Original Article

Feeding and nonnutritive sucking habits and prevalence of open bite and crossbite in children/adolescents with Down syndrome

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ABSTRACT

Objective: To analyze the influence of breastfeeding, bottle feeding, and nonnutritive sucking habits on the prevalence of open bite and anterior/posterior crossbite in children with Down syndrome (DS).

Materials and Methods: A cross-sectional study was carried out in 112 pairs of mothers/children with DS between 3 and 18 years of age at a maternal/children's hospital in Rio de Janeiro, Brazil. The children with DS were clinically examined for the presence of open bite as well as anterior and posterior crossbite. Information on breastfeeding, bottle feeding, and nonnutritive sucking habits was collected using a structured questionnaire. The control variables were age and mouth posture of children/adolescents and mother's schooling. Statistical analysis of the data was performed using the chi-square test and multiple logistic regression.

Results: The prevalence of anterior open bite was 21%, anterior crossbite was 33%, and posterior crossbite was 31%. The use of bottle feeding for more than 24 months (prevalence ratio [PR] = 1.6) was associated with the occurrence of open bite. Having breastfed for less than 6 months (PR = 1.4) and pacifier sucking for more than 24 months (PR = 3.1) were associated with the prevalence of anterior crossbite. Finger sucking (PR = 2.9) and the use of bottle feeding for more than 24 months (PR = 2.6) were associated with posterior crossbite.

Conclusion: The prevalence of open bite and crossbite in children with DS was associated with the use of bottle feeding and pacifier sucking for more than 24 months, breastfeeding for less than 6 months, and finger sucking. (*Angle Orthod.* 2010;80:748–753.)

KEY WORDS: Down syndrome; Malocclusion; Open bite; Crossbite; Breastfeeding; Sucking behavior

INTRODUCTION

Down syndrome (DS) is the best known of all malformation syndromes, since it was the first chromosomal abnormality recognized in humans.[1,2] Children with DS have insufficient bone development associated with muscle hypotonicity. This becomes more accentuated with age and leads to a greater occurrence of malocclusions in comparison to the general population.[3–6]

These orofacial disorders have a negative impact on the daily life of individuals with DS by stigmatizing them because of their facial appearance. Consequently, social relationships and potential employment opportunities are hindered.[2,6,7] Morphological deviations affect the dentition and oral cavity and cause vertical and transverse alterations, such as anterior open bite and anterior/posterior crossbite.[4,6,8,9] These dentofacial alterations lead to problems with sucking, swallowing, and salivation.[1,6,9–11]

Craniofacial growth and occlusal abnormalities may be accentuated by the interaction between genetic and environmental factors, such as breastfeeding and oral habits (pacifier sucking, finger sucking, nail biting, etc),

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depending on the duration, intensity, and frequency of the habit.[2,9,12–18] A number of reports have suggested that nonnutritive sucking habits (usually pacifier or thumb sucking) may be responsible for some forms of malocclusion in childhood, but the role of early feeding in occlusion needs to be further evaluated.[7,9,11,13–18] Children with a history of pacifier sucking demonstrated a higher prevalence of posterior crossbite and anterior open bite.[16] Although oral/motor dysfunction in DS is well known, aspects related to these factors in children with Down syndrome have not been fully clarified.[2,6,11,19]

The aim of the present study was to analyze the influence of breastfeeding, bottle feeding, and nonnutritive sucking habits on the prevalence of open bite and anterior/posterior crossbite in children/adolescents with DS.

MATERIALS AND METHODS

A cross-sectional study was carried out with 112 children/adolescents with DS, aged 3 to 18 years, and their respective mothers. Data collection took place in a maternal/children's hospital in Rio de Janeiro, Brazil, which is a healthcare reference center for individuals with DS. The data were obtained from an oral exam of the patients and a structured questionnaire to which the mothers responded in an interview format.

While awaiting the medical appointment, each mother-child pair received information regarding the study and was asked to participate. Pairs that agreed to participate were directed to an examining room in which the mother signed the informed consent, responded to the questionnaire, and watched the clinical examination of her child. The questionnaire contained items addressing breastfeeding, bottle feeding, and nonnutritive sucking habits of the children. The clinical examination recorded the presence of anterior open bite and anterior/posterior crossbite. The World Health Organization criteria were used to assess malocclusions.[20]

Confounders and other determent factors of interest were obtained, including age of the child/adolescent, mouth posture (closed/open), and mother's schooling. Mouth posture was assessed during the clinical examination and interviews with the mothers, when the child thought that he or she was not being observed and revealed a habit of the mouth remaining open or closed.

The clinical exam was performed by one of the researchers with the help of a research assistant, who recorded the data. The exam was performed under artificial light with the aid of a disposable mouth mirror (Prisma, São Paulo, SP, Brazil) and a Community Periodontal Index probe (Golgran, São Paulo, SP, Brazil), also known as a ball-point probe.[20]

The study received approval from the Human Research Ethics Committee of the National School of Public Health, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil. Intraexaminer calibration, test/retest of the questionnaire, and a pilot study were carried out prior to the main study.

To determine intraexaminer agreement, 25 children/adolescents with DS were examined and reexamined after a 10-day interval. These individuals were from a nongovernmental organization that offers care to children with DS in the city of Rio de Janeiro and did not participate in the main study. Intraexaminer diagnostic agreement was considered very good.[21] The following kappa values were achieved: 0.91 for open bite, 0.89 for anterior crossbite, and 0.94 posterior crossbite.

To test the internal validity of the questionnaire, testing and retesting of the measure were conducted with the 25 mothers of the children/adolescents who participated in the calibration test. The retest was carried out after a 10-day interval. The results of the test/retest agreement revealed kappa values ranging from 0.74 to 1.00, which are considered very good to excellent.[21]

A pilot study was then carried out with 20 pairs of mothers/children with DS treated at a maternal/children's hospital in Rio de Janeiro. These individuals also did not participate in the main study. The aim of this step was to test the method and data collection instruments, confirming the validity of the methodology to be employed.

Statistical analysis was performed employing the Software Package for the Social Sciences (SPSS for Windows, version 15.0, SPSS Inc, Chicago, Ill). Univariate analysis was first performed. The chi-square test ($P < .10$) was used to determine the relationship between the dependent variables (prevalence of open bite and anterior/posterior crossbite) and the independent variables. Multiple logistic regression was performed to identify the independent impact of each variable studied. The independent variables were included in the decreasing logistic model in accordance with their statistical significance ($P < .25$; backward stepwise procedure) or clinical-epidemiological importance.

RESULTS

The final sample included 112 children and adolescents with DS between 3 and 18 years of age (mean age: 8.3 ± 4.3 years; median: 7). Sixty-five participants were 3 to 8 years old (58.0%) and 47 were 9 to 18 years old (42.0%); 52 (46.4%) were girls and 60

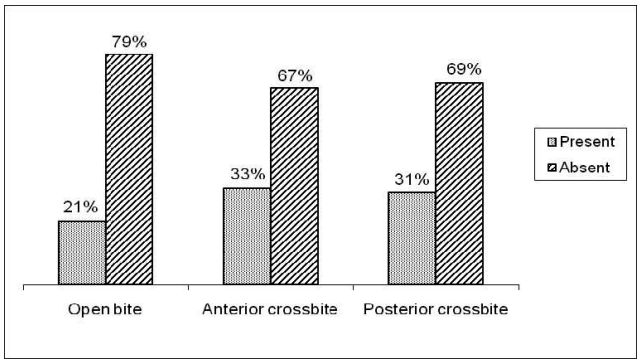

Figure 1. Prevalence of open bite, anterior crossbite, and posterior crossbite in children/adolescents with DS, Rio de Janeiro, Brazil (n = 112).

(53.6%) were boys, and all were accompanied by their mothers (mean age = 41 ± 8.4 years). Only four pairs of subjects refused to participate because of a lack of time, disinterest, or the child's refusal to be examined. Figure 1 displays the distribution of the participants based on the prevalence of open bite (21% [90% confidence interval [CI]: 15%–28%]), anterior crossbite (33% [90% CI: 26%–40%]) and posterior crossbite (31% [90% CI: 24%–39%]).

The bivariate analysis revealed that open bite was statistically associated with mouth posture ($P = .03$) (Table 1). The prevalence of anterior crossbite was statistically significantly associated with the use of pacifier sucking ($P = .01$). Posterior crossbite was statistically associated with the use of bottle feeding ($P = .07$) and age of the child/adolescent ($P < .01$).

Table 2 displays the results of the multiple logistic regression analysis. Regarding open bite, the use of bottle feeding remained in the final model, revealing a 1.6-fold increased prevalence of anterior open bite ($P > .10$) among children/adolescents who bottle fed for more than 24 months. There was an approximately threefold increased prevalence of anterior crossbite among participants with prolonged use of pacifier sucking (more than 24 months); this result achieved statistical significance ($P = .02$). Although it was not statistically significant, breastfeeding also remained in the logistic model; there was a 1.4-fold increased prevalence of anterior crossbite among those children/adolescents who were not breastfed or were breastfed for fewer than 6 months.

Regarding posterior crossbite, finger sucking and the use of bottle feeding remained in the logistic model, with both variables achieving statistical significance. There was a nearly threefold increased prevalence of posterior crossbite among children/adolescents with finger sucking habits. There was a 2.6-fold increased prevalence of posterior crossbite among those who bottle fed for more than 24 months.

DISCUSSION

The results of the present study revealed a significant prevalence of malocclusion in individuals with DS, thereby confirming the findings of previous studies, including those comparing individuals with DS to children/adolescents with normal development or some other type of disability.[3,4,6,8,19] This is related to more frequent occurrences of craniofacial deformities, abnormal growth and development, and a higher incidence of abnormal tongue posture and orofacial muscle disorders.[2,6,7,9] Some types of malocclusions are caused and maintained by abnormal tongue function or posture.[12]

Regardless of the presence of DS, studies stress the multifactorial etiopathogenesis of malocclusion.[6,8,11,13–18,22] There is interaction among congenital, morphological, biomechanical, and environmental factors during the growth and development of children, including factors linked to breastfeeding and nonnutritive oral habits.

Because the present study analyzed the influence of breastfeeding, bottle feeding, and nonnutritive oral habits on the prevalence of malocclusion, the authors opted to adjust the logistic regression model using the following confounding and risk factors: age, mouth posture, and mother's schooling. Mouth posture was measured because many individuals with DS have the habit of maintaining a mouth open position. According to a number of authors, underdevelopment of the maxilla, orbicular muscles of the lips, and facial muscles results in insufficient lip seal and can lead to mouth breathing.[2,5,9,10]

Hypotonia of the facial and lip muscles, associated with a hypotonic, protruded tongue, causes many children/adolescents with DS to experience difficulties in sucking and swallowing. According to Mizuno and Ueda,[11] sucking difficulties in infants with DS may result from the low sucking pressure and short duration, rather than a lack of will to suck. It is caused not only by hypotonicity of the perioral muscles, lips, and masticatory muscles, but also by a deficiency in smooth peristaltic-like tongue movements in the early neonatal period. Sucking pressure, which is negative intraoral pressure, is generated by the lowering of the jaw and posterior depression of the tongue, which occurs during the tongue movement sequence.

However, these characteristics do not impede such individuals from being able to breastfeed or having nonnutritive sucking habits.[2,9,11,23,24] In a study carried out in Japan involving children with DS and those with normal development, Mizuno and Ueda[11] found significant development in the sucking behavior of the individuals with DS over time, but the sucking capacity of these infants was lower than that of normal infants.

Table 1. Distribution of the Sample (n = 112) According to the Prevalence of Open Bite, Crossbite, and Associated Factors

		Open Bite		Anterior Crossbite		Posterior Crossbite	
Factor	n	n (%)	*P*	n (%)	*P*	n (%)	*P*
Breastfeeding			.26		.72		.22
<6 mo (or absent)	67	12 (17.9)		23 (34.3)		18 (26.9)	
6 mo or more	45	12 (26.7)		14 (31.1)		17 (37.8)	
Bottle feeding			.22		.31		.07*
24 mo or more	53	14 (26.4)		20 (37.7)		21 (39.6)	
<24 mo (or absent)	59	10 (16.9)		17 (28.8)		14 (23.7)	
Pacifier sucking			.86		.01*		.27
24 mo or more	22	5 (22.7)		12 (54.5)		9 (40.9)	
<24 mo (or absent)	90	19 (21.1)		25 (27.8)		26 (28.9)	
Finger sucking			.56		.69		.69
Yes	19	5 (26.3)		7 (36.8)		8 (42.1)	
No	93	19 (20.4)		30 (32.3)		27 (29.0)	
Mouth posture			.03*		.93		.77
Open	49	15 (30.6)		16 (32.7)		16 (32.7)	
Closed	63	9 (14.3)		21 (33.3)		19 (30.2)	
Age			.61		.54		< .01*
3–8 y	65	15 (23.1)		20 (30.8)		9 (13.8)	
9–18 y	47	9 (19.1)		17 (36.2)		26 (55.3)	
Maternal schooling			.18		.24		.47
<8 y	52	14 (26.9)		20 (38.5)		18 (34.6)	
8 y or more	60	10 (16.7)		17 (28.3)		17 (28.3)	

* Chi-square test ($P < .10$).

After the logistic analysis, the malocclusions investigated were strongly associated with the duration of breastfeeding and bottle feeding and with nonnutritive sucking habits. The use of bottle feeding for more than 24 months denoted an increased prevalence of open bite or posterior crossbite, which confirms the results described in previous studies carried out on children with normal development.[8,11,15,13,25] Several authors have observed an association between nonnutritive sucking habits and the prolonged use of bottle feeding.[8,13,18]

In children with nonnutritive sucking habits and those with prolonged bottle feeding, the different involvement of orofacial muscles and different impact on the palate are presumably responsible for the poor alignment of teeth and the anomalous transverse growth of the palate—conditions that lead to posterior crossbite.[8] The nonnutritive sucking habit also seems to be one of the most important factors influencing malocclusion, regardless of whether a child has DS or not.[8,11,25] A Brazilian study involving 330 four-year-old children observed anterior open bite and posterior crossbite in children with nonnutritive sucking habits, regardless of the duration of the habit.[16]

Children with pacifier sucking habits lasting for more than 24 months and finger sucking habits had an approximately threefold increased prevalence of anterior and posterior crossbite, which is in agreement with the findings of previous studies.[8,13,14,16,25] Such results stress the influence of external factors on the genetic trait of DS in the etiology of these malocclusions. A number of studies point out that individuals with DS are

Table 2. Multiple Logistic Regression Models Explaining the Prevalence of Open Bite and Crossbite in Children and Adolescents with Down Syndrome in Rio de Janeiro, Brazil (n = 112)

Dependent Variables	Independent Variables	PR (IC 90%) Crude[a]	PR (IC 90%) Adjusted*
Open bite	Bottle feeding (24 mo or more)	1.75 (0.70–4.38)	1.68 (0.75–3.72)
Anterior crossbite	Pacifier sucking (24 mo or more)	**3.12 (1.19–8.12)****	**3.14 (1.39–6.96)****
	Breastfeeding (<6 mo or absent)	1.15 (0.51–2.59)	1.41 (0.68–2.91)
Posterior crossbite	Finger sucking	1.77 (0.64–4.90)	**2.90 (1.06–7.96)****
	Bottle feeding (24 mo or more)	2.10 (0.93–4.76)	**2.67 (1.21–5.92)****

[a] PR indicates prevalence ratios; CI 90%, 90% confidence intervals.

* Adjusted for control variables (age, mouth posture, and maternal schooling).

** Statistically significant.

more prone to anterior/posterior crossbite owing to the combination of clinical aspects of the syndrome (small midface, protrusive tongue, and high palate).[2,4,9,10,23] Nonetheless, the influence of extrinsic factors, such as nonnutritive sucking habits, cannot be ignored.

The duration of thumb sucking habits was not analyzed in the present study, as there was a report of only one child with a thumb sucking habit for fewer than 24 months. Thus, only the presence or absence of this habit was considered. In a longitudinal study carried out in the United States with 372 normal children with primary teeth, an increase in the prevalence of anterior open bite and posterior crossbite was found among those children with nonnutritive sucking habits lasting until 24 or more months of age. However, when these children continued the habit to 48 months of age, the prevalence of these types of malocclusion was even higher.[15] Anterior open bite is often spontaneously corrected in individuals who abandon a finger sucking habit before the pubertal growth spurt.[14]

Having breastfed for fewer than 6 months and the presence of a pacifier sucking for more than 24 months denoted an increased prevalence of anterior crossbite. In an investigation of 300 preschool children in Brazil, Góis et al.[18] found that children with a pacifier-sucking habit that continued beyond 2 years of age had a 13-fold increased prevalence of malocclusion in comparison with children with no such habit. According to Trawitzki et al.[17] and Luz et al.,[22] early weaning with the introduction of nonhuman milk and other ''substitutive'' foods can favor the development of nonnutritive habits, such as pacifier and finger sucking.

Although the present study design is strong, it has some limitations. A weakness of cross-sectional studies resides in the difficulty in establishing causal relationships based on a cross-section in time.[25] Moreover, the data on nutritive and nonnutritive oral habits were obtained from mothers' reports and not collected directly, which makes such data subject to information and memory bias. Thus, caution should be taken to avoid influencing the respondents and avoid bias when interpreting the results.[26] In Brazil, it is very difficult to obtain a representative sample of children/adolescents with DS, as there is no official database that registers all individuals affected by this syndrome. Thus, the option was made to use a convenience sample in which important aspects related to the presence of malocclusion were identified in this portion of the population.[27]

Identifying factors associated with malocclusion in children with DS may contribute to interventions and orientation regarding breastfeeding and prolonged nonnutritive sucking habits. Caregivers and healthcare professionals should be aware of the extent to which malocclusion compromises the lives of children with DS.[9,28] Mothers need to be persistent as well as duly encouraged and oriented immediately postpartum with regard to the importance of breastfeeding their children with DS and exercising discipline in the use of bottle feeding and nonnutritive sucking habits.[23,24]

CONCLUSIONS

- The children and adolescents with DS in the present sample had a high prevalence of open bite, anterior crossbite, and posterior crossbite.
- The use of bottle feeding for more than 24 months was associated with the occurrence of open bite and posterior crossbite in children/adolescents with DS.
- Having breastfed for fewer than 6 months was strongly associated with the presence of anterior crossbite, as was the habit of pacifier sucking for more than 24 months.
- The habit of finger sucking was associated with posterior crossbite in this portion of the population.

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