Association Between Breastfeeding Type and Duration and the Molar and Facial Characteristics of Preschoolers Aged 2 To 6 Years: A Cross-Sectional Study

Catherine Sharlot Alarcón-Calle * / Ingrid Góngora- León** / Aron Aliaga-Del Castillo*** / Carlos Flores-Mir**** / Luis Ernesto Arriola-Guillén*****

Objective: *To calculate the association between the type and duration of breastfeeding and the deciduous molar relationship and facial characteristics of preschoolers aged 2 to 6 years.* ***Study design:*** *This cross-sectional study included 160 pre-schoolers aged 2 to 6 years old, enrolled in the 2019 academic year from 3 public schools in Data collection involved two phases. The first phase consisted in determining the facial type, anteroposterior and vertical profile, facial dimensions, and the molar relationship between primary second molars. The second phase included interviews with the parents or legal guardians. Children with exclusive breastfeeding and with mixed/artificial feeding (breastfeeding and bottle-feeding, or exclusive artificial bottle-feeding) were included. Chi-square test, t-test, multiple linear regression, and binary logistic regression tests were applied (p<0.05).* ***Results:*** *The facial length, width, and the lower third were greater in the exclusive breastfeeding group than in the mixed/artificial feeding group (3.74mm, p=0.002; 2.06mm, p=0.047; and 2.94mm, p=0.015; respectively). In addition, children with breastfeeding for more than six months showed greater facial length, facial width and lower third (3.20mm, p= 0.038; 3.68mm, p=0.006; and 3.57mm, p=0.026; respectively). The duration of exclusive breastfeeding influenced facial width, noting an increase of 3.32mm (p=0.011) if a pre-schooler had exclusive breastfeeding for more than six months.* ***Conclusions:*** *There were no significant associations between type and duration of breastfeeding and the molar terminal plane, facial type, or profile. However, facial dimensions were greater in the exclusive breastfeeding group, and when breastfeeding was longer than six months.*

Keywords: *Breastfeeding; Preschool; Face; Primary dentition*

*Catherine Sharlot Alarcón-Calle, Division of Pediatric Dentistry, School of Dentistry, Universidad Científica del Sur, Lima, Perú.
**Ingrid Góngora- León, Division of Pediatric Dentistry, School of Dentistry, Universidad Científica del Sur, Lima, Perú.
***Aron Aliaga-Del Castillo, Department of Orthodontics, Bauru Dental School, University of São Paulo, Bauru, São Paulo, Brazil.
****Carlos Flores-Mir, Department of Orthodontics, University of Alberta, Edmonton, Alberta, Canada.
*****Luis Ernesto Arriola-Guillén, Division of Orthodontics, School of Dentistry, Universidad Científica del Sur, Lima, Perú.

Corresponding Author:
Luis Ernesto Arriola-Guillén,
Division of Orthodontics, School of Dentistry, Universidad Científica del Sur, Lima, Perú. Av. Paseo de la República 5544, Miraflores 15074, Lima, Perú
E-mail: luchoarriola@gmail.com

INTRODUCTION

Breastfeeding goes far beyond a nutritional function as it also impacts the infants' growth and healthy development.[1-3] The Pan American Health Organization and the World Health Organization (PAHO / WHO) recommend breastfeeding as a sole source of nutrition during the first six months of life.[4-6]

When infants are breastfed, they make a great muscular effort to cover their nutritional needs, which contributes to the maturation of the masticatory muscles, stimulates mandible development and growth, allows an adequate synchronization of functions of the respiratory and stomatognathic systems (suction, breathing, deglutition, mastication, and phonation) and an adequate differentiation of the temporomandibular joints.[2,7,8]

At birth, infants have a convex profile due to the physiological posterior position of the mandible, which is later compensated by mandibular growth itself; however, breastfeeding will likely help to restructure the oral cavity shape, contributing to the mandible advancement, reaching an adequate initial molar relationship in the primary dentition (molar terminal plane). For this reason, some authors describe breastfeeding as the first natural functional orthopedic treatment.[3,9,10]

 doi 10.17796/1053-4625-46.3.10

In the literature, there is some previous assessments of the association between the duration of exclusive breastfeeding for a period shorter than six months and the presence of parafunctional habits, concluding that the shorter the duration of breastfeeding, the more parafunctional habits and malocclusions occurred.[11-13] The permanent dentition molar relationship (Class I, II, or III) depends on the mesial step, flush terminal plane, or distal step of the deciduous second molars. The duration of exclusive breastfeeding for a period shorter than six months has been associated with a higher prevalence of a posterior crossbite and a narrower maxillary arch in the temporary dentition; and also made infants more prone to the habit of using a pacifier.[12,13] Also, it has even been observed that in these children, there is a higher prevalence of Class II malocclusions. A distal step does have been associated with changes in the anteroposterior and vertical facial profile.[13]

Although facial biotype is known to have a genetic etiological component, it is also influenced by environmental factors such as breastfeeding. However, no association between the type and duration of breastfeeding with the molar terminal plane and facial characteristics has not been evaluated. Therefore, the purpose of this research was to calculate the association between the type and duration of breastfeeding and the deciduous molar relationship and facial characteristics of preschoolers aged 2 to 6 years.

MATERIALS AND METHOD

Two hundred and twenty pre-schoolers aged 2 to 6 years old, born in Peru and with Peruvian ancestry, registered in the 2019 academic year from 3 public schools located in the were evaluated. All children that fulfil the inclusion criteria (160 pre-schoolers) were included in the study. (Figure 1)

Groups were formed to evaluate each aspect studied:

Exclusive Breastfeeding: included pre-schoolers with only exclusive breastfeeding from birth to 6 months and then other types of meals according to their age.

Mixed/ Artificial: included pre-schoolers with other type of breastfeeding and use bottle, cup, glass from birth and afterwards.

The inclusion criteria consisted of: preschoolers aged 2 to 6 years old with complete primary dentition, whose parents or legal guardians agreed to participate in this research using informed consent. The exclusion criteria comprised: the presence of erupted or erupting permanent first molars, second primary molars with morphological characteristics that did not allow the establishing the molar terminal plane, presence of dental alterations in shape, size and number, macroglossia, dental absence, patients with a history of cleft lip/palate or any other surgery, with craniofacial anomalies, intellectual disability, or infants with fixed or removable oral appliances, caries or restorative work, patients with allergies and/or respiratory diseases (asthma, bronchitis, etc), habits (thumb sucking, atypical sucking, etc.) and with genetic problems.

Data collection involved two phases: the first consisted on assessing the occlusal characteristic and facial proportions of the pre-schoolers, and the second phase consisted of interviews with the parents or legal guardians about their breastfeeding habits.

Examination method

First Phase

Facial Type

A clinical facial evaluation was carried out through an extraoral examination where the facial type was identified. For this evaluation,

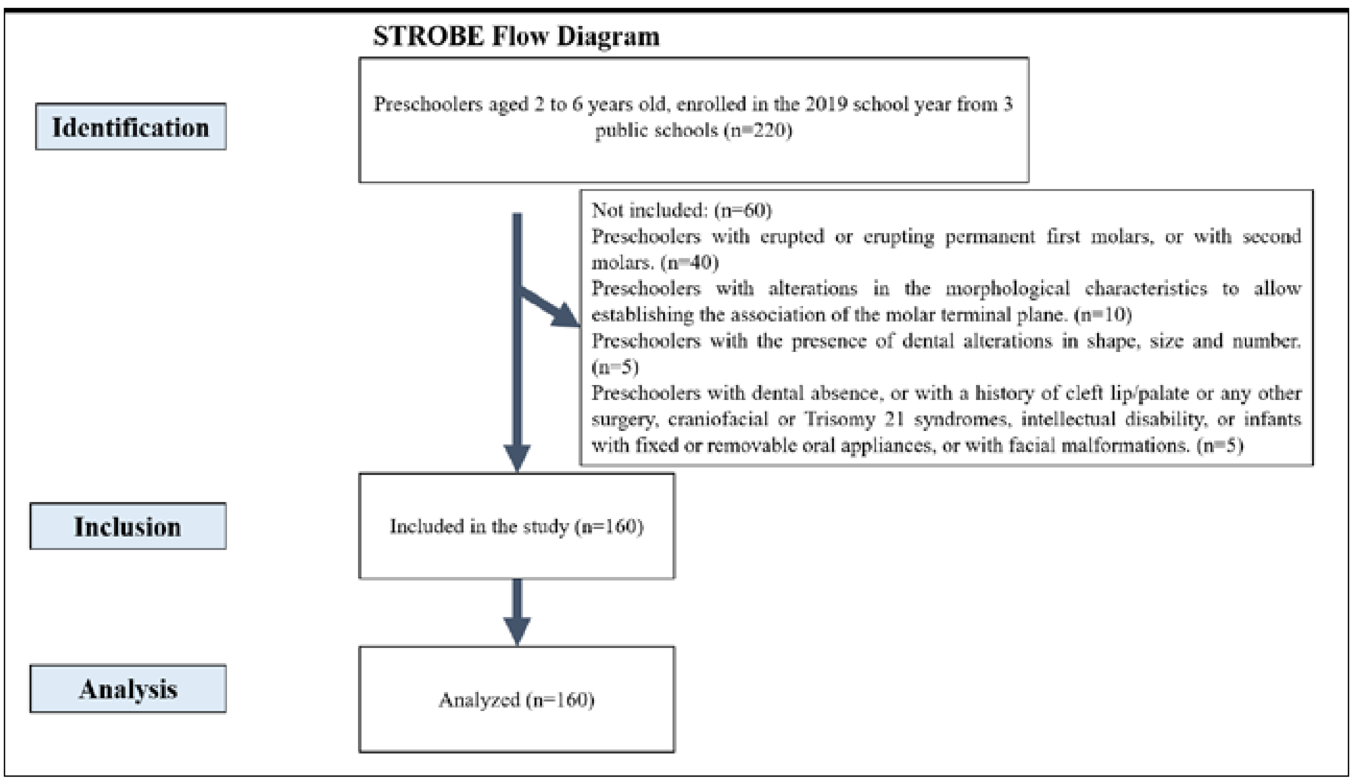

Figure 1: Flow chart to obtain the final sample.

the pre-schooler had their lips at rest, ears visible, hair up, and was looking at the observer (frontal plane). In this position, the Facial Morphological Index (FMI) was assessed.[14,15] This index is defined as the relationship between the facial morphological height (Na-Gn) x 100 and the bizygomatic width (Zy-Zy) measured in the face, from end to end, in front of the Tragus. This allowed us to classify the patients in three facial types: dolichofacial or elongated face when the value was ≥ 88mm; Mesofacial or medium face, when the value ranged from 84 to 87.9mm; and Brachyfacial or wide face, when the value was ≤ 83.9mm.

Anteroposterior Facial Profile

Imaginary lines were drawn joining three anatomical points: glabella, subnasale, and pogonion. It was classified as straight when the value was between 160.7° and 171.8°; concave, when the value was > 171.8° and convex when the value was < 160.7°.[16]

Vertical Facial Profile

It was measured with the preschooler's face in profile, comparing the Camper plane (the imaginary plane that goes from the tragus of the external ear to the inferior border of the ala of the nose) with the mandibular plane (the imaginary plane that goes along the lower border of the mandibular edge). They were classified as follows: Normodivergent: when the two planes slightly joined behind the ear (normal vertical growth); hypodivergent: when the two planes met distantly behind the ear (decreased vertical growth); and hyperdivergent: when both planes joined in front of the ear (increased vertical growth).

Facial Length

The facial length (measured from point Na to Me), facial width (measured from end to end in front of the Tragus), and lower facial third (measured from menton to the nasal septum base). These measurements were registered with a digital calliper in millimetres, with the patient in maximum intercuspation (MIC), lips at rest, and a straight head.

Intraoral examination

In the intraoral examination, the molar terminal plane was identified when the pre-schooler was in habitual occlusion, with petroleum jelly previously placed at the corners and using mono-active cheek retractors to observe the upper second deciduous molar concerning its lower molar. A flush terminal plane was determined when the distal surfaces of both molars coincide in the same plane; a mesial step; when the distal surface of the lower second molar was mesial to the distal surface of the upper second molar; and distal step, when the distal surface of the lower second molar was distal to the surface of the upper second molar.[17-19]

Second Phase

Mothers or legal guardians of the pre-schoolers were interviewed in a private room, separated from their children, avoiding distractions and generating more confidence to collect relevant data regarding the type of breastfeeding (exclusive breastfeeding, mixed or artificial), and duration of breastfeeding (only for exclusive breastfeeding or mixed) were classified as follows: up to six months, or more than six months.

Reliability

Forty percent of the sample was re-evaluated after a 10-day interval. Intraobserver calibration was evaluated with the Kappa coefficient and Intraclass Correlation Coefficient (ICC), for the qualitative and quantitative variables.

Statistical analysis

The associations between type and duration of breastfeeding with the molar terminal plane and facial characteristics were evaluated with Chi-square tests.

Comparisons regarding facial dimensions between groups with exclusive breastfeeding vs. mixed/artificial feeding and between groups with breastfeeding less or up to 6 months vs. over six months were performed with t-tests.

Multiple linear regressions were used to assess the influence of the predictor variables on the facial dimensions. Finally, a binary logistic regression was applied to evaluate the influence of the predictor variables on establishing a flush or distal step. All analyses were performed using the SPSS software (version 26.0, IBM, Armonk, NY), considering a significance level 0.05.

RESULTS

Reliability was considered adequate. The Kappa coefficient and the ICC values were greater than 0.9 for all variables.

One hundred and sixty pre-schoolers (82 girls and 78 boys) were evaluated. Children in the exclusive breastfeeding group showed a mean age of 3.98 ± 1.02 years old, and children in the mixed/artificial feeding group showed a mean age of 3.44 ± 1.04 years old.

No statistically significant associations were found between type and duration of breastfeeding (only for exclusive breastfeeding or mixed) with the deciduous molar relationship, facial type or profile. (Tables I and II)

The facial length, width, and the lower third were greater in the exclusive breastfeeding group than in the mixed/artificial feeding group (mean differences of 3.74mm, p=0.002; 2.06mm, p=0.047; and 2.94mm, p=0.015; respectively). Children with exclusive breastfeeding for more than six months showed greater facial length, facial width, and lower third when compared to children that were breastfed less than six months (mean differences of 3.20mm, p = 0.038; 3.68mm, p = 0.006; and 3.57mm, p = 0.026; respectively). (Table III)

The multiple linear regression analyses identified breastfeeding duration as an influencing factor in facial width, noting an increase of 3.32mm, respectively, if a preschooler had exclusive breastfeeding for more than six months (p=0.011). (Table IV) Besides, the children´s age influenced the facial length and width, showing an increase of 3.95 mm and 2.25 mm in older children (p<0.001). No influences of the type or duration of breastfeeding on the establishment of a flush or distal molar terminal plane were found. (Table V)

 doi 10.17796/1053-4625-46.3.10

Table I. Association between the type of breastfeeding and the establishment of the molar terminal plane and facial characteristics.

Type of breastfeeding Mesial		Type of terminal plane				
		Flush or distal		Total	p	
Exclusive breastfeeding	n	76	13		89	0.667
	%	85.4%	14.6%		100.00%	
Mixed/artificial	n	58	13		71	
	%	81.7%	18.3%		100.00%	
Total	n	133	26		160	
	%	83.6%	16.4%		100.00%	
Type of breastfeeding Mesofacial		**Facial type**				
		Brachyfacial	**Dolichofacial**	**Total**	**p**	
Exclusive breastfeeding	n	36	40	13	89	0.951
	%	40.4%	44.9%	14.6%	100.00%	
Mixed/artificial	n	27	33	11	71	
	%	38,00%	46.5%	15.5%	100.00%	
Total	n	63	73	24	160	
	%	39.4%	45.6%	15,00%	100.00%	
Type of breastfeeding Straight		**Anteroposterior facial profile**				
		Concave	**Convex**	**Total**	**p**	
Exclusive breastfeeding	n	42	5	42	89	0.168
	%	47.2%	5.6%	47.2%	100.00%	
Mixed/artificial	n	28	10	33	71	
	%	39.4%	14.1%	46.5%	100.00%	
Total	n	70	15	75	160	
	%	43.8%	9.4%	46.9%	100.00%	
Type of breastfeeding Normodivergent		**Vertical facial profile**				
		Hypodivergent	**Hyperdivergent**	**Total**	**p**	
Exclusive breastfeeding	n	51	8	30	89	0.103
	%	57.3%	9,00%	33.7%	100.00%	
Mixed/artificial	n	33	3	35	71	
	%	46.5%	4.2%	49.3%	100.00%	
Total	n	84	11	65	160	
	%	52.5%	6.9%	40.6%	100.00%	

Chi-square test

Table II. Association between the duration of breastfeeding and the establishment of the molar terminal plane and facial characteristics.

Duration of breastfeeding Mesial		Type of terminal plane				
		Flush or distal		Total	p	
Less than or up to 6 months	n	23	6		29	
	%	79.3%	20.7%		100.00%	
Over 6 months	n	95	17		112	0.474
	%	84.8%	15.2%		100.00%	
Total	n	118	23		141	
	%	83.7%	16.3%		100.00%	

Duration of breastfeeding Mesofacial		Facial type				
		Brachyfacial	Dolichofacial	Total	p	
Less than or up to 6 months	n	8	17	4	29	
	%	27.6%	58.6%	13.8%	100.00%	
Over 6 months	n	50	47	15	112	0.219
	%	44.6%	42.00%	13.4%	100.00%	
Total	n	58	64	19	141	
	%	41.1%	45.4%	13.5%	100.00%	

Duration of breastfeeding Straight		Anteroposterior facial profile				
		Concave	Convex	Total	p	
Less than or up to 6 months	n	16	2	11	29	
	%	55.2%	6.9%	37.9%	100.00%	
Over 6 months	n	50	8	54	112	0.584
	%	44.6%	7.1%	48.2%	100.00%	
Total	n	66	10	65	141	
	%	46.8%	7.1%	46.1%	100.00%	

Duration of breastfeeding Normodivergent		Vertical facial profile				
		Hypodivergent	Hyperdivergent	Total	p	
Less than or up to 6 months	n	15	4	10	29	
	%	51.7%	13.8%	34.5%	100.00%	
Over 6 months	n	61	6	45	112	0.282
	%	54.5%	5.4%	40.2%	100.00%	
Total	n	76	10	55	141	
	%	53.9%	7.1%	39.0%	100.00%	

Chi-square test

Table III. Comparison of facial dimensions, type of breastfeeding and duration of breastfeeding.

Measurement	Type of breastfeeding	n	Mean	SD	p	Mean difference	95% Confidence Interval	
							Lower	Upper
Facial length	Exclusive breastfeeding	89	100.18	7.75	0.002*	3.74	1.44	6.04
	Mixed/artificial feeding	71	96.44	6.75				
Facial width	Exclusive breastfeeding	89	108.92	6.53	0.047*	2.06	0.02	4.10
	Mixed/artificial feeding	71	106.86	6.43				
Lower third	Exclusive breastfeeding	89	54.19	7.13	0.015*	2.94	0.58	5.31
	Mixed/artificial feeding	71	51.25	7.99				
	Duration of breastfeeding							
Facial length	Less than or up to 6 months	29	96.61	6.68	0.038*	-3.20	-6.25	-0.17
	Over 6 months	112	99.82	7.54				
Facial width	Less than or up to 6 months	29	105.28	6.41	0.006*	-3.68	-6.26	-1.10
	Over 6 months	112	108.95	6.23				
Lower third	Less than or up to 6 months	29	50.38	10.14	0.026*	-3.57	-6.71	-0.43
	Over 6 months	112	53.95	6.83				

T Test

* Statistically significant at $p<0.05$

Table IV. Multiple Linear Regression to know the influence of the evaluated predictor variables regarding facial length and width.

Predictor Variable	Values	Facial length				Facial width			
		B	p	95.0% Confidence Interval for B		B	p	95.0% Confidence Interval for B	
				Lower Limit	Upper Limit			Lower Limit	Upper Limit
(Constant)		81.39	<0.001*	75.90	86.89	97.17	<0.001*	92.06	102.28
Type of breastfeeding	Exclusive breastfeeding	---	---	---	---	---	---	---	---
	Mixed/artificial feeding	-0.45	0.701	-2.78	1.88	-0.13	0.903	-2.30	2.03
Duration of breastfeeding	Less than or up to 6 months	---	---	---	---	---	---	---	---
	Over 6 months	2.42	0.082	-0.31	5.15	3.32	0.011*	0.77	5.86
Sex	Female	---	---	---	---	---	---	---	---
	Male	1.77	0.107	-0.39	3.93	-0.40	0.688	-2.42	1.60
Age	Years old	3.95	<0.001*	2.84	5.05	2.25	<0.001*	1.23	3.28

R2 facial length = 30.4%

R2 facial width = 18.6%

* Statistically significant at $p<0.05$

Table V. Binary logistic Regression to predict the establishment of flush or distal terminal plane according to the evaluated predictor variables.

Predictor Variable	Values	p	Exp. (B)	I.C. 95% for EXP(B)	
				Lower	Upper
Type of infant breastfeeding	Breastfeeding	---	---	---	---
	Mixed/artificial feeding	0.875	1.08	0.39	2.98
Duration of breastfeeding	Less than or up to 6 months	---	---	---	---
	Over 6 months	0.592	0.73	0.23	2.29
Sex	Female	---	---	---	---
	Male	0.273	1.71	0.65	4.48
Age	Years	0.115	0.67	0.40	1.10
Constant		0.826	0.76		

Cox and Snell R2 = 3.9%

DISCUSSION

The children´s facial dimensions are in constant change. They are influenced by the time of gestation, the head circumference at birth, the type of diet, the presence of oral habits, sex, and environmental factors such as the place of birth, environment conditions, and socioeconomic strata.[20-27] Likewise, direct stimuli such as breastfeeding,[20-22] breathing, mastication, deglutition, and phonation can also influence craniofacial growth. [28,29] Therefore, the global recommendations for optimal infant feeding include exclusive breastfeeding during the first six months of life, which constitutes a normative standard, not only as an immunological, nutritional, and affective contribution but as a functional contribution.[30]

This research sought to evaluate the influence of the type and duration of breastfeeding on the establishment of the molar terminal plane and the facial characteristics of preschoolers, understanding that breastfeeding directly influences the formation of the oral cavity and infant´s mandibular growth. At birth, they have a convex profile due to the posterior position of the mandible. Then, the muscular stimulation caused by breastfeeding makes the mandible grow in a forward direction. Thus, obtaining adequate facial growth and consequently, an adequate molar terminal plane.[11]

This study included 160 Peruvian pre-schoolers with indigenous facial features, which is similar to previous studies.[11-13] All patients that fulfilled the inclusion criteria were included from the three public schools. Some previous studies suggested that breastfeeding facilitates the establishment of a better occlusion.[4,12,20] Some researches even found a higher prevalence of malocclusions in children without breastfeeding.[21,22] However, in our study, no associations were found between the type or duration of breastfeeding with the molar terminal plane. Similar findings were previously reported in the literature.[23,24]

This is one of a few studies that evaluate the association of type and duration of breastfeeding with facial characteristics and dimensions. If some association exists, it will allow the education of mothers and encourage them to choose the correct form and time of infant feeding, since it will not only help them to have adequate craniofacial growth and development,[1] but also a correct modelling of the oral cavity.

No significant association was found between the type or duration of breastfeeding and the facial type, anteroposterior, and vertical profiles. Although in the literature, scant information has been reported about similar associations, a previous study concluded that neither the convex profile nor the distal occlusion presented a significant association with the duration of breastfeeding.[25] In this regard, it seems that there is no notable influence of breastfeeding in any facial type and that it is more related to genetics and other environmental factors.

Regarding quantitative measurements, the facial length, facial width, and the lower third length were greater in 3.74mm, 2.06mm, and 2.94mm in the exclusive breastfeeding group in comparison with those who had mixed/artificial feeding. Similarly, in children who had breastfed for more than six months, significant differences were found in facial length, facial width, and lower third length, being greater in 3.20mm, 3.68mm, and 3.57mm in comparison with children who were breastfed for less than or up to 6 months. It is clear that the presence and duration of adequate breastfeeding do not determine a facial biotype; however, the lack of breastfeeding did affect children's facial dimensions, a situation that must be taken into account by clinicians, parents, and health authorities to stimulate children craniofacial growth and development.

Likewise, the multiple linear regression evaluation identified the duration of breastfeeding as an influencing factor in facial width, noting an increase of 3.32mm and if a pre-schooler had breastfed for more than six months. Also, age influenced these dimensions, as expected. Older children will have greater facial dimensions than younger children. To the authors' knowledge, there are no studies that have directly compared facial dimensions in millimetres between groups according to the duration of breastfeeding. Others confirm the importance of the increase of the duration of breastfeeding since it improves sagittal mandible growth,[31-33] but did not directly compare the facial dimensions; therefore, more studies comparing these dimensions are necessary to corroborate or contradict what was found. Likewise, the binary logistic regression did not identify the type or duration of breastfeeding as variables that influenced the molar terminal plane, as reported by previous studies.[23,24,34]

Finally, with the results of this work, we look forward reinforcing the importance of breastfeeding, seeking to prevent and control prejudicial events in the oral health of children at an early age. However, although the results found in our evaluated group cannot be generalized to all racial groups, they can be a point of comparison to be compared with other samples. In addition, the possibility of changes in facial and occlusal characteristics over time can be found. Likewise, the individual genetic could vary the results, so more longitudinal studies should be carried out to continue with the stimulation of prolonged breastfeeding. Therefore, communication on the type and duration of breastfeeding from the perspective of the benefits in the growth and facial dimensions may be recommended to pregnant mothers.

CONCLUSIONS

In the evaluated sample of pre-schoolers, no associations between the type or duration of breastfeeding and primary molar relationships were identified. The facial dimensions were greater in the exclusive breastfeeding group, and especially if it was performed for more than six months. The magnitude of these differences may be considered clinically relevant.

Source(s) of support: None

Conflicting Interest: None

REFERENCES

1. Lyons KE, Ryan CA, Dempsey EM, Ross RP, Stanton C. Breast Milk, a Source of Beneficial Microbes and Associated Benefits for Infant Health. Nutrients. 2020;12(4):E1039. doi:10.3390/nu12041039
2. Pereira Lopes TS, Branco Lima CC, Cerqueira Silva RN, Almeida de Deus Moura LF, Moura de Lima MD, Pinheiro Lima MCM. Association Between Duration of Breastfeeding and Malocclusion in Primary Dentition in Brazil. J Dent Child (Chic). 2019;86(1):17-23.
3. World Health Organization, UNICEF. Global Strategy for Infant and Young Child Feeding. Geneva, Switzerland: World Health Organization; 2003. Available at: http://apps.who.int/iris/bitstream/10665/42590/1/9241562218.pdf?ua¼1&ua¼1. Accessed Apr 16, 2020.
4. Peres KG, Cascaes AM, Peres MA, et al. Exclusive Breastfeeding and Risk of Dental Malocclusion. Pediatrics. 2015;136(1):e60-e67. doi:10.1542/peds.2014-3276
5. Cleminson J, Oddie S, Renfrew MJ, McGuire W. Being baby friendly: evidence-based breastfeeding support. Arch Dis Child Fetal Neonatal Ed. 2015;100(2):F173-F178. doi:10.1136/archdischild-2013-304873
6. Zielińska MA, Sobczak A, Hamułka J. Breastfeeding knowledge and exclusive breastfeeding of infants in first six months of life. Rocz Panstw Zakl Hig. 2017;68(1):51-9.
7. Romero CC, Scavone-Junior H, Garib DG, Cotrim-Ferreira FA, Ferreira RI. Breastfeeding and non-nutritive sucking patterns related to the prevalence of anterior open bite in primary dentition. J Appl Oral Sci. 2011;19(2):161-168. doi:10.1590/s1678-77572011000200013
8. Montaldo L, Montaldo P, Cuccaro P, Caramico N, Minervini G. Effects of feeding on non-nutritive sucking habits and implications on occlusion in mixed dentition. Int J Paediatr Dent. 2011;21(1):68-73. doi:10.1111/j.1365-263X.2010.01092.x
9. Vasconcelos FM, Massoni AC, Heimer MV, Ferreira AM, Katz CR, Rosenblatt A. Non-nutritive sucking habits, anterior open bite and associated factors in Brazilian children aged 30-59 months. Braz Dent J. 2011;22(2):140-5. doi:10.1590/s0103-64402011000200009
10. Marquezin MCS, Araujo DS, Amato JN, et al. A cluster analysis of the relationship between sucking habits, consistency of food ingested, and taste sensitivity in children. J Texture Stud. 2019;50(3):248-56. doi:10.1111/jtxs.12396
11. Costa CTD, Shqair AQ, Azevedo MS, Goettems ML, Bonow MLM, Romano AR. Pacifier use modifies the association between breastfeeding and malocclusion: a cross-sectional study. Braz Oral Res. 2018;32:e101. doi:10.1590/1807-3107bor-2018.vol32.0101
12. Boronat-Catalá M, Bellot-Arcís C, Montiel-Company JM, Almerich-Silla JM, Catalá-Pizarro M. Does breastfeeding have a long-term positive effect on dental occlusion?. J Clin Exp Dent. 2019;11(10):e947-e951. doi:10.4317/jced.56312
13. Chen X, Xia B, Ge L. Effects of breast-feeding duration, bottle-feeding duration and non-nutritive sucking habits on the occlusal characteristics of primary dentition. BMC Pediatr. 2015;15:46. doi:10.1186/s12887-015-0364-1
14. Labzelter and Saller A. Reproduced from Singh IP and Bhasin MK Anthropometry. New Delhi: Bharti Bhavan, Kem Publishers. 1968.
15. Bedita T, Naranbabu Th, Jibonkumar S, Kumar B. Facial morphology and facial index: a study on secular trend of Meitei male population of Bishnupur district, Manipur, India. Int J Anat Res 2016; 4(4):3279-83.
16. Choi JY, Kim T, Kim HM, Lee SH, Cho IS, Baek SH. Effect of frontal facial type and sex on preferred chin projection. Korean J Orthod. 2017;47(2):108-17. doi:10.4041/kjod.2017.47.2.108
17. Baume LJ. Physiological tooth migration and its significance for the development of occlusion. Part I. The biogenetic course of the deciduous dentition. J Dent Res. 1950; 29:123.
18. Srinivasan D, Loganathan D, Kumar SS, Louis CJ, Eagappan S, Natarajan D. An Evaluation of Occlusal Relationship and Primate Space in Deciduous Dentition in Kancheepuram District, Tamil Nadu, India. J Pharm Bioallied Sci. 2017;9(Suppl 1):S45-S49. doi:10.4103/jpbs.JPBS_89_17
19. Doğramacı EJ, Rossi-Fedele G, Dreyer CW. Malocclusions in young children: Does breast-feeding really reduce the risk? A systematic review and meta-analysis. J Am Dent Assoc. 2017;148(8):566-574.e6. doi:10.1016/j.adaj.2017.05.018.
20. Galán-Gónzalez AF, Aznar-Martín T, Cabrera-Domínguez ME, Domínguez-Reyes A. Do breastfeeding and bottle feeding influence occlusal parameters?. Breastfeed Med. 2014;9(1):24-8. doi:10.1089/bfm.2013.0027
21. Corrêa-Faria P, Ramos-Jorge ML, Martins-Júnior PA, Vieira-Andrade RG, Marques LS. Malocclusion in preschool children: prevalence and determinant factors. Eur Arch Paediatr Dent. 2014;15(2):89-96. doi:10.1007/s40368-013-0069-9
22. Leite-Cavalcanti A, Medeiros-Bezerra PK, Moura C. Aleitamento Natural, Aleitamento Artificial, Hábitos de Sucção e Maloclusões em Pré-escolares Brasileiros [Breast-feeding, bottle-feeding, sucking habits and malocclusion in Brazilian preschool children]. Rev Salud Publica (Bogota). 2007;9(2):194-204. doi:10.1590/s0124-00642007000200004
23. Warren JJ, Bishara SE. Duration of nutritive and nonnutritive sucking behaviors and their effects on the dental arches in the primary dentition. Am J Orthod Dentofacial Orthop. 2002;121(4):347-56. doi:10.1067/mod.2002.121445
24. Lopes-Freire GM, Cárdenas AB, Suarez de Deza JE, Ustrell-Torrent JM, Oliveira LB, Boj Quesada JR Jr. Exploring the association between feeding habits, non-nutritive sucking habits, and malocclusions in the deciduous dentition. Prog Orthod. 2015;16:43. doi:10.1186/s40510-015-0113-x
25. Agarwal SS, Sharma M, Nehra K, Jayan B, Poonia A, Bhattal H. Validation of Association between Breastfeeding Duration, Facial Profile, Occlusion, and Spacing: A Cross-sectional Study. Int J Clin Pediatr Dent. 2016;9(2):162-6. doi:10.5005/jp-journals-10005-1356
26. Brustowicz KA, Padwa BL. Malocclusion in children caused by temporomandibular joint effusion. Int J Oral Maxillofac Surg. 2013;42(8):1034-1036. doi:10.1016/j.ijom.2013.03.017
27. Consolação Soares ME, Ramos-Jorge ML, de Alencar BM, Marques LS, Pereira LJ, Ramos-Jorge J. Factors associated with masticatory performance among preschool children. Clin Oral Investig. 2017;21(1):159-66. doi:10.1007/s00784-016-1768-5
28. Hinostroza-Izaguirre MC, Jara-Porroa JJ, Montalvo-Castillo SC, Romero-Gonzáles MA, Ticse-Tovar J. Impact of non-breastfeeding on the infant. Rev Cient Odontol 2017; 5 (2): 733-43. doi: 10.21142/2513-2754-0502-2017-733-743
29. López Del Valle LM, Singh GD, Feliciano N, Machuca Mdel C. Associations between a history of breast feeding, malocclusion and parafunctional habits in Puerto Rican children. P R Health Sci J. 2006;25(1):31-4.
30. Hagos D, Tadesse AW. Prevalence and factors associated with exclusive breastfeeding among rural mothers of infants less than six months of age in Southern Nations, Nationalities, Peoples (SNNP) and Tigray regions, Ethiopia: a cross-sectional study. Int Breastfeed J. 2020;15(1):25. doi:10.1186/s13006-020-00267-y
31. Sanches MT. Manejo clínico das disfunções orais na amamentação [Clinical management of oral disorders in breastfeeding]. J Pediatr (Rio J). 2004;80(5 Suppl):S155-S162. doi:10.2223/1249
32. Sánchez-Molins M, Grau Carbó J, Lischeid Gaig C, Ustrell Torrent JM. Comparative study of the craniofacial growth depending on the type of lactation received. Eur J Paediatr Dent. 2010;11(2):87-92.
33. Ling HTB, Sum FHKMH, Zhang L, et al. The association between nutritive, non-nutritive sucking habits and primary dental occlusion. BMC Oral Health. 2018;18(1):145. Published 2018 Aug 22. doi:10.1186/s12903-018-0610-7
34. López Del Valle LM, Singh GD, Feliciano N, Machuca Mdel C. Associations between a history of breast feeding, malocclusion and parafunctional habits in Puerto Rican children. P R Health Sci J. 2006;25(1):31-4.