Weight and dental eruption: the correlation between BMI and eruption

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Abstract

When planning dental treatment, particularly in orthodontics, the timing and order of tooth eruption (TE) are crucial considerations. It has been noted that fluctuations in body weight have garnered increasing scientific interest due to their potential impact on TE. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. An online database search was conducted using the keywords "dental eruption" AND "weight". A total of 14 relevant papers were scrutinised. Various population and age range were employed in different studies to evaluate surface roughness, color change, and surface fracturing. Numerous studies have investigated the impact of BMI on dental eruption, with findings suggesting a positive correlation between being overweight or obese and early tooth eruption. Understanding these relationships is crucial for identifying at-risk populations and developing effective public health interventions aimed at promoting optimal oral health outcomes worldwide. Further research is needed to comprehensively unravel the underlying mechanisms and implications of these associations.

KEYWORDS Weight, dental eruption, BMI, primary teeth, obesity, malnutrition, dental.

Introduction

Dental eruption (DE) is a physiological process involving the replacement of deciduous teeth with permanent ones [Helm and Petersen, 1989a]. The process involves the phenomenon by which growing teeth pass through the mucosa and soft tissues of the jaws to enter the oral cavity, make contact with the teeth of the opposing arch, and allow mastication [Bäckman and Wahlin, 2001; Helm and Petersen, 1989b]. The Latin word "eruptione," which meaning output with momentum, is where the word "eruption" originates [Featherstone, 2000; Fejerskov, 2004]. It is an ongoing procedure that only comes to an end when the tooth is lost [de Onis, 2007]. The eruption of deciduous teeth, their exfoliation, and the subsequent eruption of permanent teeth are regarded to be significant developmental milestones for children and occur in an ordered, sequential, and age-specific manner [Butler, 1956; Inchingolo et al., 2022; Patano et al., 2023]. DE represents a crucial phase in craniofacial and dental development in humans. While DE is a natural and universal event during growth, various environmental and biological factors may influence its timing and regularity, including development, dental caries, malnourishment, heredity, etc [Mejia, 2011; Brook and Smith, 1998; Inchingolo AM et al., 2023]. When planning dental treatment, particularly in orthodontics, the timing and order of tooth eruption (TE) are crucial considerations [Demirjian and Goldstein, 1976; Inchingolo et al., 2023b; Malcangi et al., 2023]. All permanent teeth, with the exception of third molars, which erupt between the ages of 17 and 21, typically do so between the ages of 5 and 13 [Krumholt et al., 1971]. Additionally, it has been shown that racial differences exist in the timing and order of TE [Bavetta et al., 2019; Coloccia et al., 2021; Marenzi et al., 2019; Patano et al., 2021; Santacroce et al., 2021; Virtanen et al., 1994].

Additionally, it has been noted that a number of other factors, including growth, diet, economic status, geographic location, sex, ethnicity, and hormones, might affect how quickly teeth emerge [Inchingolo et al., 2023a]. Among these factors, fluctuations in body weight have garnered increasing scientific interest due to their potential impact on DE [Psoter et al., 2008]. A few research have suggested a connection between the children's weight and the eruption periods [Gelb et al., 2021; Grippaudo et al., 2020]. TE is positively correlated with an individual's somatic growth, or weight and height [Houpt et al., 1967; Lee et al., 1965]. Numerous global research detail how inadequate nutrition during growing has a negative impact on dental development, postponing the emergence of permanent and deciduous teeth, among other things [Mummolo et al., 2020; Primozic et al., 2021]. It has been demonstrated that children with weight below average experience eruptions later than those within the normal range [Clements et al., 1953; Gates, 1966]. According to Khan, short and overweight children experienced early TE, while tall children, regardless of weight, displayed delayed eruption [Singh et al., 2020]. In line with previous research, Kutesa discovered that, for the same age group, boys who were more sexually mature had greater TE [Boccellino et al., 2019; Bollero, 2017; Campanella et al., 2018; Di Paola et al., 2022; Franco et al., 2018; Goldoni et al., 2022; Inchingolo et al., 2012, 2011; Isacco et al., 2021; Kutesa et al., 2013a; Marrapodi et al., 2022; Ortu et al., 2016; Quinzi et al., 2020; Uzunçıbuk et al., 2024]. On the other hand, Children who are overweight face both immediate and long-term health issues(Smith et al., 2020). Obesity, characterised by excess body fat accumulation, has reached epidemic proportions globally, posing multifaceted health challenges across populations [Wang and Lim, 2012]. Numerous illnesses, including diabetes, heart disease, hypertension, and obstructive sleep apnea, are associated with obesity [Xia et

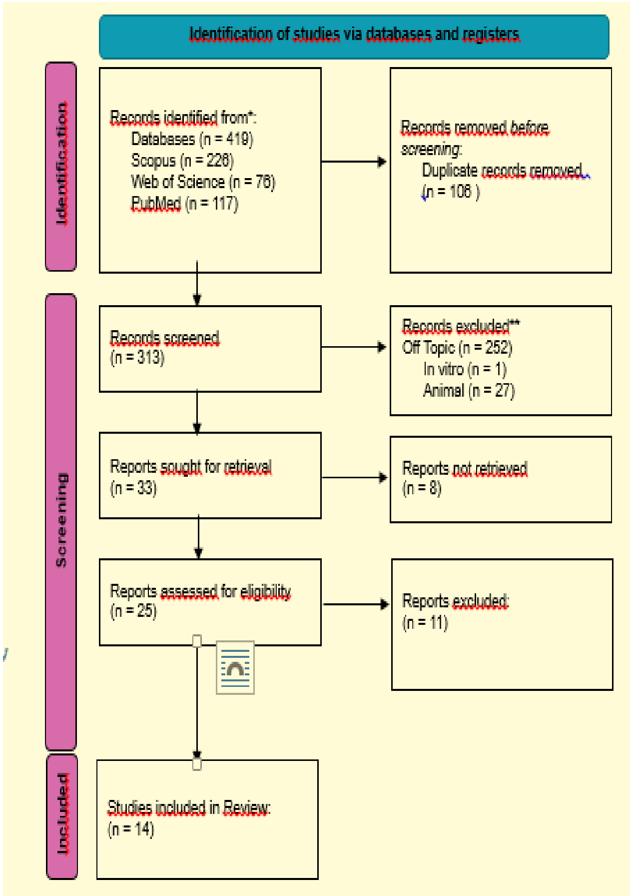

FIG 1 PRISMA ScR flowchart diagram of the inclusion process.

al., 2023]. Recent research has suggested a potential association between obesity and accelerated DE, wherein individuals with higher body mass index (BMI) levels may experience earlier and faster tooth emergence compared to their non-obese counterparts [Must et al., 2012; Piancino et al., 2019]. However, the precise mechanisms underlying this correlation remain incompletely understood [Lock et al., 2023; Minervini et al., 2023d, 2023b, 2023a, 2023c; Minervini G et al., 2023]. This systematic literature review aims to explore and critically synthesise the available evidence on the relationship between body weight variations and changes in DE. Through a detailed analysis of data from published scientific and clinical studies, we seek to identify patterns, trends, and possible mechanisms that may explain the association between these two variables. Understanding the impact of BMI on dental eruption holds significant relevance for dental practitioners and public health professionals.

Materials and Methods

Protocol and Registration

This research adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and was registered with PROSPERO (International Prospective Register of Reviews) under registration number 529408 [Selcuk, 2019].

Search Processing

The research was conducted on March 2024 on online databases PubMed, Scopus, and Web of Science, using the keywords and Boolean operator "dental eruption" AND "weight", as part of our search strategy. This research strategy was conducted to investigate the potential correlation between DE and body condition in children.

Eligibility Criteria and Study Selection

The evaluation of the title and abstract, as well as the entire content, were the two phases of the selection procedure. Any item that met the following parameters was considered: (a) clinical studies; (b) free full text; (c) children participants; and (d) English language. Articles that presented research techniques,conference presentations, paid items, review, meta-analyses, in vitro or animal studies, were excluded. The preliminary research provided titles and abstracts that were evaluated for relevance. Additional examination was conducted for relevant studies on full publications. The research of the keywords has produced 419 items in total: 226 from Scopus, 76 from Web of Science and 117 from PubMed. Among them, 106 are duplicate items, and 313 with no duplicate items were screened. The screening process highlighted 252 items off topics, 1 in vitro, 27 on animal, and 33 dealing with research. At the end, 11 reports was excluded and 14 items satisfied the research criteria. Full publications from relevant studies were obtained for additional examination. Two distinct reviewers (S.C. and L.R.) evaluated the retrieved studies for inclusion using the aforementioned criteria.

Data Processing

Two reviewers, S.C. and L.R., independently assessed the quality of the studies based on selection criteria after conducting a database search to extrapolate the findings. To resolve any differences between the two writers, a senior reviewer (F.I.) was contacted.

PICOS Requirements

The PICOS (Population, Intervention, Comparison, Outcome, Study Design) criteria, which are used in this evaluation, encompass population, intervention, comparison, outcomes, and study design (Table 1).

Quality Assessment

The quality of the included papers was assessed by two reviewers, R.F. and E.I., using the ROBINS is a tool developed to assess risk of bias in the results of non-randomised studies that compare health effects of two or more interventions. Seven points were evaluated and each was assigned a degree of bias. A third reviewer (F.I.) was consulted in the event of a disagreement until an agreement was reached. The question in the domains evaluated in the ROBINS is the following:

- bias due to confounding;
- bias arising from measurement of exposure;
- bias in the selection of participants into the study;
- bias due to post-exposure intervention;
- bias due to missing data;
- bias arising from measurement of the outcome;
- bias in the selection of the reported results.

Results

Selection and Characteristics of the Study

A total of 419 papers were found in the online database (Web of Science n= 76, PubMed n=117 and Scopus n= 226); no papers were found through a manual search. After removing 106 duplicates, 313 studies were taken in consideration by looking at the title and abstract. 33 records were selected and 280 papers were excluded (252 were off topic, 1 in vitro, 27 on animals). Subsequently, 8 non-retrieved records were excluded. There were 25 reports elegible, and 11 reports were removed. Finally, 14 papers were chosen for the systematic review. Figure 1 summarises the selection procedure. The study data was selected by analysing the study design, patients, type of intervention and outcomes (Table 2).

Quality Assessment and Risk of Bias of Included Articles

The risk of bias in the included studies is reported in Figure 2. Regarding the bias due to confounding most studies have a low risk. The bias arising from measurement is a parameter with low risk of bias. Many studies have low risk of bias due to bias in selection of participants. Bias due to post exposure cannot be calculated due to high heterogeneity. The bias due to missing data is low in many studies. Bias arising from measurement of the outcome is low. Bias in the selection of the reported results is high in most studies. The final results show that 4 studies have low risk of bias, 2 have a very high risk of bias and five have high risk of bias.

Discussion

The relationship between nutritional status, weight, and TE in children has been explored in several studies, shedding light on various aspects of this complex interplay. Traver-Ferrando et al. [2022], investigate a cross-sectional and observational study conducted on a community of Spanish schoolchildren with normal weight and overweight, to analyse the effect of BMI on DE. The study found that being overweight and obese increases twice the probability of early TE, compared to normal-weight children; suggesting a positive correlation between BMI and early DE, consistent with previous longitudinal studies. In addition, various factors, including genetic and metabolic aspects related to obesity, may contribute to this relationship and low birth weight was associated with early DE, while breastfeeding and family obesity history did not affect the process [Traver-Ferrando and Barcia-González, 2022].

Khan et al. [2011], in a cross-sectional study, investigate the eruption time of permanent teeth in Pakistani children and its relationship with genders, types of schools, upper and lower jaws, and correlations with height, weight, and BMI. The study revealed there were no significant differences in eruption time between genders, and no relationship between eruption time and BMI [Alam et al., 2022; Kotha et al., 2022]. Overall, the study highlighted differences in eruption time among Pakistani children compared to other populations and emphasised the importance of considering various factors such as genetics, environment, and socioeconomic status when interpreting such findings [Khan, 2011]. A study involving 1041 Ugandan children aged 4–15 years found notable gender differences in TE times, with girls generally experiencing earlier eruptions compared to boys. This observation was consistent across most teeth, except for three specific ones. Interestingly, TE times in Ugandan children were found to be comparable to those in African populations but lower than in non-African populations, suggesting potential ethnic variations [Dimaisip-Nabuab et al., 2018].

Similarly, a study conducted in Erbil City, Iraq, with 218 six-year-old children, aimed to elucidate the relationship between nutritional status, weight, and TE. While most

Criteria	Application in the present study
Population	Children population.
Intervention	Study of dental eruption in children.
Comparisons	Comparison between normal BMI in dental eruption pattern.
Outcomes	The BMI influence dental eruption timing.
Study design	Clinical trial.

TABLE 1. PICOS criteria.

children were of normal weight, gender disparities were observed, with more females classified as underweight and more males falling into the normal and overweight categories. Despite variations in eruption patterns across different BMI categories, statistical significance was lacking. However, a notable finding was the high prevalence of dental caries, particularly among underweight children, indicating a potential association between malnutrition and caries risk [Heinrich-Weltzien et al., 2013]. Further insights into the association between nutritional status and TE were provided by a study focusing on Filipino adolescents. High prevalence rates of malnutrition, particularly thinness and stunting, were reported, with boys being disproportionately affected. The study revealed a significant correlation between nutritional status and the eruption of permanent teeth, with thin and stunted individuals exhibiting fewer erupted teeth on average compared to their nonaffected peers. This aligns with previous research suggesting a link between delayed TE and malnutrition, potentially stemming from impaired skeletal growth due to chronic diseases or insufficient nutrient intake [Younus et al., 2020]. Building upon these findings, another study provided evidence linking the number of erupted permanent teeth to nutritional condition. Underweight and stunted children showed accelerated eruption of permanent teeth, while overweight children exhibited a similar trend. This observation underscores the potential utility of delayed permanent TE as a marker of poor overall development in children, reflecting ongoing nutritional deficits. Moreover, undernutrition during critical periods of tooth development, particularly in the early years of life, may lead to enamel hypoplasia, increasing the susceptibility of teeth to demineralisation and dental caries [Kutesa et al., 2013b].

In summary, these studies collectively highlight the intricate relationship between nutritional status, weight, and TE in children. While gender differences and ethnic variations exist in TE times, malnutrition, particularly thinness and stunting, appears to be associated with delayed TE and heightened dental caries risk. Monitoring general health indicators, including height, weight, and dental development, could aid in identifying at-risk populations and targeting support programs effectively, especially in low-income countries with high malnutrition rates. Further research is warranted to elucidate the underlying mechanisms driving these associations and inform comprehensive public health interventions aimed at promoting optimal oral health outcomes in children worldwide.

Selkari et al. [2023], evaluate significant correlation between DE and BMI, in Malwa population, with advanced dental

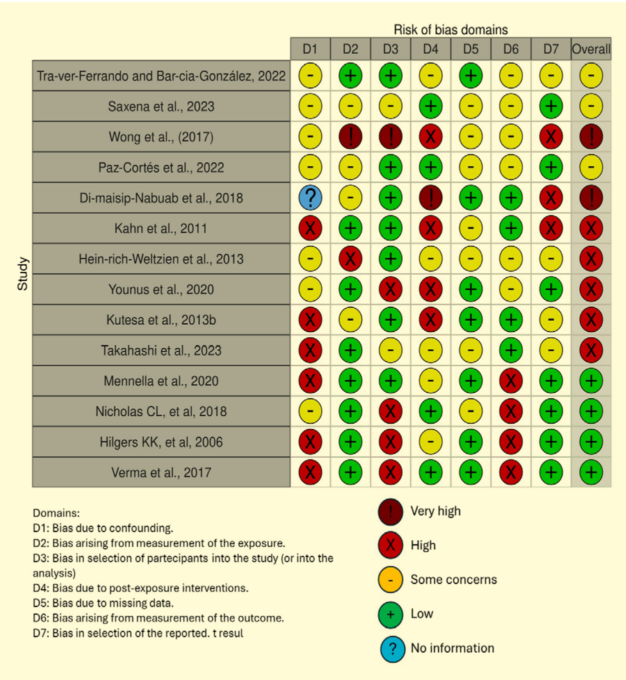

FIG 2
Bias assessment

development in obese compared to normal or underweight BMI, according to previous studies. This study, based on OPT evaluation, BMI and growth chart, evidence the influence of BMI or obesity on dental development is attributed to the endocrine system and metabolism of hormones and influences earlier TE. The influence of BMI or obesity on dental development is attributed to the endocrine properties of fat and adipose tissue. Adipose tissue functions as an active endocrine organ, impacting the metabolism of sex steroids and hormones, potentially accelerating dental maturation in children with higher BMI. This acceleration may be linked to earlier puberty and growth spurts experienced by obese and overweight children, leading to advanced skeletal and dentofacial development [Selkari et al., 2023].

Wong et al. [2017], in a cross-sectional study analyse the correlation between TE and obesity, evaluating through diagnostic criteria the TE of permanent element with visible crown in perforated mucosa. Obese and overweight children exhibited a significantly higher number of erupted permanent teeth compared to normal-weight children, supporting previous findings. Adjusted analyses showed that children with higher adiposity index levels had more erupted permanent teeth than those with lower levels. Obese and overweight children showed a significantly higher number of erupted permanent teeth compared to normal-weight children, supporting previous studies and children with higher adiposity index levels had more erupted permanent teeth than those with lower levels. The association mechanism is already unclear, but potentially involves hormonal changes in adipose tissue, increased secretion of insulin-like growth factor. Furthermore, with girls having more erupted teeth than boys. The study suggests a positive correlation between erupted permanent tooth number and adiposity in children in Hong Kong population, highlighting the importance of considering adiposity in dental health and development [Wong et al., 2017].

Nicholas et al. [2018], in a cross-sectional study, revealed a correlation between childhood BMI and the onset of dental development. Despite individual variations in dental development timing, there's an evident inclination towards earlier dental maturation in children with higher BMI, suggesting a potential link between BMI and dental maturation. Cross-sectional data also support this association, involving environmental and behavioral factors. Furthermore, this study indicates that early dental development precedes early eruption, regardless of BMI so, childhood obesity may not directly cause the eruption of underdeveloped teeth, which has implications for orthodontic treatment planning. However, the mechanism behind early eruption in obese children remains unknown, although factors such as inflammation and hormonal changes are possibly correlated. Overall, these results underscore the importance of considering BMI in paediatric dentistry and orthodontics and, above all earlier intervention for overweight and obese children [Nicholas et al., 2018].

Hilgers et al. [2006], investigate the correlation between nutritional status, particularly BMI and the timing of dental development. Results reveal that overweight and obese subjects exhibit significantly more advanced dental development compared to normal-weight subjects, and this trend is confirmed in previous findings, suggesting a relationship between dental maturity and BMI. The acceleration in dental development appears to be more pronounced in females than males; also in studies from different regions, suggesting that ethnic differences may play an important role. The study has limitations, including the lack of socioeconomic and ethnic information for the subjects and the use of an older method for assessing dental age. However, it emphasises the importance of regular obesity screenings and nutritional education in paediatric dental practice and physical health conditions [Hilgers et al., 2006].

A study conducted by Takahashi et al. focuses on Japanese children, recognising the importance of country-specific references due to racial, cultural, and environmental differences. It identifies delayed eruption compared to previous studies, with variations between maxillary and mandibular arches. While boys initially exhibit earlier eruption, no significant gender difference is found overall. DE is associated with skeletal and somatic growth, birth weight, BMI, and socioeconomic status. Low birth weight infants experience delays, while breastfed children tend to have more age-appropriate teeth, emphasising the importance of longitudinal research to explore additional influencing factors [Takahashi et al., 2023].

Also Mennella's et al. [2020] study highlights the direct influence of early rapid weight gain on primary TE during the first year. Infants gaining weight more quickly in the initial months experience earlier TE and a higher number of erupted teeth. This effect is independent of infant formula type and not observed with growth in length. Utilising a randomised controlled trial design, the study reveals that weight gain velocity significantly influences TE timing and pattern. Metabolic factors in early postnatal life are implicated, raising concerns regarding later overweight status and associated health risks [Mennella et al., 2020].

Data from a large sample of infants over a 33-year period are analysed to investigate trends in primary tooth emergence and associated factors by Verma et al. [2017]. A decrease in mean birth weight and the proportion of low birth weight infants is observed over time, correlating with a decrease in

Authors	Study Design	Number of patients and age	Aim of the study	Material and Clinical Data	Outcome
Traver-Ferrando and Barcia-González, 2022	Cross-sectional and Observational study	519 children,6 years old	Correlation of weight and schoolchildren DE	Analytic recording and observation of weight, size, BMI index, and permanent teeth	Correlation between early DE in obese and overweight schoolchildren
Selkari et al., 2023	Cross-sectional study	250 children,6-13 years	Correlation between DE and BMI	OPT study, BMI and growth chart	Advanced DE in obese compared to normal or underweight BMI
Wong et al., 2017	Cross-sectional study	806 children,12 years old	Correlation between TE and obesity	Assessment of the diagnostic criteria for the erupted teeth with visible crown in perforated mucosa	Correlation between permanent TE in obese children
Paz-Cortés et al., 2022	Cross-sectional study	725 children,4-14 years old	Correlation between TE and obesity	Clinical assessment of the erupted teeth	BMI does not affect change in the permanent eruption sequence but is a predictor for eruption symmetry
Dimaisip-Nabuab et al., 2018	Cohort Study	1499 children mean age 6.7 years	Correlation over a two-year period between DE in the primary and permanent dentition and nutritional status	Weight and height measurements were converted to BMI-for-age and height-for-age z-scores and categorized into weight status and stunting following WHO standardised procedures. C	Children who were underweight or stunted had a significantly reduced number of erupting permanent teeth.
Kahn et al., 2011	Cross-sectional study	4394 children,9-12 mean age	Correlation with eruption time and gender, schools, height, weight and BMI	Random sampling proce dure of Pakistani children	There is no relationship between eruption time and BMI
Heinrich-Weltzien et al., 2013	Cross-sectional study	1554 children aged 10 to 13(711M and 843 F)	Possible correlation between a delay in DE of permanent teeth) among Filipino adolescents with stunting or thinness	Children had their height, weight, and number of permanent teet	Thin and stunted teenagers have delayed TE.
Younus et al., 2020	Cross-sectional study	218 children of 6 years (116 M and 102 F)	Correlation between BMI and caries or eruption of incisors and molars	WHO criteria for decaying, missing, and filled primary teeth and indices (DMFT) were used to conduct dental caries examinations. BMI was used to categorize the state of obesity.	Underweight children had fewer erupted teeth and a higher caries index
Kutesa et al., 2013b	Cross-sectionalStudy	1041 children aged 4 to 15 years (520 M and 521 F)	To assess the association between timing of eruption of permanent teeth with height and weight	The children's weight and height were measured, and their oral mucosa was used to do a clinical assessment for dental emergencies.	Child's weight had a non-significant effect on TE.
Takahashi et al., 2023	Cross-sectional study	27,454 infants (13,906 M and 13,548 F)	The objective of this investigation was to examine patterns of primary teeth emergence trends and to pinpoint any possible physical correlates.	A dentist with at least 5 years of clinical experience performed the oral examination	The findings showed that the pattern of tooth emergence was related to birth weight, weight at 18 months old, and height..
Mennella et al., 2020	Cross-sectional study	113 children	to assess if the development of deciduous teeth and the presence of obesity during the first year are influenced independently or in combination by early food and weight increase velocity	Over the course of a one-year trial, monthly data on anthropometry and TE were gathered (0.5-12.5 months).	Accelerated primary TE and a higher percentage of overweight children were predicted with faster weight gain accumulation.
Nicholas et al., 2018	Cross-sectional study	77 children 4-12 years old	Correlation between dental maturation and BMI	Study of periapical rx	Positive correlation between childhood BMI andearly dental development
Hilgers et al., 2006	Cross-sectional study	104 children 8-15 years old	Correlation between dental development and BMI	Demirjian method and panoramic rx	Positive correlation between childhood BMI andaccelerated dental development
Verma et al., 2017	Cross-sectional study	1601 subjects, 4 to 36 months old data (903 M and 698 F)	To determine the status of teeth in relation to BMI	To prevent interexaminer variability, a single trained and calibrated investigator collected the data.	Indian children experienced delayed eruption of primary teeth associated with BMI variation

TABLE 2. Descriptive summary of the included studies.

the mean number of emerged primary teeth. Boys consistently exhibit more teeth than girls, and low birth weight infants have fewer emerged teeth compared to normal birth weight infants. Factors such as examination year and birth order are significant predictors for the proportion of emerged teeth in boys. The study suggests a potential correlation between decreasing birth weight and primary tooth emergence patterns, although further research is needed to understand underlying factors [Verma et al., 2017].

Paz-Cortés et al. [2022], in a cross-sectional study conducted in Spanish paediatric sample investigate the chronology and sequence of permanent dentition eruption, through intraoral and clinical examination, according to the nutritional status of the patient, assessed by BMI. This study found that BMI did not predict the appearance of permanent teeth. However, overweight and obese children tended to have accelerated DE compared to normal-weight children and overweight or obese led to early eruption, persisting throughout growth, while low weight or malnutrition correlated with fewer erupted teeth, according to previous studies. Addictionally, previous studies focused on BMI and DE revealed mixed findings, with some studies suggesting a positive correlation between weight/height and DE, while others found no significant association. In fact, height, weight, and BMI were identified as predictive variables for eruption symmetry, the upper and lower jaws. In this research BMI did not influence the sequence of permanent TE and a predictive model for the eruption of the first tooth could not be established. Possible limitations may be the exclusion of certain patient groups, and variability in BMI and population [Paz-Cortés et al., 2022].

The study has several limitations:

1. Heterogeneity of the studies: A range of study designs, including case-control, observational, retrospective, and prospective studies, are included in the studies analysed. The analysis of the dental elements were in vivo or after the extraction. The combination of different designs could result in heterogeneity and compromise the reliability of the review's findings.
2. Small sample sizes: The statistical power and generalisability of the results may be limited by the small sample sizes of some of the included research.
3. Absence of quality evaluation: The review makes no indication of whether or not the included studies underwent a quality assessment. To determine the overall dependability of the evidence, it is crucial to evaluate the methodological quality of the studies.
4. Limited scope of analysis: The review mainly focuses on enamel modification after debonding analysing different techniques and procedures, but it does not discuss other potential complications on the tooth (e.g. the variation of temperature on pulpar chamber)

Further studies are needed to establish standardised and increasingly effective debonding protocols.

Conclusions

Numerous studies have investigated the impact of BMI on DE, with findings suggesting a positive correlation between being overweight or obese and early TE. The associations between nutritional status and TE were explored, with malnutrition, particularly thinness and stunting, being linked to delayed TE. Additionally, underweight children showed delayed eruption of permanent teeth, while overweight children exhibited an accelerated trend. This suggests that DE may serve as a marker of overall development and nutritional status in children. Moreover, factors such as birth weight, breastfeeding, and socioeconomic status were identified as potential influencers of TE patterns. Low birth weight infants tended to experience delays in eruption, while breastfed children exhibited more age-appropriate teeth. Furthermore, the precise mechanisms underlying the observed associations remain to be fully elucidated, warranting further research in this area. In conclusion, the review underscores the intricate interplay between nutritional status, weight, and TE in children. Understanding these relationships is crucial for identifying at-risk populations and developing effective public health interventions aimed at promoting optimal oral health outcomes worldwide. Further research is needed to comprehensively unravel the underlying mechanisms and implications of these associations.

Abbreviations

BMI: body mass index
DE: dental eruption
TE: teeth eruption

Author Contributions

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualisation, A.D.I., A.M.I. and F.I.; methodology, L.R.; software, S.C.; validation, G.D., A.P. and F.I.; formal analysis, S.C.; investigation, L.R.; resources, A.P.; data curation, F.I.; writing—original draft preparation, G.D.; writing—review and editing, A.M.I.; visualisation, A.D.I.; supervision, F.I.; project administration, L.R.; funding acquisition, A.P. All authors have read and agreed to the published version of the manuscript..

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Data Availability Statement

Not applicable.

Conflicts of Interest

The authors declare no conflicts of interest.

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