World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(Review Article)

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Correlation between nutritional status and permanent tooth eruption in children

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World Journal of Advanced Research and Reviews, 2025, 26(02), 2583-2589

Publication history: Received on 29 March 2025; revised on 05 May 2025; accepted on 08 May 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.26.2.1735

Abstract

Childhood is basically important in terms of growth, development and maturation. All growth consisting of accumulation of energy reserves, formation of body muscles, strengthening of bone growth, occurs in this period. The eruption of a person's teeth reflects the general growth of the body. When a person experiences delayed tooth eruption, the person's general body growth can be said to be hampered. Objectives: This research is a study using a literature review approach to explore the influence of nutritional status on the eruption of permanent teeth in children. The research articles used in this research are limited to the last 10 years, namely between 2013 and 2023. This research includes research articles published in English. Discussion: Based on a review of several literatures, an increase in adipose tissue causes hormonal changes in obese individuals, increasing the secretion of growth factors which accelerate tooth eruption. Conclusions: A person's nutritional status is known to influence tooth eruption, where widespread chronic malnutrition after childhood is associated with delayed tooth eruption. On the other hand, obesity is associated with premature maturity of children and accelerated tooth eruption. Further research is needed to determine the exact causal relationship between nutritional status and the time of permanent tooth eruption.

Keywords: Nutritional Status; Permanent Tooth; Tooth Eruption; Children

1. Introduction

The formative years are crucial for maturity, growth, and development. During this time, all growth takes place, including the building of muscle, the strengthening of bones, and the collection of energy reserves. As a result, diet is crucial during a man's formative years as well as throughout his life. Because fat and protein levels are significantly reduced throughout the newborn and infant stages, there is an increased need for sufficient nourishment at this time. As we get older, we need to store more protein and energy in addition to creating reserves to fend against illness. higher infection. Adolescence then brings with it another growth spurt and the development of secondary sexual traits and puberty, which are signs of sexual maturation. During this stage, the body need more nutrition to meet its needs for different vitamins and minerals [15, 12, 17].

Teeth eruption is a reflection of a person's overall body growth. One may say that a person's overall body growth is hindered when they have delayed tooth eruption. When teeth erupt, they start to travel toward the oral cavity while they are still embedded in the jawbone. Children's development and nutritional health are strongly correlated with the emergence of their teeth. The age at which permanent teeth erupt in the majority of live people stays stable, falling within a specific range. Nonetheless, a number of factors, such as those related to nutrition, hormones, heredity, or genetics, can affect how teeth grow. It is also recognized that caries conditions, socioeconomic status, and nutrition might affect how quickly permanent teeth erupt. As a result, malnutrition may cause a delay in tooth emergence. The combined effects of malnutrition [11, 1].

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Given all of the variables that affect tooth eruption, it is clear that a child's general development has a big influence on tooth eruption. Knowing each tooth's age and eruption order is crucial because variations in tooth eruption might impact how dental care plans are carried out. Variations in tooth eruption can have a major effect on oral health since they can result in crowding of teeth and occlusion problems, which can lead to bad oral hygiene and periodontal disease. In early adolescence and adulthood, obesity and overweight are regarded as risk factors for periodontal disease [11, 6]

2. Material and methods

This research is a study using a literature review approach to explore the influence of nutritional status on the eruption of permanent teeth in children. This research was carried out using a literature review approach. The article search method used in this research was entirely carried out via the internet. The database used in this research is an international journal database that has extensive research article coverage from various countries in the world. The research articles used in this research are limited to the last 10 years, namely between 2013 and 2023. This research includes research articles published in English. The keywords used in this research are arranged based on the research title, including "nutritional status" AND "tooth eruption" OR "permanent tooth eruption" AND "children". Other keywords are also arranged based on synonyms and other related terms. This research uses secondary data from research articles that have been published in various journals indexed nationally and internationally. This research includes all previous research related to the research objectives. Apart from that, secondary data in this research was also obtained through books and official publications from government institutions and Non-Government Organizations (NGOs) based on previously determined topics.

Inclusion criteria are defined as the main characteristics of the target population that the researcher will use to answer the research question. Inclusion criteria are protocols that detail the basis for which sources will be considered for inclusion in the study and must be clearly defined. The following are the inclusion criteria used in this study, as follows:

- Research evaluating the influence of nutritional status on the eruption of permanent teeth in children
- Using the keywords “nutritional status” AND “tooth eruption” OR “permanent tooth eruption” AND “children”
- Articles published between 2013-2023
- Articles are published in English
- Article is available in full-text
- This is an original article

Exclusion criteria were defined as characteristics of the study sample that met inclusion criteria but had additional characteristics that could compromise the success of the study or increase the risk of unfavorable outcomes. The exclusion criteria in this study include the following:

- This is a review study
- Not accessible full-text
- Publication of journal proceedings or abstracts of national and international conferences
- The journal publication period exceeds 10 years
- Does not meet inclusion criteria

Data extraction in this research was carried out by grouping data in inclusion research to answer the research objectives and summarized in a table containing the name of the author, year of publication, country where the research was conducted, year of publication, research title, research design, number of research samples, research objectives, and research results. Each included study was sorted alphabetically according to a predetermined format.

3. Results and discussion

3.1. Tooth Eruption

The process by which developing teeth travel from their non-functional position in the alveolar bone to their eventual functional position (occlusal plane) in the oral cavity, crown aspect, through the gingiva, is known as tooth eruption. Generally speaking, bone remodeling processes controlled by the dental follicle are involved in tooth eruption. The periodontal ligament (which is thought to aid in tooth eruption at the supraosseous stage) and tooth eruption (bone production and resorption) are both mediated by the dental follicle, which also controls metabolic changes in the alveolar bone. The process of bone resorption creates an eruption channel, which is subsequently followed by growing teeth. It is thought that the force exerted by the apical bone's attachment to the developing tooth propels the tooth along this path in an occlusal direction. Root development initiates at the same time as the eruptive action. Teeth eruption can occur even in the absence of roots; root formation is merely one factor in tooth eruption. Supraosseous events may be mediated via the periodontal ligament. The periodontal ligament has nothing to do with intraosseous occurrences. Pre-eruption movement, mucosal penetration, intraosseous eruption, pre-occlusal eruption, and post-occlusal eruption are the five steps that make up tooth eruption [7].

Before eruption, there are tiny, erratic motions inside the alveolar bone, which is where crown growth takes place. This movement is not axially eruptive; rather, it is localized. It is unknown if follicular events or jaw growth and maturation are responsible for the movement of the growing crown [16]. When the crown reaches the end of its development and root production starts, the first eruptive movement starts. Resorption of the tooth's eruption site clears the eruption channel during this stage. Studies on canine premolars, however, demonstrate that despite the tooth germ being immobilized by being anchored to the lower border of the jaw, the eruption pathway—occlusal resorption of the alveolar to the tooth—forms. Additionally, resorptive activity forms an eruptive pathway for the immobile tooth bud when it is unintentionally ligated during the care of a jaw fracture. Hence, regardless of the strength of the growing tooth, the alveolar resorption that forms the eruption pathway happens first [16]. The translocation of the tooth to the alveolar crest is thought to be facilitated by distinct regions of the dental follicle that cause alveolar bone production apical to the growing root and occlusal bone resorption onto the developing crown. In the early stages of tooth creation, the tooth germ is surrounded by organized connective tissue called dental follicles. The periodontal ligament, which is thought to mediate tooth eruption at the supraosseous stage, is also derived from it. Following crown completion, the dental follicle undergoes resorbtive cellular activity incorporating signals from the enamel epithelium. Interleukin-1, epidermal growth factor-1, matrix metalloproteinases, and a few unidentified proteins found in tooth follicles and the enamel organ are examples of potential mediators. The simultaneous occurrence of root development and eruption can quicken the rate of eruption. But tooth eruption is not solely caused by the creation of roots; teeth can also erupt with closed apexes or without roots, as in Type I dysplasia [7].

The eruption pathway is complete when the cusp reaches the alveolar crest, at which point the eruption pace quickens before slowing down once more as the tooth approaches the occlusal plane. Proteolytic events and the proliferation of the external enamel epithelium cause the enamel epithelium to thicken, alter, and fuse with the oral epithelium. It is believed that the release of proteins from the enamel matrix occurs both prior to and during the penetration of the oral mucosa. These reactions are hypersensitive and cause fever, rhinitis, and local erythema, which are typical teething symptoms. The development of junctional epithelium on the tooth surface occurs during mucosal penetration and is a significant event. The periodontal ligament's collagen fibers are thought to be the main source of the eruption movement that moves the tooth from the gingival plane to the occlusal plane. Collagen maturation involves cross-linking and shortening processes, which provide a propulsive eruption mechanism. This process will be activated by oral force, which will alter the number and direction of fibers. Medication that inhibits the maturation of collagen also inhibits the eruption of teeth, indicating that the main mechanism causing post-emergency axial movement is the collagen fibers in the periodontal ligament. The protruding tooth is propelled from the gingival emergence to the occlusal plane by a driving force that includes bone apposition at the base of the crypt, root development, and interradicular septa. This eruption stage only happens during a crucial few hours in the afternoon when growth hormone levels are at their peak, according to research. Furthermore, it appears that variations in blood flow within the periodontal ligament impact the rate of eruption during this time [5, 7].

Once the tooth has achieved its functional position in the occlusal plane, a series of events occur to stabilize it in its new placement. This is achieved by bone activity, which includes the formation of circular bone and lamina dura visible on x-rays, as well as the growth of periodontal ligament fibers. Furthermore, the post-occlusal stage is when the roots finish developing. In a horizontal plane, like the buccally plane, teeth may move due to coordinated cementum apposition, resorption, and bone formation. Cementum apposition is another theory that could account for the compensatory eruption brought on by tooth attrition. Teeth may continue to erupt later in life to compensate for the loss of opposing teeth, indicating that eruptive activity continues into maturity [16].

3.2. Abnormalities in the Time of Tooth Eruption

Different racial and ethnic groupings exhibit differences in both the eruption patterns and the age at which individual primary teeth emerge, according to a number of studies. Other hypothesized variables that could affect when an eruption occurs include growth, nutrition, disease, and gestation. In addition to hereditary variables, it has been established that environmental factors, such as maternal smoking, the newborn's birthweight and height, and nutritional condition, influence the eruption of the first primary tooth. A few reports concentrate on how nutrition, especially breast milk, affects a child's early development. Eruption time-influencing factors: [2]

Weight of children: Seow examines low birth weight and notes delayed tooth development and growth in premature infants. In a different study, Seow discovered that the biggest delay in tooth maturation occurred in children born weighing less than 1000g and fewer than 30 weeks gestation.

3.3. Malnutrition: Severe malnourishment affects the eruption of teeth.

Height: In boys, there is a substantial correlation between the number of teeth and height, weight, and head circumference; in girls, there was a strong correlation between teeth and height. These results imply that there may be a significant relationship between general somatic growth and nutritional health and the timing of primary tooth emergence.

- Exclusive nursing: A child's growth and development are significantly impacted by breastfeeding. Numerous research works have observed the impact of nursing practices on the development of the orofacial region, encompassing the emergence of primary and permanent teeth. During teething, Larson et al. observed increased dribbling and biting or gnawing activity, particularly in the vicinity of the eruption area.
- Maternal age: The GUSTO trial conducted in Singapore discovered a link between older mothers and babies' first primary teeth erupting earlier.
- Socioeconomic status: According to Clemens et al. (1953), children in higher socioeconomic groups typically have earlier average birth times than other children.
- Climate: A number of factors were taken into consideration by Al-Jasser NM et al. as influencing the timing and order of tooth emergence. These include climate, gender, nutrition, socioeconomic position, and early extraction of primary teeth.
- Race: When compared to children of Caucasian descent (which includes children from Iceland and the US), dental patterns among Saudi Arabian children revealed that they had a delayed eruption of the first main tooth.
- Illness: The severity of thyroid deficit is associated with dentofacial abnormalities in cretinism. Teeth erupt and fall out later in hypopituitarism or pituitary dwarfism, as does general body growth. Delayed Tooth also has a correlation with other systemic illnesses linked to development abnormalities, including hypoxic, histotoxic, and hypoxic anemia, as well as renal failure.

3.4. Nutritional Status

Since food is a necessity for survival, it is crucial for promoting good health and preventing sickness. The regulation of nutrient intake, including appetite and satiety, is a very intricate physiological process. These mechanisms exert a significant impact on nutritional status, which is contingent upon nutritional consumption, the equilibrium of macro- and micronutrient supply, and fluid intake. Sick patients may find it difficult to meet their water and nutritional demands for a variety of reasons, which leads to 20–50% of patients being malnourished or at high risk of malnutrition at home. Not enough food is consumed by one in five patients to meet their demands for protein or energy. The underlying illness may induce metabolic, psychological, or other issues that either increase or reduce food intake, as well as directly interfere with nutritional intake. In this context, common issues such difficulty chewing and swallowing, immobility, medication side effects, and polypharmacy should not be undervalued. Chronic low-grade inflammation and catabolic metabolism brought on by a prolonged decline in nutritional status have the potential to cause a number of dangerous side effects, including immunological dysfunction, loss of fat-free mass, complications, increased mortality rates, decreased quality of life, and prolonged hospital stays. The effectiveness or tolerance of several therapies, including chemotherapy, radiation, antibiotic therapy, and surgery, is also impacted by malnutrition [10, 14].

The stress of surgical procedures leads to increased metabolism, which exacerbates the risk of nutrient metabolism. This hypermetabolic state may further increase the patient's risk and is characterized by endocrine responses, immunological and hematological changes, and sympathetic nervous system activation. dietary requirements.

Furthermore, inadequate food intake and worsening of the patient's condition regarding the patient's nutritional status are caused by fasting periods prior to numerous examinations and interventions, inappropriate food service, inadequate quality and flexibility of hospital catering, and a lack of assistance from healthcare staff to the most vulnerable patients. Malnutrition results from an unbalanced diet. There is currently no universal definition for the term "malnutrition." The two main conditions that are addressed by the word malnutrition, namely marasmus and kwashiorkor, are inadequate energy intake and nutritional insufficiency. Whereas kwashiorkor refers to a protein shortage marked by peripheral edema, marasmus mostly relates to a lack of energy or calories [10, 14]. Nonetheless, disorders resulting from insufficient or excessive consumption of macro- and micronutrients are now included in the definition of malnutrition. According to WHO recommendations, there are three types of malnutrition: [9, 14]

A lack or excess of micronutrients (vitamins and minerals), excess nutrition (overweight, obesity, and other diet-related health issues like type 2 diabetes mellitus, cardiovascular illnesses, etc.), and malnutrition (low weight for height, low height for age, and low weight for age). Malnutrition can cause acute, subacute, or chronic symptoms, and it's possible that they have little to do with underlying inflammation. Moreover, numerous studies have also highlighted the dual burden of malnutrition. Malnutrition is difficult to diagnose since it has both overnutrition and undernutrition as concurrent symptoms [9]. Depending on the body composition model being utilized, body composition specifies various bodily sections in percentages, including bone mineral mass, muscle mass, fat mass, and fat-free mass.

Starvation, underlying diseases, and mobility/exercise all affect body composition. Children's Anthropometric Standards are determined by measuring body weight and length/height using four (four) indices, which are as follows: [8]

- Body Weight according to Age (WW/U);
- Body Length/Height according to Age (PB/U or TB/U);
- Body Weight according to Length/Height (BB/PB or BB/TB);
- Body Mass Index according to Age (BMI/U).
- Children's Anthropometric Standards that use: [8]
- Body Weight Index according to Age (WW/U) for children aged 0 (zero) to 60 (sixty) months;
- Body Length or Height Index according to Age (PB/U or TB/U) for children aged 0 (zero) to 60 (sixty) months;
- Body Weight Index according to Body Length or Height (BB/PB or BB/TB) for children aged 0 (zero) to 60 (sixty) months;
- Body Mass Index according to Age (BMI/U) for children aged 0 (zero) to 60 (sixty) months; And
- Body Mass Index according to Age (BMI/U) for children aged more than 5 (five) years up to 18 (eighteen) years.

Body mass index (kg/m2) is calculated by measuring body height and weight. Both low and high BMI values are associated with increased morbidity and mortality. Weight (Wt) for height (Ht) is usually expressed in this form and allows comparison between the sexes and most age groups over a narrow normal range. BMI does not reliably indicate the distribution between lean mass and adipose tissue because there is no linear relationship between BMI and body compartments. Individuals with a low BMI may have increased fat-free mass; on the other hand, individuals with a high BMI may have disproportionately low fat-free mass (e.g. sarcopenic obesity), placing them at increased risk of failing to overcome disease or trauma [4].

3.5. Correlation Between Nutritional Status and Permanent Tooth Eruption in Children

A vital component of children's growth and development is nutrition. One in twelve children globally suffer from malnutrition, which continues to be a public health concern. Children with this illness are more likely to experience delayed physical and cognitive development, which raises their chance of dying from infectious infections. However, because of their high prevalence and comorbidities, overweight and obesity are also linked to a number of systemic illnesses that have an impact on children's health and have emerged as a public health issue in recent years. The timing of permanent tooth eruption is influenced by nutritional status, and this can have a significant impact on occlusion, caries risk, and the timing of orthodontic and preventative treatments. The cost of treating these dental conditions puts a strain on healthcare systems. Thus, studies that try to figure out what influences when permanent teeth emerge have a lot to do with medicine and public health initiatives [15].

The connection between kids' oral health and overall well-being is becoming a more popular topic for study. Nonetheless, there is ongoing debate on the nature of this relationship, including its underlying mechanisms and direction. A cellular mismatch between the body's requirements for development, maintenance, and particular functions and the availability of nutrients and energy can be attributed to malnutrition. Malnutrition is a serious public health issue that is prevalent in urban slum areas, rural areas, and tribal communities. Health issues are portrayed as unseen adversaries, silent killers, and silent emergencies [15, 18]. Diet, nutritional status, oral health issues, and overall health are connected concerns. Malnutrition negatively impacts the mouth's structural integrity. Early malnutrition has been linked to increased dental caries, delayed tooth eruption, and altered tooth structure, according to research. It is also linked to altered salivary gland function, altered salivary output, and altered salivary composition, all of which enhance a person's vulnerability to dental cavities [13, 10]. Teeth eruption is known to be influenced by an individual's nutritional state; widespread chronic malnutrition following infancy is linked to delayed tooth eruption. However, despite contradictory findings from other studies, obesity is linked to early childhood maturation and faster tooth eruption. The majority of research mainly link an individual's nutritional status to the quantity of teeth that have emerged in relation to a specific tooth eruption stage. Despite these findings, there is still a dearth of knowledge concerning the relationship between a person's nutritional state and the emergence of permanent teeth [13, 10].

Studies conducted across multiple populations have determined the effects on permanent teeth eruption in children at the extremities of the BMI score spectrum. Hormone modulation and metabolic process regulation are both influenced by adipose tissue. Obese people's increased adipose tissue alters their hormone levels, which in turn increases the growth factors secreted and speeds up tooth eruption. Therefore, the timing and chronology of tooth eruption might be affected by childhood obesity, leading to both physical and behavioral alterations. According to an American study, children who were obese saw an earlier onset of tooth emergence compared to their eutrophic counterparts. Mexican children who were overweight likewise showed a higher incidence of erupted teeth. Sindelarova et al. noted that obese Czech children were said to have particular types of teeth that emerged early. It has also been shown in the past that there is a connection between tooth eruption and being overweight or obese in Brazilian children. Evangelista et al. found that in children in the Brazilian Amazon region, the appearance of permanent teeth was linked to obesity and overweight. Similar outcomes were also noted by Arid et al. in children from the state of São Paulo [15].

4. Conclusion

A person's nutritional status is known to influence tooth eruption, with widespread chronic malnutrition after childhood being associated with delayed tooth eruption. On the other hand, obesity is associated with premature maturity of children and accelerated tooth eruption. Further research is needed to determine the exact causal relationship between nutritional status and the time of permanent tooth eruption.

Compliance with ethical standards

Acknowledgments

Author would like to thank the evaluators for their valuable input in reviewing and providing a very significant offer of feedback on this journal.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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