ORIGINAL ARTICLE

Breast feeding, bottle feeding, and non-nutritive sucking; effects on occlusion in deciduous dentition

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Aims: To assess the effect of the type of feeding and non-nutritive sucking activity on occlusion in deciduous dentition.
Methods: Retrospective study of 1130 preschool children (3–5 years of age) who had detailed infant feeding and non-nutritive sucking activity history collected by a structured questionnaire. They all had an oral examination by a dentist, blinded to different variables evaluated.
Results: Non-nutritive sucking activity has a substantial effect on altered occlusion, while the effect of bottle feeding is less marked. The type of feeding did not have an effect on open bite, which was associated (89% of children with open bite) with non-nutritive sucking. Posterior cross-bite was more frequent in bottle fed children and in those with non-nutritive sucking activity. The percentage of cross-bite was lower in breast fed children with non-nutritive sucking activity (5%) than in bottle fed children with non-nutritive sucking activity (13%).
Conclusions: Data show that non-nutritive sucking activity rather than the type of feeding in the first months of life is the main risk factor for development of altered occlusion and open bite in deciduous dentition. Children with non-nutritive sucking activity and being bottle fed had more than double the risk of posterior cross-bite. Breast feeding seems to have a protective effect on development of posterior cross-bite in deciduous dentition.

The development of the cranio-facial complex (jaws, dental arches, tongue, facial muscles) results from the interaction between genetic and environmental factors.[1 2] An attractive hypothesis is that early sucking activity influences the growth of the cranio-facial complex.[3] Several reports have suggested that non-nutritive sucking (usually in the form of dummies/pacifiers or thumb sucking) may be responsible for some forms of malocclusion of infancy (especially open bite and posterior cross-bite),[4–7] but the role of early feeding on occlusion appears unclear based on published results[8–10] and needs to be further evaluated. It is clear that breast feeding and bottle feeding involve different oro-facial muscles, possibly leading to different effects on harmonic growth of maxilla and dental arches.[11–13] Our aim was to evaluate the effect of the type of feeding in the first year of life and of non-nutritive sucking activity on the occlusion in a large cohort of preschool children (3–5 years of age).

SUBJECTS AND METHODS

The children were participants in a school project related to oral health monitoring. The cohort was formed by 1130 children born in the years 1993, 1994, and 1995, aged 3–5 years, attending the public school of Cava de' Tirreni (a town in the south of Italy). This cohort represents 60% of all children (1876) born in these years and resident in the city. The study was performed in 1998 by clinicians (paediatrician and dentist) and nurses. It involved the collection of socioeconomic and historical data using a structured questionnaire aimed at exploring children's behaviour, interactions with their mothers, social integration and activities, and dynamics within the household. Complete data were available for 1099 children. Statistical analysis was performed only on this sample.

The study had the approval of the ethical committee of Local Health Unit ''Salerno 1''.

The following definitions were used:

- *Breast feeding*: if a child was exclusively breast fed for more than the first three months of life
- *Bottle feeding*: if a child was exclusively bottle fed from birth or if bottle feeding started in the first three months of life
- *Non-nutritive sucking*: if a child had sucking for more than the first year of life of an object (usually a digit or a dummy/pacifier) not related to feeding.

Oral examination was carried out by a single paediatric dentist (DF). The following definitions were used:

- *Normal occlusion*: the harmonious fitting of two dental arcades with the distal surface of the second inferior deciduous molar slightly mesialised or in the same plane of the distal surface of the superior second molar, with correct transversal relationship, with the superior canine cusp inserting just distally to the inferior canine and with the superior incisors partial overhanging the inferior incisors
- *Altered occlusion*: any modification of the occlusal relations described as ''normal occlusion''
- *Anterior open bite*: missing vertical contacts between upper and lower anterior teeth
- *Posterior cross-bite*: reverse transverse interrelation of one or several teeth (canine and or deciduous molars) on either or on both hemi-arcades.

Statistical analysis

Statistical calculations were done automatically by the tables and logistic regression command in EPI INFO, a word processing, database, and statistics program for epidemiology on microcomputers (Dean AG, Dean JA, Burton AH, Dicker RC. USD, Inc., Stone Mountain, Georgia; ''Epi Info'' is a trademark of the Center for Disease Control and Prevention (CDC), November 2002).

Table 1 Effect of the type of feeding and non-nutritive sucking on occlusion in 1099 preschool children

Group of children	Type of occlusion		Logistic regression	
	Altered (%)	Normal (%)	Adjusted OR (95% CI)	p value
Bottle feeding	188 (41)	271 (59)	1.28 (0.99 to 1.66)	0.0576
Breast feeding	205 (32)	435 (68)		
NNS+	312 (42)	425 (58)	2.43 (1.82 to 3.25)	<0.0001
NNS−	81 (22)	281 (78)		

NNS+, children with non-nutritive sucking activity for more than 1 year; NNS−, children without non-nutritive sucking.

We used simple dichotomous (yes or no) variables and therefore logistic regression was used. We computed the odds ratio (OR), which is a measure of the association directly estimated from a logistic regression model (without requiring special assumptions), because the study design is cross-sectional. Frequently there is ''interaction'' among variables so that the OR for one depends on the value of another (for example, bottle/breast feeding and NNS are associated, so that an apparent effect of the one may be partly due to the other). Because we have two categorical explanatory variables in the best model, we have systematically tested the interaction term in the logistic regression model. The interaction term in the logistic regression model corresponds to the mathematical product of the two variables (for example, NNS × bottle/breast feeding). Several ORs were measured and the 95% confidence interval (CI) was calculated according to previously described methods.[14 15]

Physicians and patients were kept blind to the ongoing results of the study.

RESULTS

Altered occlusion was detected in 36% of 1099 children (n = 393), anterior open bite was detected in 13% (n = 144), and posterior cross-bite in 7% (n = 80).

An increased percentage of altered occlusion (table 1) was found in children with history of non-nutritive sucking (42% *v* 22%) with a doubled risk (adjusted OR = 2.43; 95% CI 1.82 to 3.25; $p < 0.0001$). The type of feeding had a less marked effect on occlusion (adjusted OR = 1.28; 95% CI 0.99 to 1.66; p = 0.0576), even if an increased percentage of children with altered occlusion are bottle fed (41% *v* 32%).

Non-nutritive sucking activity also seems to be also the most important factor influencing open bite. The type of feeding (table 2) did not have an effect on open bite (adjusted OR = 0.93; 95% CI 0.65 to 1.33; p = 0.678). Open bite was mostly associated with non-nutritive sucking (89% of children with open bite) with a risk more than quadruplicate (adjusted OR = 4.61; 95% CI 2.69 to 7.92; $p < 0.0001$).

The effects of type of feeding and non-nutritive sucking on posterior cross-bite (table 3) were different. Our data indicate that this malocclusion is more frequent both in bottle fed children (11% *v* 4%; adjusted OR = 2.54; 95% CI 1.57 to 4.12; p = 0.0002) and in those with non-nutritive sucking activity (9% *v* 4%; adjusted OR = 1.87; 95% CI 1.04 to 3.56; p = 0.0367).

Breast feeding seems to have a protective effect on posterior cross-bite development and this protective effect is also evident when data are aggregated. The percentage of cross-bite is still lower in breast fed children with non-nutritive sucking activity (5%) compared with that of bottle fed children with non-nutritive sucking activity (13%) (fig 1).

DISCUSSION

Based on our sample of 1099 preschool children, non-nutritive sucking activity rather than the type of feeding in

Table 2 Effect of the type of feeding and non-nutritive sucking on open bite in 1099 preschool children

Group of children	Open bite		Logistic regression	
	Yes (%)	No (%)	OR (95% CI)	p value
Bottle feeding	64 (14)	395 (86)	0.93 (0.65 to 1.33)	0.678
Breast feeding	80 (13)	560 (87)		
NNS+	128 (17)	609 (83)	4.61 (2.69 to 7.92)	<0.0001
NNS−	16 (4)	346 (96)		

NNS+, children with non-nutritive sucking activity for more than 1 year; NNS−, children without non-nutritive sucking.

Table 3 Effect of type of feeding and non-nutritive sucking on posterior cross-bite

Group of children	Cross-bite		Logistic regression	
	Yes (%)	No (%)	OR (95% CI)	p value
Bottle feeding	52 (11)	407 (89)	2.54 (1.66–4.03)	0.0002
Breast feeding	28 (4)	612 (96)		
NNS+	65 (9)	672 (91)	1.86 (1.04–3.36)	0.0367
NNS−	15 (4)	347 (96)		

NNS+, children with non-nutritive sucking activity for more than 1 year; NNS−, children without non-nutritive sucking.

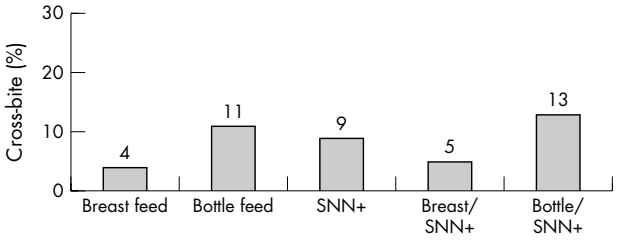

Figure 1 Percentage of children with posterior cross-bite with different types of feeding and non-nutritive sucking activity. SNN+, children with non-nutritive sucking activity for more than 1 year.

the first months of life seems the main risk factor for development of altered occlusion. Previous reports have provided conflicting results showing some effect[8 9] or no effect of breast feeding on altered occlusion.[10] It is possible that the different results are related to the differences in the prevalence of non-nutritive sucking activity in the studied populations.

Our data support an aetiological role of non-nutritive sucking on open bite, whereas we did not find the type of feeding to be a risk factor. Previous publications agree with this relation.[5–7]

In posterior cross-bite malocclusion, children with non-nutritive sucking activity and children who were bottle fed had a twofold risk of posterior cross-bite. Others authors have addressed the relation between non-nutritive sucking activity and posterior cross-bite.[6 7] Karjalainen and colleagues[9] studied the relation between the type of feeding and posterior cross-bite; they reached conclusions similar to ours, showing the prevalence of posterior cross-bite being inversely correlated with duration of breast feeding. Furthermore, our data show that the effect of breast feeding remains valid after aggregating the data with those of non-nutritive sucking activity: the prevalence of posterior cross-bite in breast fed children remains low, even when they have non-nutritive sucking activity. Thus, it may be concluded that breast feeding seems to have a protective effect on development of posterior cross-bite in preschool children.

The detrimental effect of non-nutritive sucking activity on occlusion development in primary dentition, particularly open bite and posterior cross-bite, has been reported by several investigators since the 1870s (see Warren and colleagues[7] for a comprehensive review of this topic). The prevalence of these two malocclusions increases with duration of sucking habits.[7] A key question is whether spontaneous resolution of this malocclusion occurs when non-nutritive sucking habits stop. Limited data suggest that open bite tends to resolve, while cross-bite tends to persist.[16–18]

The positive effect of breast feeding on occlusion development constitutes an interesting observation. The few published reports regarding this matter are inconclusive.[8–10] The theoretical mechanisms[3] refers to cranio-facial musculature and skeletal development being differently influenced if a child is bottle fed or exclusively breast fed. The mechanism of sucking is different in the two instances.[11–13] The breast feeding child draws milk, putting both the nipple and areola into the mouth; the movement of lips and tongue contribute more to squeezing than to sucking. Lips squeeze the areola where the mother's lactiferous sinuses are located, and the tongue compresses the soft breast nipple against the palate using a peristaltic-like motion. The bottle feeding child uses the tongue with piston-like motion in order to compress the artificial teat against the palate. In this case there is a more powerful sucking activity of lips and cheeks. Secondly, there is a different impact of this activity on the palate.[3] The greater consistency of artificial teat compared to breast nipple causes a greater upward force, to which the tongue adds further push with the piston-like movement aimed at squeezing milk.

In children with non-nutritive sucking activity and in those bottle fed, the different involvement of oro-facial muscles and the different impact to the palate is presumably responsible for the poor alignment of teeth and the anomalous transversal growth of the palate, conditions which lead to a posterior cross-bite. Breast feeding is the ideal stimulus for the physiological development of both the muscular and skeletal components of the oro-facial complex.

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