotracheal intubation. Pediatr Dent. 1984;6(1):28–31.

PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

None

Figures and Tables

Table 1: Summary of study's material and methods

Study	Setting	Number of patients	Gender	Type of dentition	Measurement of eruption	Method of measurement
Golden NL et al.[15]	Nursery school	167: S129, C 38	NR	D	First tooth	First erupted tooth, clinical examination
Seow WK et al.[16]	Clinic of Mater Children's Hospital, Univ of Queensland Dental School	153: VLBW 73, LBW 33, NBW 47	VLBW: M 30, F 43; LBW: M 14, F 19; NBW: M 22, F 25	D	Number of teeth	Dental examination, intraoral photographs, medical and dental histories
Viscardi RM et al.[17]	Univ of Maryland Hospital	35: S 21, C 14	M 16; F 19	D	Number of teeth	Medical records, pictorial records, clinical examinations
Ramos SR et al.[18]	Pediatric Ambulatory of Hospital Univ Evangelico	146: S 77, C 69	NR	D	First tooth	Medical records, immunization records, pediatric records, clinical examinations
Neto PG et al.[19]	High-risk Infant Outpatient Clinic	40: S 25, C 15	M 18; F 22	D	First tooth	Medical records, clinical examinations
Khalifa AM et al.[20]	Bab El Sharia Univ Hospital	250: S 72, C 178	M 122, F 128	D	First tooth	Medical history, oral examination
Draidi Y et al.[21]	Prince Hashim Ben Al Hussein Military Hospital	110	M 50, F 60	D	First tooth	Medical history, oral examination
Pavičin IS et al.[22]	Parent organizations	592:00:00 S 194, C 398	M 313; F 279	D	First tooth	Electronic questionnaires
Wang XZ et al.[23]	Health departaments	2230	M 1196, F 1034	D	First tooth	Birth records, questionnaires, clinical examination
Backström MC et al.[24]	Univ Hospital of Tampere	150:00:00 S 1)60, 2)60 C 30	C: M 14; F 16 S: 1) M 28, F 32; 2) M 28, F 32	P and D	First tooth	Medical records, dental examinations, bone mineral content/density, plasma D (25(OH)D) and D(1,25(OH)2D), body weight/length
Seow WK[25]	Univ Dental School	110: S 55, C 55	M 50; F 60	P	Number of teeth	Panoramic radiographs, dental examinations, medical records
Harila-Kaera V et al.[26]	Six medical centers	2132: S 328, C 1804	Preterm: white M 40, F 20; black M 140, F 128 Full term: white M 408, F 395; black M 477, F 524	P	Number of teeth	Dental examinations, alginate impressions, oral photographs, medical records

Univ – university, S – subjects, C – control, M – male, F – female, D – deciduous teeth, NR – not reported, VLBW – very low birth weight, LBW – low birth weight, NBW – normal birth weight, P – permanent teeth.

Table 2: Summary of study's results – primary dentition

Study	Prematurity		Eruption Age		Outcome (Preterm : full term)
	Gestational age	Birth weight	Chronologic Age	Other perinatal period	
Golden NL et al.[15]	Pr: 26-28w, 29-31w, 32-34w, 35-37w; F: 38-40w	NR	** P<.01 Pr: 44w, 42w, 34.5w, 35w; F: 30.5w	*Postconceptual* Pr:70w, 70w, 66.5w, 69w; F: 67.5w	Delayed eruption in chronologic age
Seow WK et al.[16]	VLBW: mean 29w (24-33w); LBW: mean 37.4w (32-41w); NBW >37w	VLBW: mean 1.179kg (.783-1.499kg); LBW: mean 2.176kg (1.577-2.48kg); NBW: 3.36kg (2.51-4.045kg)	** P<.01 6-11mo: VLBW 1 tooth, LBW 3.7 teeth, control 3 teeth >24mo: VLBW 18.7 teeth, LBW 19 teeth, NBW 18.4 teeth	*Corrected* P>.1 6-11mo: VLBW 3.7 teeth, LBW 5 teeth, NBW 3 teeth; >24mo: VLBW 19 teeth, LBW 14.8 teeth, NBW 18.4 teeth	Delayed eruption in VLBW children
Viscardi RM et al.[17]	All subjects ≤36w	All subjects <2.5kg	**** P≤.0001 S 51.6/51.6w, C 35.5/34.9w	*Corrected* **** P≤.0001 S 41.2/41.4w, C 26.7/26.5w	Delayed eruption in chronological and corrected ages
Backström MC et al.[24]	Pr: median 31w (23.7-35w) F	Pr: median 1.505kg (.69-1.93kg) F	** P<.01 Pr: M 7mo (6-15mo), F 9mo (5-17mo) F: M 6mo (2-10mo), F 6mo(3-12mo)	*Corrected* P=.18 Pr: M 5mo (2-12mo), F 8mo (3-16mo) F: M 6mo (2-10mo), F 6mo (3-12mo).	Delayed eruption in chronological age
Ramos SR et al.[18]	S <37w; C >37w	VLBW <1.5kg, LBW 1.5-2.499kg; C ≥2.5kg	** P=.004 Age: S 34.9w; C 30.1w Weight: S 33.3w-37.9w; C 30.9w	*Corrected* P= .997 Age: S 69w; C 69w Weight: S 68.5w-68.6w; C 69.4w	Delayed eruption in chronological age
Neto PG et al.[19]	All subjects <37w	All subjects <1.5kg	M 12 mo, F 11mo	*Corrected* M 9.7mo, F 9,5mo Brazilian children full term 8,3mo	Relatively delayed eruption
Khalifa AM et al.[20]	Pr <37w F >37w	VLBW <1.5kg LBW 1.5-2.5kg NBW >2.5kg	**** P=.0001 Pr: mean 9.32mo F: mean 7.97mo	*Corrected* P=.1222 Pr: mean 7.47mo F: mean 7.97mo	Delayed eruption in chronologic age
Draidi Y et al.[21]	I. ≤ 32w II. >32w	I. ≤1.5kg II. >1.5kg	** P=.002 >40w (delayed): I.37;II.14 <40w (normal): I.25;II.34	*Corrected* P=.375 >25w (delayed):I.49;II.34 <25w (normal): I.13;II.14	Delayed eruption in chronologic age

Pavičin IS et al.[22]	S <37w; C >37w	<1.5kg 1.5-2.5kg 2.501-3.5kg >3.5kg	Age: S 8.44mo; C 7.05mo (*** P<.001) Weight: S 7.43mo-10.22mo; C6.66mo (*** P<.001)	*Postmenstrual* Age: S 16.1mo; C 16.22mo (P=.59) Weight: S 16.37mo-16.82mo; C 15.88mo (* P=.019)	Delayed eruption in chronological age
Wang XZ et al.[23]	Pr 28-37w F >37w	LBW <2.5kg NBW 2.5-4kg HBW >4kg	* P=.037 Pr: mean 8.4mo F: mean 7.3mo	NR	Delayed eruption in chronological age

w – weeks, g – grams, * P=.05, ** P=.01, *** P=.001, ****P=.0001, Pr – preterm, F – full term, S – subjects, C – control, mo – months, NR – not reported, VLBW – very low birth weight, LBW – blow birth weight, NBW – normal birth weight, M – male, F – female, HBW – high birth weight.

Table 3: Summary of study's results – permanent dentition

Study	Prematurity		Eruption Age		Outcome
	Gestational age	Birth weight	Chronologic Age	Other perinatal period	(Preterm : full term)
Seow WK[25]	VLBW mean 29.8w (24-35w); NBW mean 40w (38-42w)	VLBW <1.5kg NBW >2.5kg	*** P<.001 Measured dental minus chronologic age: VLBW 6 yrs – 0.31 yrs delay NBW 6 yrs – 0.26 yrs acceleration	NR	Delayed eruption in VLBW up to 6 years of age
Backström MC et al.[24]	Pr: median 31w (23,7-35w); F	Pr: median 1.505g (.69-1.93kg); F	Eruption age did not differ	*Corrected* Eruption age did not differ	No delayed eruption
Harila-Kaera V et al.[26]	Pr <36w white and <35w black infants; F	NR	NR	*Conceptional* Measured at the same age. Differs number of teeth erupted earlier (max12). White boys 2, girls 1 (P< .04) Black boys 7, girls 8 (P< .05)	Earlier eruption in conceptual age

w – weeks, g – grams, VLBW – very low birth weight, NBW – normal birth weight, * P=.05; *** P=.001, yrs – year olds, NR – not reported, Pr – preterm, F – full term

Figure 1: Distribution of collected data

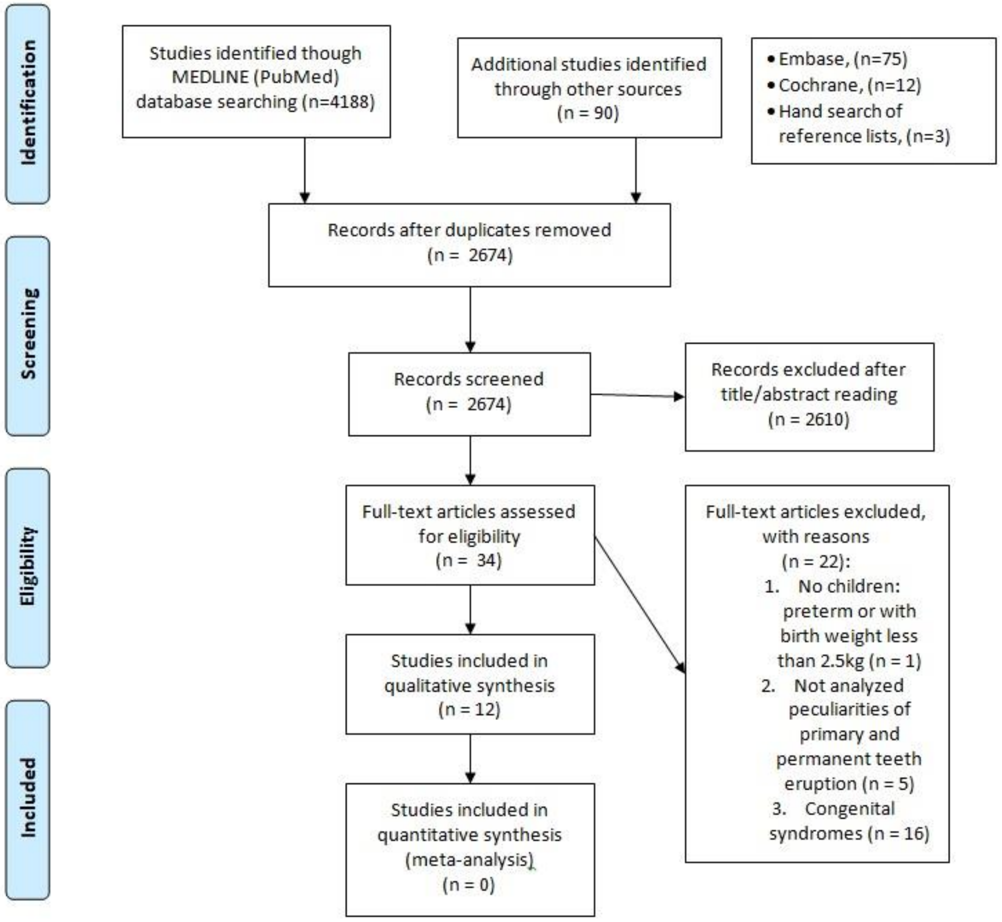

Table 4: Risk of bias assessment of included cohort and cross-sectional studies using the Newcastle Ottawa risk of bias assessment[29]

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Golden NL et al.[15]	Y	N	U	U	N	Y	Y	N	Y	N	Y	U	U	N
Seow WK et al.[16]	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	U	NA	Y
Viscardi RM et al.[17]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Ramos SR et al.[18]	Y	Y	U	Y	N	Y	Y	Y	Y	N	Y	U	U	Y
Neto PG et al.[19]	Y	Y	U	Y	N	Y	Y	Y	Y	Y	N	U	U	Y
Khalifa AM et al.[20]	Y	Y	U	Y	N	Y	Y	Y	Y	N	Y	U	U	Y
Draidi Y et al.[21]	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y
Pavičin IS et al.[22]	Y	Y	U	U	Y	Y	Y	Y	Y	NA	Y	U	NA	Y
Wang XZ et al.[23]	Y	Y	U	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
Backström MC et al.[24]	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Seow WK[25]	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Harila-Kaera V et al.[26]	Y	N	U	N	N	Y	U	N	Y	NA	Y	N	NA	Y

N, no; NA, not applicable; U, unclear; Y, yes.