Association between oral habits, mouth breathing and malocclusion in Italian preschoolers

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Abstract

Aim This cross-sectional study was carried out to evaluate the prevalence of malocclusion and associated factors in preschoolers with the aim of assessing the existence of an association between bad habits and mouth breathing with the most severe malocclusions.

Materials and methods A sample of 1616 children aged 3–6 years was visited by applying the Baby ROMA index, an orthodontic treatment need index for preschool age. The following were searched: the prevalence of malocclusion, the association of bad habits and mouth breathing with malocclusion, how often are found in association and how this association is statistically significant. Chi-square and Fischer test were applied to verify the statistical significance of the association between the variables.

Results The data show that 38% of the sample need orthodontic treatment and 46% have signs of malocclusion of less severe degree that require a close monitoring and the elimination of risk factors so that they can improve spontaneously with growth. Moreover the prevalence of bad habits and oral breathing increases with increasing severity of the malocclusion, and sucking habits and oral breathing are both closely related to anterior open bite, posterior crossbite and increased overjet.

Conclusions In the context of prevention and early treatment of disorders of the craniofacial growth, bad habits and mouth breathing, being risk factors of malocclusion, should be intercepted and corrected early on to prevent the development of malocclusion, or the worsening of existing ones. From this point of view it is important to follow the patients with a multidisciplinary approach.

KEYWORDS Malocclusion, Bad habits, Mouth breathing, Early orthodontic treatment, Primary teeth.

Introduction

Etiopathogenesis of malocclusion involves not only genetic but also environmental factors, since craniofacial development is stimulated by functional activities such as breathing, chewing, sucking and swallowing [Salone et al., 2013].

Non-nutritive sucking habits and mouth breathing are the most significant environmental risk factors for malocclusion [Grippaudo et al., 2016; Gòis et al., 2008; Primožič et al., 2013], as they can interfere with occlusion and normal craniofacial development. Infants have an inherent, biological drive for sucking, that can be satisfied through nutritive sucking, including breast- and bottle-feeding, or through non-nutritive sucking on objects such as digits, pacifiers, or toys that may satisfy psychological needs. While sucking behaviours are normal in infants and young children, prolonged duration of such behaviours may have consequences to the developing orofacial structures and occlusion.

Unlike artificial feeding, it has been observed that breastfeeding promotes correct craniofacial development owing to the intense muscular activity it requires, which favours proper lip closure, stimulates mandibular function and positions the tongue correctly against the palate [Silveira et al., 2013]. The movements of lips and tongue during breastfeeding mean that the child obtains milk through a "squeeze action", whereas bottle-fed children make a more passive movement to obtain the milk, causing less stimulation of the orofacial structures [Viggiano et al., 2004]. Nevertheless, the influence of breastfeeding on occlusion has been studied in depth. Some authors have studied the relationship between breastfeeding and occlusion and reached very different conclusions, from the absence of any association between breastfeeding and occlusion [Warren and Bishara, 2002; Lopes-Freire et al., 2015] to a specific relationship between a shorter duration of breastfeeding or prolonged non-nutritive sucking habits (especially pacifier or thumb sucking) and malocclusion [Silva and Manton, 2014; Tomita et al., 2000], such as posterior crossbite [Limeira et al., 2014; Peres, 2015; Galan-Gonzalez, 2014], open bite [Correa-Faria, 2014] or Class II malocclusion [Caramez Da Silva et al., 2012].

Relationships between non-nutritive sucking habits and occlusal anomalies have been extensively studied. Non-nutritive sucking habits are commonly associated with certain malocclusions in the primary dentition, including anterior open bite, increased overjet, and Class II canine and molar relationships [Warren and Bishara, 2002].

The question of how mouth breathing affects craniofacial growth is controversial [Kluemper, 1995], so mouth breathing has been an object of interest in various studies [Souki et al.,

2009; Milanesi et al., 2011; Franco et al., 2015]. Mouth breathing aetiological factors may be obstructive, such as palatine and pharyngeal tonsillar hypertrophy and nasal septum deviation. They can also be described as functional, when resulting from prolonged oral habits, muscular alterations, transitory oedema of nasal mucosa such as intermittent rhinitis, and repaired airway obstruction [Lee et al., 2015; Basheer et al., 2014]. Most authors believe that nose breathing is a key factor in the proper development of oral cavity [Scarano et al., 1998], so the obstruction of the upper respiratory airway may negatively affect dental and skeletal growth, resulting in typical features: long face, narrow maxilla, high palatal vaults, skeletal Class II or Class III profiles, open bite, crossbite, displacement, shortened upper lip, everted lower lip and forward head posture [Cattoni et al., 2009]. In a previous study we verified the existence of a statistically significant association between mouth breathing, bad habits and malocclusion in children over 6 years [Grippaudo et al., 2016]. With this work we intend to verify if this association is also found in preschoolers. Therefore the aim of this study was to evaluate the association between sucking habits and mouth breathing with different malocclusion traits in primary and early mixed dentition in preschool children using the Baby ROMA index [Grippaudo et al., 2014].

The Baby ROMA index (Table 1) is an index of orthodontic treatment needs for orthodontic screening in children aged between 2 and 6 years, in complete deciduous or early mixed dentition. It is reproducible, it has internal validity and provides a degree of severity and need for treatment proportional to the severity of the detected condition. It is complete, takes into consideration systemic, skeletal, dental and functional problems. It is intended as a guide to clinical signs of malocclusion in paediatric patients. The most severe characteristic is identified for any patient during examination, and the patient is then categorised on the index risk factor scale according to this most severe characteristic. As in the following list, categories are ranked in order of seriousness, thus also indicating treatment timing as follows.

- Grade 1: absence of risk factors and signs of malocclusion, need for periodic check-ups.
- Grade 2: presence of risk factors for malocclusion and malocclusion traits that often tend to self-correct with growth, need for close monitoring and removal of risk factors.
- Grade 3: presence of malocclusion that tend to persist and sometimes worsen with growth, need for intervention and removal of risk factors.
- Grade 4: presence of dentoskeletal malocclusion and/or severe alterations of the occlusion, orthodontic treatment need.
- Grade 5: congenital facial malformations and syndromes, orthodontic treatment need.

Baby ROMA Index	Grade
Systemic Problems	
Maxillo-facial trauma with condylar fracture	5a
Maxillo-facial trauma without condylar fracture	2a
Congenital syndromes/malformations	5b
Postural/orthopaedic problems	2c
Medical or auxological conditions	2d
Inheritance of malocclusion	2e
Craniofacial Problems	
Facial or mandibular asymmetries	4f
TMJ dysfunctions	4g
Outcomes of trauma or surgery on the cranio-facial district	5j
Maxillary hypoplasia/mandibular hyperplasia OVJ<0	4k
Maxillary hypoplasia/mandibular hyperplasia OVJ>0	2k
Maxillary hyperplasia/mandibular hypoplasia OVJ>6mm	3h
Maxillary hyperplasia/mandibular hypoplasia 3mm<OVJ<6mm	2h
Dental Problems	
Caries and early loss of deciduous teeth	4l
Scissor bite	4m
Crossbite >2mm or lateral shift	4n
Crossbite <2mm or no laterl shift	2n
Displacement >2mm	3o
Displacement >1mm - absence of diastema	2o
Open bite >4mm	3p
Open bite >2mm	2p
Hypodontia/hyperdontia less than 2 teeth	3q
Hypodontia/hyperdontia more than 2 teeth	4q
OVB >5mm	2r
Poor oral hygiene	2t
Functional Problems	
Parafunction	2v
Thumb/finger sucking habit	2w
Oral breathing/OSAS	2x
None of the problems listed above	1

TABLE 1 Items of the Baby ROMA index.

Grade	N	%
1	260	16
2	750	46
3	142	9
4	435	27
5	29	2
TOTAL	1616	100

TABLE 2 Index grade recorded.

Materials and methods

Sample

The study is cross sectional. The sample included 1,616 children (808 males and 808 females), aged 3 to 6 years (mean age 4.7 years ± 0.9) visited in kindergartens in the cities of Rome (n= 1,248), Vicenza (n= 253), Messina (n= 76), Milan (n= 28). The visit consisted of a screening using the Baby ROMA index. Only children with complete deciduous or early mixed dentition, with no history of orthodontic treatment were included and whose parents parents gave their written informed consent to the visit.

Data collection, operator calibration and reproducibility criteria

The screening took place from September 2017 to April 2018. Data were collected using the Baby ROMA Index during screening visits carried out by calibrated operators inside kindergarten classroom.

All the examiners attended a course on the Baby ROMA index, given by two instructors (EGP and CG). The course was

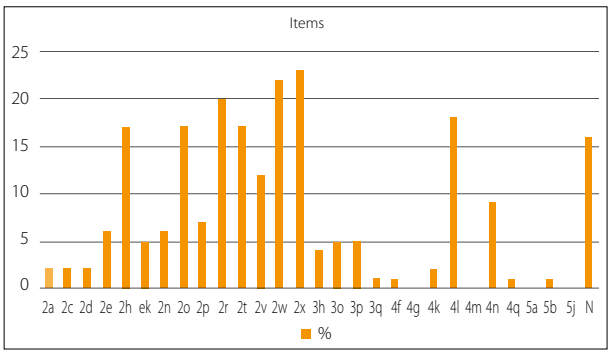

TABLE 3 Prevalence of the items.

Variable	Total sample	Sucking habits (2w)			Oral breathing (2x)		
	%	No	Yes	p	No	Yes	p
		%	%		%	%	
2h	17,3%	16,5%	20,1%	0,115	16%	22%	0,008
2k	4,9%	4,9%	4,7%	0,889	4,4%	6,5%	0,101
2n	6,1%	5,4%	8,4%	0,037	4,8%	5,1%	0,000
2o	17%	18,1%	12,8%	0,019	16,4%	18,7%	0,310
2p	6,6%	3,5%	17,3%	0,000	4,8%	12,5%	0,000
3h	4,1%	1,4%	13,4%	0,000	3,8%	5,1%	0,239
4k	2,4%	2,6%	1,7%	0,303	2,2%	3,3%	0,232
4n	9,4%	9,1%	10,6%	0,375	8,4%	12,7%	0,013
3o	4,8%	4,9%	4,5%	0,721	8,4%	12,7%	0,047
3p	4,5%	1,3%	15,9%	0,000	3,8%	6,8%	0,017

TABLE 4 Statistical significance of the association between sucking habits, oral breathing and index items.

GRADE INDEX – TRATMENT NEED	2w (%)	2x (%)	TOTAL of 2w and 2x (%)
2 – timetabled orthodontic checks	23	29	52
3-4-5 – early orthodontic treatment	30	24	54

TABLE 5 Prevalence of 2w and 2x in the grade index.

completed with clinical training.

Intra-examiner and inter-examiner reproducibility were calculated to verify the reliability of the index using K test. The intra-examiner reproducibility was tested comparing the data of 20 children examined by the same operator two weeks apart. The inter-examiner reproducibility was tested comparing data of a group of 20 children collected by two different operators. At the K test, a high correlation between operators was observed, therefore the index is highly reproducible. The K values of intra-examiner correlation ranged between 0.643 and 1.00 and the K values of inter-examiner correlation were between 0.773 and 1.00.

Statistical analysis

The data obtained were recorded in a computer programme (Microsoft Excel), and later analysed with the software SPSS 22.0 for Windows at the Department of Public Health and Infectious Diseases, 'Sapienza' University of Rome.

Prevalence of malocclusion was calculated on the basis of the degree of orthodontic risk determined by the index; then it was evaluated the prevalence with which non-nutritive sucking habits (NNSH, 2w) and oral breathing (2x) were found in association with the grades of the index and index items (increased overjet, reduced overjet, crossbite, open bite, displacement)

Chi-square and Fischer test were applied to verify the statistical significance of the association between the variables.

Results

Malocclusion (prevalence)

Table 2 shows data regarding the prevalence of malocclusion. The percentage of children with moderate to severe grades is 38% (grade 3= 9%; grade 4= 27%; grade 5= 2%). 46% of the sample has grade 2 with early signs of malocclusion in association with oral breathing and/or bad habits. Only 16% of the sample is totally healthy with nothing to report (grade 1).

As in table 3, the most common index items were displacement (22%), increased overjet (21%), increased overbite (20%), caries and early deciduous loss (18%), poor oral hygiene (18%), crossbite with lateral shift (15%), open bite (12%), negative overjet (7%).

Sucking habits and oral breathing (prevalence and association with index grade and index items)

Prevalence of non-nutritive sucking habits (2w) was 22%, while prevalence of mouth breathing (2x) was 23% (Table 3).

Table 4 shows the results regarding the association between sucking habits, oral breathing and items index. Both sucking habits and oral breathing resulted associated with open bite (2p, 3p). Sucking habits were associated with overjet >6 mm (3h), cross bite without lateral shift (2n) and open bite (2p, 3p). Oral breathing was associated with overjet 3–6 mm (2h), cross bite (2n, 4n), displacement >2 mm (3o) and moderate and severe open bite (2p, 3p). These associations were all statistically significant after Chi Square and Fischer test ($p<0.05$).

Discussion

Habits are acquired automatisms, represented by an altered pattern of muscle contraction with complex characteristics, which proceed unconsciously and on a regular basis. Repetitive behaviour or habit is common in infancy and mostly start and stop spontaneously. An oral habit in infancy and early childhood is normal, while it is considered abnormal over 3 years of age. Parafunctional habits are acquired by practicing a nonfunctional or unnecessary action, such as thumb or lip sucking, bruxism, mouth breathing and tongue thrusting. The persistence of deleterious parafunctional oral habits has bad

effect on child health and play a significant role in altering the position of the teeth, the inter-arch relationship, interfering with the normal growth of the jaws, and the function of the orofacial musculature [Gòis et al., 2012]

The present study aimed to provide detailed insight into the prevalence of clinically relevant occlusal traits and their relationship with oral habits at the early occlusion development stages, in order to plan reliable orthodontic prevention protocols. Orthodontic prevention and early treatment are fundamental for promoting eugnatic dentoskeletal growth. Absence of malocclusion in primary dentition is a favourable prognostic factor for the development of a good occlusion in mixed and permanent dentition; conversely, malocclusion in deciduous dentition usually persists in mixed and permanent dentition too [Majorana et al., 2015].

We found a statistically significant association ($p < 0.05$) between mouth breathing, bad habits and some malocclusions (open bite, crossbite, increased overjet and displacement) so we believe that mouth breathing and bad habits in preschoolers can be considered risk factors for malocclusion.

In our study prevalence of malocclusion and treatment need were verified by means of the Baby ROMA index. Thirty-eight percent of the sample (grade 3, 4 and 5) had already clinically clear malocclusion that need orthodontic treatment and more than half of them had also risk factor 2w and 2x (Table 5); 46% of the sample (grade 2) has risk factors for malocclusion (Table 5) and malocclusion traits (as in Table 3) which, without risk factors, could improve with growth. So In these cases it is necessary to correct the bad habits and promote nasal breathing, also with help of speech therapy or ENT treatment, and carry out periodic orthodontic checks to monitor the occlusion or promptly intervene in case of worsening. Sixteen percent (grade 1) of the sample had no risk factors and no signs of malocclusion, so they need only routine checks to monitor the occlusion and the craniofacial growth.

There are many studies about the prevalence of malocclusion in deciduous dentition, giving results ranging from 30–90%, depending on the population and the data collection methods [Souki et al., 2009].

Our results are in agreement with other studies conducted which used the Baby ROMA or ROMA index [Grippaudo et al., 2014; Majorana et al., 2015; Grippaudo et al., 2016] or studies with a sample made of Italian children [Vitale et al., 2015].

Non-nutritive sucking habits (NNSH)

Sucking behaviours are physiological habits in newborns as they are associated with physical and psychological development. The activity of sucking stimulates orofacial muscles and contributes to normal growth, but persistent non-nutritive sucking habits may result in long-term problems and can affect the stomatognatic system, leading to an imbalance between external and internal muscles [Saccomanno et al., 2012]. The prevalence of NNSH was 22% and a statistically significant association was found with anterior open bite, increased overjet, posterior crossbite and dental crowding. Such findings are not surprising, as numerous studies have linked non-nutritive sucking habits to malocclusion [Warren et al., 2001; Katz et al., 2004].

Anterior open bite is the most common malocclusion in children who have bad habits [Lopes Freire et al., 2016]. The pacifier or the thumb interfere with dental eruption and skeletal development, causing alteration of dentoskeletal growth and anterior open bite. If the bad habit is stopped, anterior open bite often tends to self-correct [Silvestrini Biavati et al., 2016], so early interruption of the bad habit is needed. In our study the association between open bite (2p, 3p) and bad habits is highly significant (p=0.000) (Table 5). Increased overjet has been associated with finger sucking. The pressure of the finger causes retrognathia, protrusion of premaxilla, proinclination of upper incisors and negative inclination of lower incisors [Larsson, 1994]. These alterations contribute to determine an increased overjet.

In our study, non-nutritive sucking habits were associated with item 3h, which refers to a severe Class II malocclusion with overjet >6 mm (p=0.000) and need for orthodontic intervention and removal of risk factors.

The association between posterior crossbite and non-nutritive sucking habits is controversial [Klein, 1986; Vig, 1998].

Prolonged sucking activity may interfere with transversal development of maxilla and the low position of the tongue may promote lower arch expansion, resulting in a posterior crossbite [Primožič et al., 2013].

In our study non-nutritive sucking habits is statistically associated with item 2n, posterior cross bite without lateral shift (p=0.037), that requires close monitoring and removal of risk factors.

Mouth breathing

Nasal breathing is considered a key factor for normal development of skeletal jaws.

Allergic rhinitis and enlarged adenoids can cause airway obstruction, resulting in mouth breathing. It leads postural changes such as lip incompetence, low position of the tongue and increased vertical facial height for clockwise rotation of the jaw [Harari et al., 2010]. The association between poor nasal breathing and dentofacial morphology has been studied extensively and many authors believe that the pattern of craniofacial growth can be affected by unbalanced muscle function typical of mouth breathing [Zicari et al., 2009]. Facies adenoidea is the typical alteration described in individuals who breath through the mouth and dental malocclusion is recurrent too [Abreu et al., 2008]. However, there is still a lack of consensus regarding the role of mouth breathing on orofacial alterations: only some of mouth breathers have adenoid facies and not all of them have the same occlusal traits; so many authors give more importance to genetics.

In this study, the prevalence of open bite is 23%, and a statistically significant association ($p<0.05$) was found with anterior open bite (2p, 3p), increased overjet (2h), posterior crossbite (2n, 4n) and displacement (3o).

Oral breathers have often open mouth and a low posture of the tongue, so there is a lack of thrust of the tongue on the palate causing a transverse maxillary skeletal deficit and crossbite. Moreover they have a clockwise rotation and distal positioning of lower jaw, developing increased overjet and anterior open bite.

Bresolin et al. [1983] found that mouth breathers had long faces with narrower maxilla and retrognathic jaws, with iperextrusion of molars, due to the open positioning of the mouth, that can determine anterior open bite.

The influence of breathing on the craniofacial morphology, such as the obstruction of the upper airways resulting in mouth breathing, changes the pattern of craniofacial growth with typical facial features and dentition: long face, contraction of the upper dental arch, high-arched palate, gummy smile, dental malocclusion both Class II and Class III [Harari et al., 2010]. In mouth breathing there was a higher prevalence of posterior crossbite, anterior open bite and Class II malocclusion [Laganà et al., 2013] and this agrees with our results.

Conclusion

The development of a correct, stable and functional

occlusion is the result of several factors, both genetic and environmental. The latter should be monitored during growth so that it is possible to early intercept the factors that endanger the physiological dento-skeletal growth.

We believe that oral habits and mouth breathing can affect occlusion precociously and, if not removed, can develop a malocclusion or make it worse. So it is important to erlier intercept and remove risk factors, in order to prevent malocclusion and promote a normal dento-skeletal growth.

Our study shows that mouth breathing and bad habits are closely associated with malocclusion and are found in over half of preschoolers with malocclusion; 38% of preschoolers have malocclusion and need early orthodontic treatment, often in association with logopedic and ENT therapies for removal of associated risk factors; 46% of preschoolers have risk factors for malocclusion that need to be immediately removed or have early malocclusion traits which could worsen in the presence of risk factors. These patients need periodic orthodontic check-ups often associated with myofunctional therapy, speech therapy, allergological checks or ENT treatment; 16% of preschoolers is definitely healthy and need only periodic orthodontic checks to monitor occlusion and craniofacial growth.

Sucking habits and oral breathing are both closely related to some malocclusions for which they can be considered risk factors (anterior open bite, posterior crossbite, increased overjet and displacement).

Orthodontic prevention should aim at removing risk factors in order to promote a correct dento-skeletal growth.

Close collaboration is needed between different specialists (paediatrician, allergist, ENT specialist, orthodontist, speech therapist) to promote early diagnosis and treatment.

References

» Abreu RR, Rocha RL, Lamounier JA et al. Etiology, clinical manifestations and concurrent findings in mouth-breathing children. J Pediatr (Rio J). 2008;84(6):529-535.
» Basheer B, Hegde KS, Bhat SS et al. Influence of mouth breathing on the dentofacial growth of children: a cephalometric study. J Int Oral Health. 2014;6(6):50-5.
» Bresolin D, Shapiro PA, Shapiro GG et al. Mouth breathing in allergic children: its relationship to dentofacial development. Am J Orthod. 1983 Apr;83(4):334-40.
» Caramez Da Silva F, Giugliani ER, Pires SC. Duration of breastfeeding and distoclusion in the deciduous dentition. Breastfeed Med 2012; 7: 464–8.
» Cattoni DM, Fernandes FDM, Di Francesco RC, Latorre MRDO. Quantitative evaluation of the orofacial morphology: anthropometric measurements in healthy and mouth-breathing children. Int J Orofacial Myology. 2009;35:44-54
» Correa-Faria P, Ramos-Jorge ML, Martins-Junior PA et al. Malocclusion in preschool children: prevalence and determinant factors. Eur Arch Paediatr Dent 2014;15: 89–96.
» Franco LP, Souki BQ, Cheib PL et al. Are distinct etiologies of upper airway obstruction in mouth-breathing children associated with different cephalometric patterns? Int J Pediatr Otorhinolaryngol. 2015;79(2):223-8.
» Galan-Gonzalez AF, Aznar-Martín T, Cabrera-Dominguez ME et al. Do breastfeeding and bottle feeding influence occlusal parameters? Breastfeed Med 2014; 9: 24–9.
» Góis EGO, Ribeiro-Júnior HC, Vale MPP et al. Influence of nonnutritive sucking habits, breathing pattern and adenoid size on the development of malocclusion. Angle Orthod. 2008;78(4):647-654.
» Góis EG, Vale MP, Paiva SM et al. Incidence of malocclusion between primary and mixed dentitions among brazilian children. A 5-year longitudinal study. Angle Orthod. 2012;82(3):495-500
» Grippaudo C, Paolantonio EG, Pantanali F et al. Early orthodontic treatment: A new index to assess the risk of malocclusion in primary dentition. Eur J Paediatr Dent. 2014;15(4):401-406.
» Grippaudo C, Paolantonio EG, Antonini G et al. Association between oral habits, mouth breathing and malocclusion. Acta Otorhinolaryngol Ital. 2016; 36(5):386-394.
» Harari D, Redlich M, Miri S et al. The effect of mouth breathing versus nasal breathing on dentofacial and craniofacial development in orthodontic patients. Laryngoscope. 2010;120(10):2089-2093.
» Katz CRT, Rosenblatt A, Gondim PPC. Nonnutritive sucking habits in brazilian children: Effects on deciduous dentition and relationship with facial morphology. Am J Orthod Dentofacial Orthop. 2004;126(1):53-57.
» Klein JC. Nasal respiratory function and craniofacial growth. Arch Otolaryngol Head Neck Surg. 1986;112(8):843-849.
» Kluemper GT, Vig PS, Vig KW. Nasorespiratory characteristics and craniofacial morphology. Eur J Orthod. 1995;17:491.
» Laganà G, Fabi F, Abazi Y, Beshiri Nastasi E, Vinjolli F, Cozza P. Oral habits in a population of Albanian growing subjects. Eur J Paediatr Dent. 2013 Dec;14(4):309-13.
» Lee SY, Guilleminault C, Chiu HY et al. Mouth breathing, "nasal disuse," and pediatric sleep-disordered breathing. Sleep Breath. 2015;19(4):1257-64.
» Larsson E. Artificial sucking habits: Etiology, prevalence and effect on occlusion. Int J Orofacial Myology. 1994;20:10-21
» Limeira AB, Aguiar CM, Bezerra N et al. Association between breast-feeding duration and posterior crossbites. J Dent Child 2014; 81: 122–7.
» Lopes-Freire GM, Cahuana Cárdenas AB, Espasa Suarez de Deza JE et al. Exploring the association between feeding habits, non-nutritive sucking habits, and malocclusions in the deciduous dentition. Prog Orthod 2015; 16: 1–7.
» Lopes Freire GM, Espasa Suarez de Deza JE, Rodrigues da Silva IC, Butini Oliveira L, Ustrell Torrent JM, Boj Quesada JR. Non-nutritive sucking habits and their effects on the occlusion in the deciduous dentition in children. Eur J Paediatr Dent. 2016 Dec;17(4):301-306.
» Majorana A, Bardellini E, Amadori F et al. Timetable for oral prevention in childhood--developing dentition and oral habits: A current opinion. Prog Orthod. 2015;16:39.
» Melink S, Vagner MV, Hocevar-Boltezar I et al. Posterior crossbite in the deciduous dentition period, its relation with sucking habits, irregular orofacial functions, and otolaryngological findings. Am J Orthod Dentofacial Orthop. 2010;138(1):32-40.
» Milanesi JM, Borin G, Corrêa ECR et al. Impact of the mouth breathing occurred during childhood in the adult age: biophotogrammetric postural analysis. Int J Pediatr Otorhinolaryngol. 2011;75(8):999-1004.
» Peres KG. Exclusive breastfeeding and risk of dental malocclusion. Pediatrics 2015; 136:60–7.
» Primožič J, Franchi L, Perinetti G et al. Influence of sucking habits and breathing pattern on palatal constriction in unilateral posterior crossbite--a controlled study. Eur J Orthod. 2013;35(5):706-712.
» Saccomanno S, Antonini G, D'Alatri L, D'Angelantonio M, Fiorita A, Deli R. Causal relationship between malocclusion and oral muscles dysfunction: a model of approach. Eur J Paediatr Dent. 2012 Dec;13(4):321-3.
» Salone L. R., Vann W. F., Dee D. L. Breastfeeding an overview of oral and general health benefits. J Am Dent Assoc. 2013; 144: 143–51.
» Scarano E, Ottaviani F, Di Girolamo S et al. Relationship between chronic nasal obstruction and craniofacial growth: An experimental model. Int J Pediatr Otorhinolaryngol. 1998;45(2):125-131.
» Silva M, Manton D. Oral habits--part 1: The dental effects and management of nutritive and non-nutritive sucking. J Dent Child 2014;81(3):133-139.
» Silveira, LM, Sauer, L, Maria A et al. Influence of breastfeeding on children's oral skills. Rev Saúde Pública 2013; 47: 37–43.
» Silvestrini-Biavati A, Salamone S, Silvestrini-Biavati F et al. Anterior open-bite and sucking habits in italian preschool children. Eur J Paediatr Dent. 2016;17(1):43-46.
» Souki BQ, Pimenta GB, Souki MQ et al. Prevalence of malocclusion among mouth breathing children: do expectations meet reality? Int J Pediatr Otorhinolaryngol. 2009;73(5):767-73.
» Tomita NE, Bijella VT, Franco LJ. [The relationship between oral habits and malocclusion in preschool children]. Rev Saude Publica. 2000;34(3):299-303.
» Vig KW. Nasal obstruction and facial growth: The strength of evidence for clinical assumptions. Am J Orthod Dentofacial Orthop. 1998;113(6):603-611.
» Viggiano F, Fasano D, Monaco G et al. Breast feeding, bottle feeding and non-nutritive sucking; effects on occlusion in deciduous dentition. Arch Dis Child 2004; 89: 1121–3.
» Vitale MC, Barbieri F, Ricotta R et al. Epidemiological study of dental and facial asymmetries in a sample of preschool subjects. Epidemiol Prev. 2015;39(1):45-51
» Warren JJ, Bishara SE, Steinbock KL et al. Effects of oral habits' duration on dental characteristics in the primary dentition. J Am Dent Assoc. 2001;132(12):1693.
» Warren JJ, Bishara SE. Duration of nutritive and nonnutritive sucking behaviours and their effects on the dental arches. Am J Orthod Dentofacial Orthop 2002; 121: 347–56.
» Zicari AM, Albani F, Ntrekou P, Rugiano A, Duse M, Mattei A, Marzo G. Oral breathing and dental malocclusions. Eur J Paediatr Dent. 2009 Jun;10(2):59-64.