

# Influence of the type of breastfeeding as a risk or protective factor for the onset of malocclusions: a systematic review



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## Abstract

**Aim** The correlation between malocclusions in deciduous dentition and type of breastfeeding has been described by many authors in numerous articles. The aim of this article is to investigate the literature about this important topic.

### Materials and methods

The research was conducted by querying the following databases: PubMed, EBM, Cochrane Library, Web of Sciences, Medline, Web of Sciences, Ovid and Embase. The key words were: "infant" OR "baby", AND "breastfeeding" AND "malocclusion". As with similar literature review papers, the PRISMA-P (Preferred Reporting Items for Systematic Reviews Protocols) was used. The examined articles were of the following types: randomised controlled trials (RCTs), case-control studies and cohort studies. For the qualitative analysis of the selected studies, it was employed the NOS scale (Newcastle-Ottawa Quality Assessment Scale).

### Results and conclusions

Two hundred and fifty articles were selected. After filtering out the articles deemed irrelevant or with obvious bias, only 16 articles were left. From our results, it can be concluded that breastfeeding seems to play a decisive role in preventing the onset of posterior cross-bites and Class II malocclusions, and that this protective effect appears to be time-dependent.

**KEYWORDS** Malocclusion, Breastfeeding, cross bite

genetic and epigenetic control. In fact, correct functions, can guide the morpho-functional growth of the stomatognathic system [Lanteri et al., 2020].

Primordial non-nutritive swallowing already occurs around the fifth month of intrauterine life, while sucking for nutritional purposes is the first coordinated muscular activity of the newborn [Lanteri et al., 2020; Lopes-Freire et al., 2015]. Considering that craniofacial growth occurs mainly during the first 4 years of life, it is clear how important this period is for the correct development of the infant. In this time, correct functions, including breast sucking, must be performed to best express the intrinsic growth potential of each individual [World Health Organization, 2006; Sum et al., 2015; Maspero et al., 2020; Kramer and Kakuma, 2004].

During breastfeeding, the newborn activates multiple lingual and facial muscles to squeeze the milk out of the nipple [Parker and Chia, 2020]. Unlike bottle-feeding, the child positions the tongue correctly by squeezing the nipple against the palate, thus developing lip tone and stimulating mandibular movements which in turn act on the development of the functional matrix [Silveira et al., 2013]. During breast sucking, the jaw acts through protruding movements contrary to what happens with the use of the bottle.

The differences between the two types of feeding can be understood by considering the shapes and materials of which the teat is made, trying to mimic the mother's nipple as much as possible. Different shapes and materials can therefore induce altered positions of the tongue, jaw and lip tone in the newborn, which can result in early onset of malocclusions by altering the position and function of bones and soft tissues [Sum et al., 2015; Vázquez-Nava et al., 2006; Pegoraro et al., 2021; Peres et al., 2015], although some articles disagree with this statement [Aznar et al., 2006; Luz et al., 2006; Warren and Bishara, 2002; Abate et al., 2020].

The WHO recommends exclusive breastfeeding for at least the first 6 months of life, as mother's milk is rich in

## Introduction

The concept of functional growth and rehabilitation responds to the following dogma: *function develops the organ and anatomical harmony coincide with functional harmony*.

The stomatognathic apparatus is involved in suction, swallowing, breathing, chewing, speech articulation, facial expression. These functions have a crucial role in the complex development of not only the craniofacial district and of the teeth, but also the whole body [Maspero et al., 2009; Pisani et al., 2016; Farronato et al., 2008; Farronato et al., 2013].

The development of the stomatognathic system is under

immunoglobulins and other components of the immune system, capable of protecting the newborn from the most common causes of infant mortality, such as pneumonia and diarrhea. Furthermore, it contains all the nutrients needed for the development and growth of the subject, which are particularly intense in this period [World Health Organization, 2014].

Various authors have investigated the relationship between malocclusion and type of breastfeeding, without reaching a consensus.

For some of them, the onset of malocclusions — such as the skeletal Class II, anterior open bite, posterior crossbite — is specifically due to lack of or shorter breastfeeding duration [Farronato et al., 2008; DaCosta et al., 2018; Limeira et al., 2014; Chen et al., 2015; Carames Da Silva et al., 2012; Peres et al., 2015]. Other authors, on the other hand, found a connection between duration of breastfeeding and onset of malocclusion [Lopes-Freire et al., 2015; Warren and Bishara, 2002]. In addition, several studies have reported that ankyloglossia (anterior tongue-tie or submucosal restriction) and the presence of a tied maxillary labial frenulum (upper lip ligament) cause impaired closing and suction mechanics [Shamseer et al., 2015].

This article is a systematic review of the literature on the potential correlations between type of breastfeeding and onset of malocclusion. Furthermore, it aims to evaluate the influence of the type of breastfeeding on the onset of malocclusions.

## Materials and methods

This research was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA-P) 2015 principles [Shamseer et al., 2015], protocol number CRD42019137471 of the PROSPERO registry (Prospective International Registration of Systematic Reviews).

*The following describes the design of the PICO (Population, Intervention, Comparison, Outcome) model:*

*Population: children in primary or mixed dentition;*

*Intervention: breastfeeding > 6 months, presence of non-nutritive sucking habits such as use of a pacifier;*

*Comparison: no breastfeeding or breastfeeding duration < 6 months;*

*Outcome: presence or absence of malocclusion, assessed through physical examination, observation and analysis of plaster casts, administration of questionnaires, measurements of transversal maxillary width, increase or decrease of anterior and posterior vertical dimensions, presence or absence of open or deep dental bite and sagittal discrepancies, such as Class II Division 1 and Division 2 Angle malocclusion, and overjet variations*

### Search strategy

To identify the suitable scientific papers, a search was conducted in Medline, PubMed, Embase, Cochrane Library, Evidence-Based Medicine Review (EBMR), Web of Science, and Ovid platforms. The search terms comprised the keywords “child” OR “infant” OR “Baby”, AND “breastfeeding” AND “malocclusion”. In addition, the apparently pertinent studies cited in the reference list of the articles included in the first research cycle were gathered, with the aim to increase the size of the sample, without renouncing the appropriateness of the results found.

Two independent reviewers evaluated the titles and abstracts of the collected papers. The computer program “EndNote”

(version X7 × 9.21, Thomson Reuters, released September 2014, Toronto, ON, Canada) was used to store and analyse the retrieved reference articles.

To evaluate the agreement of the reviewers, after reading the title and the abstract of each work, the kappa scale and related point assignment method were adopted [Landis and Koch, 1977], which were useful for estimating the agreement of the researchers on the eligibility of each obtained result. In those cases where the title and abstract were not sufficient to make a decision, the full article was read to decide on inclusion or exclusion. In cases of disagreement between the two reviewers, the opinion of a third reviewer was sought.

### Inclusion and exclusion criteria

Articles were included that reported a clear description of the diagnostic method used as well as information on infant feeding methods, the presence of bad habits (for example sucking the pacifier or thumb or other fingers, and the possible presence of a tongue thrust), length of breastfeeding and any diagnoses of malocclusion present only in the deciduous and mixed dentition, without any time limit. The articles collected were about randomised controlled trials (RCTs), case-control studies and cohort studies.

Non-English-language articles, textbook chapters, conference abstracts, animal studies, personal opinions, and papers reporting insufficient information about data collection methods were excluded. In total, the study involved 10.990 children, with an average age of 3–5 years.

### Data collection

For each selected article, the following data were collected: name of the journal and date of publication, size of the samples, gender, design of the study, diagnosis of malocclusion, information on breastfeeding methods, odds ratio (OR) between the type of breastfeeding and malocclusion, and finally duration of breastfeeding.

### Quality assessment

For the qualitative analysis of the selected studies, the NOS scale (Newcastle-Ottawa Quality Assessment Stairs [Wells et al., 2020]) was used. This qualitative evaluation tool consists in 8 points, with each point being assigned a maximum of one star, except for comparability, which can be assigned a maximum of two stars. Hence, the highest achievable score is nine stars. Both reviewers independently applied the NOS scale to the selected papers. In those cases where their opinion differed, the input of a third auditor was sought.

### Limitations of the review

Only a qualitative analysis of the selected works was performed since the variety of the study protocols did not allow for a proper meta-analysis.

## Results

In accordance with the guidelines of the protocol registered on PROSPERO, the present study focused exclusively on results published after the year 2000. A comprehensive search of databases yielded a total of 250 articles. The first search identified 100 studies. Following a thorough evaluation of abstracts, titles, and study design, four articles were excluded. Seventy articles were eliminated because they reported random sequence generation or concealment of participant or staff assignment, outcome analysis, or selection of incomplete

outcome data as irrelevant. Consequently, 26 articles were carefully reviewed, resulting in the exclusion of 10 and inclusion of 16 articles for qualitative analysis.

#### Description of the included studies

Sixteen studies were reviewed, including 13 cross-sectional studies, 1 retrospective study, 1 cohort study, and 1 prospective study. In total, the study involved 10,990 children, with an average age of 3–5 years. Ten studies investigated the relationship between breast or bottle feeding and the possible presence of a posterior cross-bite and, consequently, transverse maxillary hypoplasia. However, these studies only considered children in the deciduous dentition stage [Lopes-Freire et al., 2015; Sum et al., 2015; Chen et al., 2015; Peres et al., 2015; Viggiano et al., 2014; Peres et al., 2007; Castelo et al., 2010; Moimaz et al., 2015] except for the works by Limeira et al. [2014] and Sánchez-Molins et al. [2010] evaluating also patients in mixed dentition. The vertical dimension expressed as open bite was analysed in numerous studies reporting the relationship between breastfeeding and the presence of an anterior open bite in the deciduous dentition [Sum et al., 2015; DaCosta et al., 2018; Chen et al., 2015; Peres et al., 2015; Viggiano et al., 2004; Peres et al., 2007]. Ten articles evaluated the sagittal dimension discrepancy, examining the dental class associated with the presence of an anterior crossbite in the primary dentition [Pisani et al., 2016; Lopes-Freire et al., 2015; Sum et al., 2015; DaCosta et al., 2018; Carames Da Silva et al., 2012; Peres et al., 2015; Viggiano et al., 2004; Castelo et al., 2010; Thomaz et al., 2012; Moimaz et al., 2014]. Only Sánchez-Molins et al. [2010] examined the association between maxillofacial growth and breastfeeding in the mixed dentition. Finally, 3 studies evaluated the presence of interdental spaces in the primary dentition of breastfed patients [DaCosta et al., 2018; Chen et al., 2015; Agarwal et al., 2014].

#### Qualitative synthesis

All selected studies obtained moderate to high scores on the NOS scale.

Limeira et al. [2014] concluded that a shorter duration of breastfeeding or the absence of breastfeeding may represent a risk factor for the development of posterior cross-bites in the mixed dentition.

In relation to the deciduous dentition, in all the analysed studies emphasised a greater risks of the onset of posterior cross-bite in children who were not breastfed or breastfed for less than six months [Viggiano et al., 2004; Peres et al., 2007; Chen et al., 2015; Peres et al., 2015; Castelo et al., 2010]. Regarding the vertical discrepancy, the authors reached different conclusions. Peres et al. [2015] reported that limited or no breastfeeding was identified as a contributing factor of anterior open bite. On the other hand, Moimaz et al. [2014] found a greater likelihood of children having an anterior open bite when breastfed for more than 1 year. In contrast, Sum et al. [2015] concluded that there was no association with the occurrence of open bite.

Regarding the sagittal problems, some articles have indicated a correlation between a decrease of overjet [Sum et al., 2015; Peres et al., 2015] and prolonged breastfeeding. However, contrasting findings have been reported by other authors [Moimaz et al., 2014], who observed an increase in the overjet value among infants breastfed beyond 12 months. Additionally, children with extended breastfeeding were less likely to develop Class II malocclusion [Carames Da Silva et al., 2012; Thomaz et al., 2012]. When evaluating the onset of malocclusion in

preschool-age children using pacifiers, it was observed that prolonging this habit was associated with a higher prevalence of anterior open bite, increased overjet, and posterior cross-bite. Furthermore, from a myofunctional perspective, this habit may lead to a reduced transverse palatal diameter (high arched palate, “narrow palate”), atypical swallowing, oral breathing, and hypertonicity of the facial muscles [Cenzato et al., 2021; Cenzato et al., 2022].

In relation to the onset and severity of malocclusion, different conclusions were drawn, depending on the studies considered: Campos et al. [2020] found that infants who were not breastfed were at higher risk of developing malocclusions, in contrast with Lopes-Freire et al. [2015] who did not observe such correlation. Abate et al. [2020] noted that infants who were not exclusively breastfed and used a pacifier developed more severe malocclusions than infants who were exclusively breastfed and did not present non-nutritive sucking habits.

Chen et al. [2015] found that when breastfeeding lasted up to 6 months there were no jaw diastemas.

Finally, in the study by Sánchez-Molins et al. [2010], it was concluded that vertical biotypes tending towards brachyfacial could be observed more frequently in breastfed infants.

#### Discussion

Based on the analysis of existing literature, it can be concluded that breastfeeding has preventive effects on the onset of malocclusions, as well as a positive impact on the functional growth matrix, bone model and muscle tone [Peres et al., 2015]. Additionally, it breastfeeding promotes proper nasal breathing, reducing the risk of oral-type breathing which is associated with the development of malocclusions [Peres et al., 2015; Thomaz et al., 2012].

Specifically, exclusive breastfeeding has a positive correlation with the growth and development of dental arches in the primary dentition, particularly in the transverse and anteroposterior dimensions [Sum et al., 2015; Lescano de Ferrer et al., 2006]. Research indicates that preschool children who were breastfed for more than 6 months demonstrated proper development of the maxillo-mandibular complex, both in terms of transverse and postero-anterior dimensions. This serves as a protective factor against the development of dysgnathias, such as transversal hypoplasia of the maxilla with potential posterior cross-bite, as well as distocclusion in the lower jaw. Furthermore, from a skeletal perspective, the telerradiographic analysis of children's skull and occlusions revealed that breastfeeding subjects more frequently exhibited parameters within the normal range with respect to vertical and sagittal dimensions. Also, mandibular parameters, both with respect to the cranial base and the upper maxilla, proved to be more correct in breastfeeding subjects.

One study on infants aged 2–6 months, which recorded the muscle activity of the masseters and temporal muscles by performing surface electromyography during breast and bottle feeding, found greater muscle development in the exclusively breastfed infant group [Gomes et al., 2006]. Similarities were observed in children who were both breastfed and bottle-fed. These results suggest that cup feeding may be a better and preferred method than using a bottle [Leite-Cavalcanti et al., 2007].

Data from the selected studies indicate that breastfeeding for at least 6 months reduce the chances of developing bad habits, as it helps to strengthen the mother-child bond and acts positively on psychological and behavioral aspects

[Farronato et al., 2012; Farronato et al., 2009]. In this regard, Mendoza et al. [2008] found that exclusive bottle feeding in the first 6 months of life poses a risk factor for the onset of non-nutritive sucking habits that persists beyond the child's first year of age, compared to exclusively breastfeeding.

In fact, 71% of non-breastfed infants developed non-nutritive sucking habits, versus 48% of exclusively breastfed infants. By transmitting the child a feeling of well-being and security, breastfeeding likely prevents the establishment of bad habits which over time could potentially have harmful effects on the orofacial growth of the child.

Thomaz et al. [2014] observed that breastfeeding directly from the mother's nipple does not induce the onset of malocclusions. However, a synergistic effect may be observed if there were parafunctional habits in infants who were breastfed for less than 6 months. The association between the duration of breastfeeding and the onset of malocclusions was investigated in the research carried out by Lopes et al. [2016]. The absence of parafunctional habits was observed in subjects who received exclusive breastfeeding.

Another Brazilian research, carried out on a sample of 442 children aged between 3 and 5 years carried out by Leite et al. [2007], highlights a statistically significant relationship between the presence of non-nutritive habits and the onset of malocclusion, supported by the observation that the incidence of non-nutritive sucking habits was lower in breastfed infants compared to those who had been bottle-fed.

According to scientific literature, bottle feeding predisposes to the development of malocclusions.

Mendoza et al. [2008] highlights that bottle-fed infants are more likely to develop bad habits such as finger sucking, pacifier sucking, and low forward posture language; and that these two factors, i.e. breastfeeding with an artificial teat and the establishment of one or more bad habits, together increase the risk of the onset of malocclusions. Cenzato et. al [2022] and Farronato et al. [2011] found that exclusive breastfeeding exerted a protective effect on the development of dental skeletal anomalies and prevented the establishment of non-nutritive sucking habits.

Chen et al. [2015] conducted a study involving 734 children, which concluded that subjects who were bottle-fed for a period longer than 18 months exhibited a greater risk of developing a Class II canine malocclusion and a posterior cross-bite—both of which are probable consequences of maxillary hypoplasia. However, a lower risk was observed in children who had been breastfed for a shorter period. The teat of baby bottle it is made of rigid material, which leads to reduced muscular activity during bottle-feeding with consequent insufficient transversal growth of the palate, thus establishing a strong correlation with the development of dysgnathic conditions affecting not only dental but also skeletal aspects.

According to Storari et al. [2021] exclusive breastfeeding in the first months of life is important to prevent Obstructive Sleep-disordered Breathing (SDB), especially HS (Hypopnea syndrome), in children and adolescents. In fact, breastfeeding promotes the harmonious development of the oral cavity and jaws; it educates the oral muscles to function correctly and maintain tone, trains the tongue to adopt the correct posture, coordinates nasal breathing, and prevents hypertrophy of the adenoids and tonsils. Furthermore, as stated by the WHO, breastfeeding protects against childhood obesity and overweight. By mitigating these risk factors, breastfeeding has the potential to reduce the prevalence of Sleep-Disordered Breathing (SDB) could reduce the prevalence of SDB in childhood

[Storari et al., 2021].

In the systematic review by Paglia et al. [2021] it emerged that several studies reported prolonged and unrestricted breastfeeding as a potential risk factor for early childhood caries (ECC). On-demand breastfeeding, particularly when lying down at night, may appear to contribute to ECC because the milk remains in the baby's mouth for extended periods. However, there is a lack of evidence that human milk is cariogenic. Other factors, such as oral hygiene, may be more significant on the development of caries than on-demand breastfeeding. Additionally, the biomechanics of breastfeeding differ from those of bottle feeding, and the milk is swallowed without lingering on the teeth. Indeed, we cannot forget that the main factor influencing the development of caries in newborns is the presence of *Streptococcus mutans* bacteria, which thrives in an environment characterised by a combination of sugars, small amounts of saliva, and a low pH [Straw, 2015]. A study by Colombo et al. [2019] reported a higher frequency of ECC among newborns, suggesting a potential correlation between caries and breastfeeding.

Beneath these issues is the importance of educating mothers about the benefits of breastfeeding, as parents and health professionals often have limited knowledge of their children's oral health. To enhance parental awareness, Colombo et. al [2023] evaluated the educational effectiveness of a book on nutrition and oral disease prevention titled "Mother and Infant Oral Health in the First 1000 Days of Life". The results indicate that this educational resource holds the potential to be an invaluable tool in preventing oral diseases in paediatric patients [Colombo et al., 2023].

## Conclusions

The data analysed from the literature allow to extrapolate some scientific evidence regarding the existence of relationships present in children with deciduous and mixed dentition, specifically between the type of breastfeeding received and the onset of malocclusions. Not only does the type of breastfeeding seem to play a fundamental role as a risk or protective factor against dysgnathic frameworks, but the duration of exposure to one type of breastfeeding rather than another also seems to be decisive. Not all types of malocclusions appear to be related to bottle feeding, which would seem to predispose the development of crossbite, palatal hypoplasia and distocclusions to the detriment of Class III occlusions and deep bites. However, it is desirable that other studies be conducted to reduce bias and improve the quality of the results available so far.

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