

G.M. Lopes Freire\*, J.E. Espasa Suarez de Deza\*,  
I.C. Rodrigues da Silva\*\*, L. Butini Oliveira\*\*\*,  
J.M. Ustrell Torrent\*\*\*\*, J.R. Boj Quesada\*

\*Department of Paediatric Dentistry, Faculty of Dentistry,  
University of Barcelona Hospitalet de Llobregat, Barcelona  
\*\*Faculty of Pharmacy, University of Brasília, Brasília, Brazil  
\*\*\*Division of Pediatric Dentistry, SLMandic  
School of Dentistry, Campinas, Brazil.

\*\*\*\*Faculty of Dentistry, University of Barcelona  
Oral Health and Masticatory System Group  
(Bellvitge Biomedical Research Institute) IDIBELL  
L'Hospitalet, Barcelona, Spain

e-mail: gabimlopes@gmail.com

## Non-nutritive sucking habits and their effects on the occlusion in the deciduous dentition in children

### ABSTRACT

**Aim** The study evaluated the presence of non-nutritive sucking habits and their effects on the occlusion in the deciduous dentition in Spanish children.

**Materials and Methods** Study design: Cross-sectional survey. A clinical examination was performed by an experienced examiner in 275 children aged 3 to 6 years and the collected data included the presence of anterior open bite (vertical dimension), unilateral or bilateral posterior crossbite (transverse dimensions), midline deviation and sagittal relationships between incisors, molars and canines. In addition, the parents of each child completed a questionnaire about oral habits. Data analysis included descriptive statistics (frequency distribution). Statistical significance for the association between the non-nutritive sucking habits and development of malocclusion was determined using Chi-square and Fisher's exact tests. Multiple logistic regression analysis was used in order to adjust the results for confounding effects of non-nutritive habits before assessing statistical significance.

**Results** Non-nutritive sucking habit was observed in 224 children (81.5%) and malocclusions were present in 152 children (55.2%). There were significant

relationships between pacifier sucking habit and transverse dimension alteration (OR= 3.29, CI: 0.97-11.17,  $p=0.044$ ), midline deviation (OR= 3.00, CI: 1.22-7.38,  $p=0.013$ ). Children with a history of finger sucking (or thumb sucking) had an increased risk of malocclusion 4.25 times higher (CI: 0.92-19.58,  $p=0.044$ ) and there was a significant relationship between finger sucking and vertical relationship (OR= 8.25, CI: 2.50-27.25,  $p=0.001$ ). Children with non-nutritive sucking habits had an increased risk of malocclusion 2.55 higher compared to those without non-nutritive sucking habits ( $p=0.004$ ).

**Conclusion** There was an impact of non-nutritive sucking habit and development of malocclusions in this sample of children.

**Keywords** Child; Finger sucking; Malocclusion; Pacifier.

### Introduction

Recent studies have reported that the prevalence of malocclusion appears to be increasing in preschool and school children [Correia-Faria et al., 2014; Dimberg et al., 2013; Peres et al., 2015]. The prevalence of non-nutritive sucking habits in children aged 3 years or more has been estimated between 40% and 76.1% [Fernandes et al., 2015]. Non-nutritive sucking habits such as the use of a pacifier or finger sucking are probably the earlier sucking habits developed by infants in response to frustrations and to satisfy their urge and need for contact, ensuring a feeling of well being, warmth and sense of security [Jyoti et al., 2014]. It is important to investigate the relationship between the presence of non-nutritive sucking habits and development of malocclusion in the deciduous dentition because it is a public dental health problem in young children and may affect their quality of life [Abanto et al., 2011; Bönecker et al., 2012; Dimberg et al., 2015]. The effects on the development of the dentofacial structures with the persistence of these habits depend on: frequency and duration of the habit; intensity of the sucking; relationship of the dental arches; child's physical health; direction and nature of the force exerted by the finger [Jyoti et al., 2014]. Prolonged periods of non-nutritive sucking may lead to a more severe imbalance in the orofacial structures and these disorders could affect the child's physical, social and psychological wellbeing.

Non-nutritive sucking habits can have negative consequences on the development of orofacial structures and occlusion if they persist after 3 years of age [Warren et al., 2002]. Some authors suggested that non-nutritive sucking habits discontinued at 3 to 5 years of age may still lead to malocclusion in certain cases. Thus, in order to prevent more malocclusion caused by non-nutritive

sucking habits, recommendation should be revised to advocate cessation of habit prior to 3 years of age and emphasise that the earlier the habit is ceased after age 3, the less the risk for development of malocclusion due to the habit itself [Warren et al., 2005].

Only one Spanish study on the presence of non-nutritive sucking habits and occlusion alterations in children was identified [Aznar et al., 2006]. The authors analysed variations in dental arch width in relation to certain oral habits in children. They observed that in most cases, dummy use and mouth breathing were associated with a reduction in the intercanine distance in the maxillary arch. A dummy habit leads to a reduction in maxillary arch width, and mouth breathing causes a reduction in the size of both arches.

The assessment of the impact of oral habits and their effects on the occlusion is a relevant subject because it turns possible to verify the demand and the distribution of malocclusions treatment needs within the target population. Different sucking habits are known to affect occlusion in different ways. Therefore, the objective of this study was to assess the non-nutritive sucking habits and their effects on the occlusion in the deciduous dentition in a population of Spanish children.

## Material and Methods

A cross-sectional observational survey was carried out on a convenience sample of children enrolled at the Barcelona Child Hospital and at the daycare center CAP Montcada i Reixac, Spain. A clinical examination was performed by an experienced examiner in 275 children aged 3 to 6 years and included clinical evaluations of malocclusions and structured questionnaires about oral habits.

Ethical clearance was obtained from the Ethical Committee of the University of Barcelona, Hospital and CAP Montcada i Reixac. A letter was given to all parents explaining the aims of the study and asking them for consent for their children to participate in the study.

### *Study population and eligibility criteria*

The calculation of sample size was performed using a prevalence of malocclusion of 50%, a 95% confidence interval, and a standard error of 7%. The sample size calculation resulted in a minimum of 195 children. Participants were selected from a population of children of the same age group enrolled at two selected public hospitals.

Inclusion criteria: all the children in the study met the inclusion criteria which included children of both genders aged 3 to 6 years; exclusively in the deciduous dentition phase; agreement to participate in the clinical exam; normal number, size, and shape of deciduous teeth; no major tooth destruction or reconstruction; no systemic diseases and/or neurological diseases, and filling of a

parental questionnaire about the child's habits.

Children were excluded from the study if their parents did not agree to their participation; had syndromes or systemic diseases affecting craniofacial growth; presence of at least one permanent tooth; loss of mesial-distal diameter due to caries, previous orthodontic treatment.

### *Children's oral examination*

All clinical exams were performed by an experienced examiner, a PhD Student (GMLF) who had previous experience in cross-sectional data. The child remained seated in a chair in front of the examiner. Examinations were performed under artificial light, using latex gloves and a disposable mirror. The clinical exam was performed with the aid of disposable tongue depressor. To ensure that natural occlusion was evaluated, the child was asked to open and close the mouth several times and to swallow the saliva before the examination began. When needed, the mandible was gently guided towards centric occlusion by the examiner.

The malocclusions assessed were diagnosed according to published clinical criterion [Foster and Hamilton, 1964; Warren et al., 2001; Bhat et al., 2012; Dimberg et al., 2015 and Sum et al., 2015].

The outcomes related to the children's dental arch characteristics were examined in the three dimensions with the following criteria.

The transverse relation was measured by direct inspection in presence of posterior crossbite, its absence was considered normal occlusion. The type of relationship was chosen among the following five categories: normal relationship; posterior unilateral crossbite on the left side; posterior unilateral crossbite on the right side; bilateral posterior crossbite; just one teeth in crossbite. Posterior crossbite was considered present when, in occlusion, one or more of the maxillary deciduous canine or molars occluded lingually to the buccal cusps of the opposing mandibular teeth. Upper midline shift was registered if the midline was displaced by at least 1 mm. In addition, midline deviation data was also collected and the distance between the upper and lower midlines in the frontal plane was considered.

The vertical relationships (of incisors) was measured by direct inspection and recorded as normal, anterior open bite or overbite. Overbite was assessed by measuring the vertical distance between the upper and lower central incisor edges with the teeth in occlusion [Warren et al., 2001]. This distance was considered: normal when the upper incisor covered the lower incisors for up to 3 mm; and overbite for values greater than 3 mm. When there was no overlap between the upper and lower incisors, with a minimum space of 1 mm between both incisal edges, it was considered anterior open bite [Bhat et al. 2012].

The sagittal interarch relationship was classified according to the deciduous canine relationship as Angle Class I, Class II, or Class III, with Class I considered normal

occlusion: Class I canine and molar – bilateral – or Class I canine and molar – unilateral –, and Class II or Class III considered altered: Class II – bilateral – ; Class II Division 1 (increased overjet); Class II Division 2 (without overjet); Class II subdivision (I o III); Class II – unilateral – other (no classification); Class III or anterior crossbite.

### Questionnaire about oral habits

After clinical examinations, the parents of each child completed a questionnaire about oral habits. The data collected included the presence and the duration of non-nutritive sucking habits such as pacifier sucking habit and finger sucking. Rimossa parte della frase perché incomprendibile, vedi di lato

### Data analysis

The data analyses were performed using the Statistical Package for Social Sciences (SPSS for Windows, version 20.0, SPSS Inc. Chicago, IL, USA) and included descriptive statistics (frequency distribution). In addition, statistical significance for the association between the non-nutritive sucking habits and development of malocclusion was determined using Chi-square, and Fisher's exact tests. Multiple logistic regression analysis was used in order to adjust the results for confounding effects of non-nutritive habits before assessing statistical significance. Odds ratio and their confidence intervals were not calculated if empty cells were observed. The differences between sample size in some tables was due to missing data for some people who did not provide answers to relevant questions or when confounding variables were observed. The level of significance was set at 5%.

## Results

The sample consisted of 275 children aged 3 to 6 years; 144 (52.4%) were male and 131 (47.6%) were female. The presence of non-nutritive sucking habit was observed in 224 children (81.5%) and the presence of malocclusion was observed in 152 children (55.2%). There were no significant differences ( $p=0.798$ ) in the presence of non-nutritive sucking habit between boys (56.5%) and girls (59.2%) (Table 1).

The results indicated significant relationships between pacifier sucking habit and transversal relationship alteration (OR= 3.29, CI: 0.97-11.17,  $p=0.044$ ), and midline deviation (OR= 3.00, CI: 1.22-7.38,  $p=0.013$ ) (Table 2).

Table 3 shows that children with a history of finger sucking had 4.25 times an increased risk of malocclusion (CI: 0.92-19.58,  $p=0.044$ ) and there were significant relationships between finger sucking and anterior open bite (vertical dimension) (OR= 8.25, CI: 2.50-27.25,  $p=0.001$ ).

Children with non-nutritive sucking habits had 2.55 an increased risk of malocclusion compared to those without non-nutritive sucking habits ( $p=0.004$ ) (Table 4).

## Discussion

This study evaluated the presence of non-nutritive sucking habits and their effects on the occlusion in the deciduous dentition in a population of children in Spain. To the best of our knowledge, only one study

		Gender				OR	CI 95%	P value
		girls		boys				
		N	%	N	%			
Transversal Relationship	malocclusion in Transversal Relationship	22	16.8%	12	8.4%	2.20	1.04-4.65	0.035
	normal	109	83.2%	131	91.6%			
	Total	131	100.0%	143	100.0%			
Midline Deviation	malocclusion in midline	29	23.0%	29	20.4%	1.16	0.65-2.08	0.61
	normal	97	77.0%	113	79.6%			
	Total	126	100.0%	142	100.0%			
Vertical Relationship	malocclusion in Vertical Relationship	31	23.8%	39	27.5%	0.83	0.48-1.43	0.498
	normal	99	76.2%	103	72.5%			
	Total	130	100.0%	142	100.0%			
Sagittal Relationship	malocclusion in Sagittal Relationship	54	42.5%	50	36.0%	1.32	0.81-2.16	0.273
	normal	73	57.5%	89	64.0%			
	Total	127	100.0%	139	100.0%			
Presence of malocclusion	Any type of malocclusion	74	59.2%	78	56.5%	0.93	0.56-1.54	0.798
	normal	51	40.8%	60	43.5%			
	Total	125	100.0%	138	100.0%			
Non-nutritive sucking habits	Yes	108	82.4%	116	80.6%	1.13	0.62-2.09	0.757
	No	23	17.6%	28	19.4%			
	Total	131	100.0%	144	100.0%			

TABLE 1 Relationship between malocclusion, non-nutritive sucking habits and gender.

assessed the presence of non-nutritive sucking habits and occlusion problems in children in Spain [Aznar et al., 2006]. A previous retrospective study using a sample of lateral telerradiographs compared the craniofacial growth depending on the type of lactation received. The results showed that the frequency of use of sucking habits were greater in the bottle-fed group, without statistical significance [Sánchez-Molins et al., 2010].

In general, the results of the present investigation showed that non-nutritive sucking habits were risk factors to malocclusion development. It was observed that children with non-nutritive sucking habits had 2.55 times an increased risk of malocclusion compared to those without non-nutritive sucking habits. It is important to

emphasise that alterations may occur to the dental arches and the position of the teeth, as well as problems with joints and changes in the facial and masticatory muscles.

Pacifier sucking and finger sucking habit have different effects on various occlusal characteristics [Bishara et al., 2006]. There is no consensus regarding the effects of non-nutritive sucking habits on occlusal abnormalities in the deciduous dentition.

This study also showed that children with pacifier sucking habit had significantly greater alterations of the transverse dimension. Pacifier sucking habit also increases the risk of midline deviation. Some authors verified that prolonged pacifiers habit results in significant risk of developing certain occlusion characteristics such as

		PACIFIER HABIT				OR	CI 95%	P value
		Yes		No				
		N	%	N	%			
Transversal Relationship	malocclusion in Transversal Relationship	31	14.6%	3	4.9%	3.29	0.97-11.17	0.044
	normal	182	85.4%	58	95.1%			
	Total	213	100.0%	61	100.0%			
Midline Deviation	malocclusion in midline	52	25.0%	6	10.0%	3	1.22-7.38	0.013
	normal	156	75.0%	54	90.0%			
	Total	208	100.0%	60	100.0%			
Vertical Relationship	malocclusion in Vertical Relationship	53	25.1%	17	27.9%	0.87	0.46-1.65	0.663
	normal	158	74.9%	44	72.1%			
	Total	211	100.0%	61	100.0%			
Sagittal Relationship	malocclusion in Sagittal Relationship	88	41.5%	16	29.6%	1.68	0.88-3.21	0.110
	normal	124	58.5%	38	70.4%			
	Total	212	100.0%	54	100.0%			
Presence of malocclusion	Any type of malocclusion	127	60.5%	25	47.2%	1.72	0.94-3.14	0.079
	normal	83	39.5%	28	52.8%			
	Total	210	100.0%	53	100.0%			

TABLE 2 Relationship between pacifier habit and malocclusion.

		FINGER SUCKING HABIT				OR	CI 95%	P value
		Yes		No				
		N	%	N	%			
Transversal Relationship	malocclusion in Transversal Relationship	0	0.0%	34	13.1%	0	NA	0.229
	normal	14	100.0%	226	86.9%			
	Total	14	100.0%	260	100.0%			
Midline Deviation	malocclusion in midline	1	7.1%	57	22.4%	0.27	0.03-2.08	0.209
	normal	13	92.9%	197	77.6%			
	Total	14	100.0%	254	100.0%			
Vertical Relationship	malocclusion in Vertical Relationship	10	71.4%	60	23.3%	8.25	2.50-27.25	0.001
	normal	4	28.6%	198	76.7%			
	Total	14	100.0%	258	100.0%			
Sagittal Relationship	malocclusion in Sagittal Relationship	7	53.8%	97	38.3%	1.88	0.61-5.75	0.264
	normal	6	46.2%	156	61.7%			
	Total	13	100.0%	253	100.0%			
Presence of malocclusion	Any type of malocclusion	11	84.6%	141	56.4%	4.25	0.92-19.58	0.044
	normal	2	15.4%	109	43.6%			
	Total	13	100.0%	250	100.0%			

TABLE 3 Relationship between finger sucking habit and malocclusion.

		Non-nutritive sucking habit				OR	CI 95%	P value
		Yes		No				
		N	%	N	%			
Transversal Relationship	malocclusion in Transversal Relationship	31	13.9%	3	5.9%	2.58	0.76-8.81	0.117
	normal	192	86.1%	48	94.1%			
	Total	223	100.0%	51	100.0%			
Midline Deviation	malocclusion in midline	53	24.3%	5	10.0%	2.89	1.09-7.66	0.026
	normal	165	75.7%	45	90.0%			
	Total	218	100.0%	50	100.0%			
Vertical Relationship	malocclusion in Vertical Relationship	61	27.6%	9	17.6%	1.78	0.82-3.87	0.143
	normal	160	72.4%	42	82.4%			
	Total	221	100.0%	51	100.0%			
Sagittal Relationship	malocclusion in Sagittal Relationship	92	41.6%	12	26.7%	1.96	0.96-4.00	0.061
	normal	129	58.4%	33	73.3%			
	Total	221	100.0%	45	100.0%			
Presence of malocclusion	Any type of malocclusion	135	61.6%	17	38.6%	2.55	1.31-4.96	0.004
	normal	84	38.4%	27	61.4%			
	Total	219	100.0%	44	100.0%			

TABLE 4 Relationship between no nutritive sucking habit and malocclusion.

posterior crossbite. According to de Sousa Ribeiro [2014], the prevalence of posterior crossbite was greater among children who used pacifiers. The same result was observed by Urzal [2013] in a cross-sectional study. Bishara [2006] also reported that prolonged pacifier sucking habit was strongly associated with the development of posterior crossbites, whereas prolonged finger sucking habit was associated with increased overjet.

Controversially, a birth cohort study showed that pacifier sucking habit and finger sucking at 12, 18 and 30 months of age were associated with overjet and open bite [Peres et al., 2007]. An association between pacifier habit and overbite was observed in a Brazilian longitudinal study [Moimaz et al., 2014]. Some researchers reported that the use of pacifier was associated with reduced maxillary intercanine distance and concluded that duration and frequency of pacifier-sucking habit is associated with occlusal and myofunctional alterations [Nihi et al., 2014].

Our results demonstrated that children with a history of finger sucking had 4.25 times increased risk of malocclusion (CI: 0.92-19.58,  $p=0.044$ ), and a significant relationship between finger sucking and anterior open bite (vertical dimension) (OR= 8.25, CI: 2.50-27.25,  $p=0.001$ ). Previous studies also have shown that finger sucking habit increases the risk of vertical malocclusion [Correia-Faria et al., 2014; Nogueira-Fialho et al., 2014; Kasparaviciene et al., 2014]. Greater prevalence rates of open bite were found in children with a history of harmful oral habits [Correia-Faria et al. 2014]. Other researches also concluded that these habits during the deciduous dentition stage play a key role in determining anterior open bite malocclusions regardless of the children's morphological facial pattern [Nogueira-Fialho et al., 2014]. Kasparaviciene [2014] also found that finger suckers have a higher incidence of anterior open bite and

posterior crossbite.

This study also showed that non-nutritive sucking habits were not risk factors to sagittal malocclusion. This finding corroborates previous researches. Pacifier and finger sucking habits resulted in similar incidence of anterior open bite and Class II canine relationships [Bishara et al., 2006]. On the other hand, Charchut [2003] observed that children who used a pacifier were more likely to develop a nonmesial step occlusion. Luz et al. [2006] carried out a cross-sectional study and examined 249 children in mixed dentition and concluded that there were statistically significant associations between non-nutritive sucking habits and Class II malocclusions. Non-nutritive sucking habits after the first year of life was associated with a greater risk of Class II molar relationships [Montaldo et al., 2011]. Warren [2002] collected sucking behavior data on 372 children followed longitudinally from birth by using periodic questionnaires completed by parents. They also found a higher prevalence of Class II deciduous canine and molar relationships. Analyses of the available results confirm that there was an impact of non-nutritive sucking habits and development of malocclusion in this sample of children. The importance of the present study is the assessments for oral bad habit based not only on the questionnaire filled by parents, but also on clinical examinations.

In offering an explanation for the presence of non-nutritive sucking habit and their effects on the occlusion in the deciduous dentition in Spanish children, some potential limitations of this study should be taken into account. First, no cause-effect relationship can be deduced from a cross-sectional design study such as this one. Longitudinal designs (cohort studies) would increase the knowledge on this subject.

Comparisons between published studies should be



interpreted with caution due to the lack of uniformity in sample selection, age groups, examination procedures and diagnostic criteria. Moreover, our study would have benefited from a large and representative sample. However, it is difficult to access children's population in hospitals and dental clinics and to collect data in a population-based sample. In addition, pacifier use and thumb sucking are confounder variables, since it is not possible to determine whether malocclusion was caused by bottle feeding or pacifier/thumb sucking. A recent systematic review [Hermond et al., 2015] showed that the clinical heterogeneity among studies disrupts the strength of evidence. Confounders were hardly reported and adjustments for non-nutritive sucking habits were performed in only half of the studies and this may have led to biased results. The authors recommend this statistical adjustment. Exclusion of children that had non-nutritive sucking habits from the sample during data analysis is a good strategy in studies evaluating this issue [Hermond et al., 2015].

The development of malocclusion can be avoided through measures of non-nutritive sucking. Malocclusion in the deciduous dentition is a risk factor for orthodontic treatment in the permanent dentition [Peres et al., 2015]. Interruption of non-nutritive sucking as early as possible is a very important measure to prevent malocclusions. It is essential to promote more efforts and health promotion policies to reduce the frequency of oral habits and malocclusions in children.

## Conclusion

Based on this research results, it can be concluded that there was an impact of non-nutritive sucking habits and development of malocclusion in this sample of children. Children with pacifier habits had significantly greater alterations in transverse dimension. Finger sucking habit increases the risk of vertical malocclusion.

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