

# Exclusive Breastfeeding and Risk of Dental Malocclusion

Ren Glazer Peres, BDS, PhD<sup>a</sup>, Andreia Morales Cascaes, BDS, PhD<sup>b</sup>, Marco Aurelio Peres, BDS, PhD<sup>a</sup>, Flavio Fernando Demarco, BDS, PhD<sup>c</sup>, Iná Silva Santos, MD, PhD<sup>c</sup>, Alicia Matijasevich, MD, PhD<sup>d</sup>, Luisio J.D. Barros, MD, PhD<sup>c</sup>

## abstract

**OBJECTIVES:** The distinct effect of exclusive and predominant breastfeeding on primary dentition malocclusions is still unclear. We hypothesized that exclusive breastfeeding presents a higher protective effect against malocclusions than predominant breastfeeding and that the use of a pacifier modifies the association between breastfeeding and primary dentition malocclusions.

**METHODS:** An oral health study nested in a birth cohort study was conducted at age 5 years ( $N = 1303$ ). The type of breastfeeding was recorded at birth and at 3, 12, and 24 months of age. Open bite (OB), crossbite, overjet (OJ), and moderate/severe malocclusion (MSM) were assessed. Poisson regression analyses were conducted by controlling for sociodemographic and anthropometric characteristics, sucking habits along the life course, dental caries, and dental treatment.

**RESULTS:** Predominant breastfeeding was associated with a lower prevalence of OB, OJ, and MSM, but pacifier use modified these associations. The same findings were noted between exclusive breastfeeding and OJ and between exclusive breastfeeding and crossbite. A lower prevalence of OB was found among children exposed to exclusive breastfeeding from 3 to 5.9 months (33%) and up to 6 months (44%) of age. Those who were exclusively breastfed from 3 to 5.9 months and up to 6 months of age exhibited 41% and 72% lower prevalence of MSM, respectively, than those who were never breastfed.

**CONCLUSIONS:** A common risk approach, promoting exclusive breastfeeding up to 6 months of age to prevent childhood diseases and disorders, should be an effective population strategy to prevent malocclusion.

## WHAT'S KNOWN ON THIS SUBJECT:

Breastfeeding provides a protective effect against some malocclusions, and there is a strong inverse correlation between the duration of breastfeeding and the duration of pacifier use.

## WHAT THIS STUDY ADDS:

The protective effects of predominant and exclusive breastfeeding against malocclusion are distinct: exclusive breastfeeding reduces the risk of malocclusions regardless of pacifier use, whereas the effect of predominant breastfeeding depends on the duration of the pacifier use.

<sup>a</sup>Australian Research Centre for Population Oral Health, School of Dentistry, University of Adelaide, Adelaide, Australia; <sup>b</sup>School of Dentistry, Department of Social and Preventive Dentistry, Federal University of Pelotas, Pelotas, RS, Brazil; <sup>c</sup>Postgraduate Program in Epidemiology, Federal University of Pelotas, Pelotas, RS, Brazil; and <sup>d</sup>Department of Preventive Medicine, Faculty of Medicine, University of Sao Paulo, Sao Paulo, Brazil

Dr K. Peres coordinated the oral health data collection, conceptualized the study, and drafted the initial manuscript; Dr Cascaes conducted all statistical analyses and reviewed and revised the manuscript; Dr M. Peres trained field workers and supervised data collection and critically reviewed the manuscript; Dr Demarco, together with Dr K. Peres, coordinated the oral health data collection, trained field workers and supervised data collection, and critically reviewed the manuscript; Dr Santos coordinated all stages of the birth cohort study and critically reviewed the manuscript; Dr Matijasevich critically reviewed the manuscript; and Dr Barros, together with Dr Santos, coordinated all stages of the birth cohort study and critically reviewed the manuscript. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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It is well known that breastfeeding provides a protective effect for a range of diseases and reduces the risk of mortality (mainly caused by infectious diseases) in low- and middle-income countries; breastfeeding also offers protection against gastrointestinal and respiratory diseases as found in high-income countries. However, all of this evidence is associated with the protective effect of exclusive breastfeeding up to 6 months.<sup>1</sup>

Exclusive breastfeeding is defined as the provision of breast milk without the introduction of any other foods or drinks to the child. In contrast, predominant breastfeeding is another method of breastfeeding the infant in which other liquids (eg, teas, water), except other milk, are provided, but breast milk is the main source of nutrients.<sup>2</sup>

Malocclusion is a developmental disorder that occurs in the craniofacial structures comprising the jaw, tongue, and facial muscles.<sup>3</sup> It causes deformity or lack of functionality and has been associated with negative impacts on smiling, emotion, and social contact<sup>4</sup> as well as teasing at school.<sup>5</sup> Breastfeeding may play an important role in preventing malocclusion in primary dentition because of its capacity to promote adequate growth and development of the muscles and bones of the jaws.<sup>6</sup> However, the positive effect of breastfeeding on primary dentition malocclusion is controversial. Some studies did not identify any association between breastfeeding and different types of primary dentition malocclusions.<sup>7,8</sup> Conversely, other studies have highlighted the fact that the protective effect on malocclusion depends on the duration and cessation of breastfeeding, as well as its combination with other factors such as nonnutritive sucking habits.<sup>9-11</sup> Despite a number of studies addressing this topic, only 2 were nested in birth cohort studies.<sup>10,11</sup> In the 1993 Pelotas Birth

Cohort Study, predominant breastfeeding for <9 months was associated with a higher prevalence of posterior crossbite<sup>10</sup> and open bite.<sup>12</sup> Moreover, to the best of our knowledge, no study has investigated the effect of predominant and exclusive breastfeeding on malocclusion separately, as well as controlling for important potential confounders such as anthropometric characteristics and sucking habits over the lifetime.

It is crucial to distinguish between the role of predominant and exclusive breastfeeding on primary dentition malocclusion, given that: exclusive breastfeeding up to 6 months of life is a World Health Organization (WHO)<sup>2</sup> recommendation; the number of children who are exclusively breastfed is increasing worldwide; and the duration of exclusive breastfeeding has also risen worldwide.<sup>13</sup>

The goals of the present study were to investigate the effects of predominant and exclusive breastfeeding on malocclusion. We hypothesized that exclusive breastfeeding presents higher protective effects against malocclusions than predominant breastfeeding and that the use of a pacifier modifies the association between breastfeeding and primary dentition malocclusions.

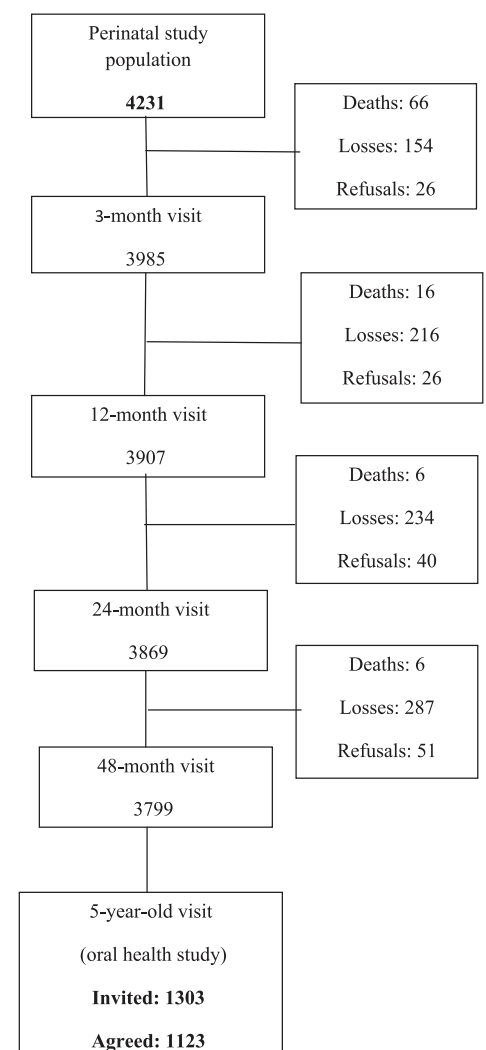
## METHODS

### Subjects

This study was part of a comprehensive oral health assessment conducted between August and December 2009, nested in the 2004 Pelotas Birth Cohort Study, which was conducted in Pelotas, a city in southern Brazil with ~350 000 inhabitants. The cohort included all children born in the urban zone of the city in 2004 ( $n = 4263$  [99%]). The 2004 Pelotas Birth Cohort study was planned to assess variations in maternal and child

health status and their determinants considering the epidemiologic and nutritional changes that have occurred in the last decades in Brazil.<sup>14</sup> Children were visited at 3, 12, 24, and 48 months of age (Fig 1).

In 2009, all cohort members born between September and December 2004 and followed up to the age of 4 years ( $n = 1303$ ) were invited to participate in the oral health study, given that there is no seasonality in terms of the outcomes and the main exposure. Children with no data on breastfeeding or malocclusion were excluded from the analysis. This sample was sufficient to test the main hypothesis with a power of at least 80% to detect significant relative risks of  $\geq 1.3$ , considering a prevalence of 8%<sup>10</sup> of malocclusion



**FIGURE 1** Flowchart of the 2004 Pelotas Birth Cohort Study.

in those exposed (ie, breastfed) and using a significance level of 5%. The age of 5 years is recommended by the WHO as appropriate to study primary dentition in epidemiologic studies.<sup>15</sup>

### Examination of Malocclusions

The fieldwork was performed by 8 trained and calibrated dentists who were responsible for the examination of malocclusions in a single home visit. The calibration process was performed at schools with children at the same age ( $n = 100$ ). Interexaminer reproducibility was assessed by using the  $\kappa$  coefficient (categorical variables) and the intraclass correlation coefficient (continuous and discrete variables). The diagnostic reliability for malocclusions varied from 0.60 (crossbite) to 0.90 (open bite), which was considered adequate.<sup>16</sup> The present study considered as outcomes 3 classifications for malocclusions, which were analyzed separately: (1) overjet; (2) anterior open bite; and (3) posterior crossbite.<sup>17</sup> Overjet was defined as the horizontal overlap contact between the upper and lower teeth in the anterior region and unilateral or bilateral (left and/or right side). Presence of overjet was considered if 1 of the following conditions was observed: overjet  $>2$  mm, upper and lower central primary incisors with the incisal edges on top, or negative overjet (lower central primary incisors extending past the upper central primary incisors in a horizontal direction). Anterior open bite was defined as lack of vertical contact between the upper and lower teeth in the anterior region; and posterior crossbite was defined as transverse and reverse interrelationship of  $\geq 1$  posterior teeth in 1 or both hemi-arches. The severity of malocclusion was also investigated according to the WHO criteria,<sup>15</sup> defined as none (no malocclusion), mild (discrete anomalies such as rotation in  $\geq 1$

teeth and dental crowding or spacing), and moderate/severe malocclusion (presence of overjet  $\geq 9$  mm, crossbite, open bite, diastema  $\geq 4$  mm, and crowding or spacing  $\geq 4$  mm). All outcomes were dichotomized (0 = no, 1 = yes) and followed the WHO classification (0 = none or mild, 1 = moderate or severe).

### Nutritive and Nonnutritive Sucking Habits

Predominant and exclusive breastfeeding were defined according to WHO<sup>2</sup> as mentioned earlier and were the main exposure variables. Information on breastfeeding was collected immediately after birth and at 3, 12, and 24 months and classified as 0 = never, 1 = 0.1 to 2.9 months, 2 = 3.0 to 5.9 months, and 3 =  $\geq 6.0$  months for predominant breastfeeding and up to 6 months for exclusive breastfeeding.

Other explanatory variables analyzed as confounders between the association of breastfeeding and malocclusions were also obtained from various cohort follow-up visits by using face-to-face interviews. The data gathered included: demographic, socioeconomic, and anthropometric measures; respiratory diseases; sucking habits; and number of teeth (counted and recorded by the interviewer). The child's gender and skin color (0 = white, 1 = light-skinned black, 2 = black) were obtained at the age of 5 years. Data on the mother's schooling (0 = 0–4 years, 1 = 5–8 years, 2 = 9–11 years, 3 =  $\geq 12$  years) and per capita family income, collected in Brazilian currency (Reais) and later categorized in quintiles, were obtained at the child's birth. Children's anthropometric measures were collected at birth, as follows: (1) weight at birth (0 =  $\geq 2500$  g [adequate], 1 =  $\leq 2500$  g [low birth weight]); (2) head circumference (0 =  $>10$ th percentile [ $>32.3$  cm] or  $\leq 10$ th percentile [ $\leq 32.3$  cm]); and (3) prematurity (0 = no, 1 = yes) as

described elsewhere.<sup>18</sup> Sucking habits, including pacifier use, were assessed at 3, 12, 24, and 48 months and classified as 0 = never used or partially used during this period and 2 = always used. Digital sucking at 12 months of age was classified as 0 = never used, 1 = partially used, and 2 = always used in the period. Respiratory disease was defined according to the mother's answer to the following question at 24 months of age: Has a doctor ever said that your child has asthma or bronchitis?

### Statistical Analysis

Statistical analysis was performed by using Stata version 11.0 (Stata Corp, College Station, TX). Absolute and relative frequencies were calculated for each variable to describe the sample. Bivariate and multivariable Poisson regression models with robust variance were used to produce direct estimates of all calculated prevalence ratios and confidence intervals of 95% to test the associations between malocclusions and predominant and exclusive breastfeeding; never breastfed was the reference category. All potential confounders with  $P < .2$  in the bivariate analysis were included as controlling in the multivariable analysis. Model 1 presented the unadjusted associations between breastfeeding and malocclusions; model 2 adjusted the associations for controlling variables; and model 3 included the same variables as in model 2 and added pacifier use up to 48 months. The standard 5% significance level was used to claim significance in the final models. Interactions between predominant and exclusive breastfeeding and sucking habits were tested.

### Ethical Aspects

The project was approved by the ethics committee of the Federal University of Pelotas (process number 100/2009 on June 29, 2009). Informed consent was obtained from all of the participants' mothers. The

present article was structured according to Strengthening the Reporting of Observational Studies in Epidemiology guidelines for observational studies.<sup>19</sup>

## RESULTS

The response rate was 86.6% ( $n = 1129$ ) and among those, 6 children who did not complete a dental examination were not included in the analyses ( $n = 1123$ ) (Fig 1).

The sample comprised 588 boys (52.4%), and most children were reported as having white skin color (67.6%) (Table 1). A substantial proportion of the mothers (75.7%) had between 5 and 11 years of education. Nearly 11% of the sample presented with a head circumference at birth  $\leq 32.3$  cm. The prevalence of prematurity and low birth weight was 11.9% and 8.6%, respectively. Nearly one-fifth (20.9%) of the children had been diagnosed with asthma or bronchitis, and 11.4% presented with full dentition at 24 months of age. Only 16.1% and 9.5% of mothers reported breastfeeding their children predominantly and exclusively for  $\geq 6$  months, respectively, and 40.1% of the children used pacifiers during the entire day for 4 years.

The prevalence of malocclusions was as follows: (1) overjet affected 34.0% of the children; (2) anterior open bite was  $\sim 37.0\%$ ; (3) posterior crossbite was nearly 10.0%; and (4) moderate/severe (WHO malocclusion) was present in slightly  $>25.0\%$  of the sample (data not presented in tables). The overall mean  $\pm$  SD duration of predominant and exclusive breastfeeding was  $2.8 \pm 2.02$  months and  $1.96 \pm 1.95$  months, respectively, and the overall median was 2.5 and 1.3 months.

Table 2 presents the results of unadjusted and adjusted Poisson regression models between

**TABLE 1** Distribution of Demographic and Socioeconomic Characteristics at 5 Years of Age in the 2004 Pelotas Birth Cohort Study

Variable	N	%
Gender		
Male	588	52.4
Female	535	47.6
Self-reported skin color (mother)		
White	748	67.6
Light-skinned black	220	19.9
Black	139	12.5
Maternal completed years of education		
0–4	144	13.1
5–8	441	40.1
9–11	392	35.6
$\geq 12$	123	11.2
Family income at birth (quintiles, values in Reais) <sup>a</sup>		
1° (0–260)	260	23.2
2° (265–410)	189	16.8
3° (411–700)	263	23.4
4° (710–1080)	186	16.6
5° (1100–10 000)	225	20.0
Birth weight		
Adequate ( $\geq 2500$ g)	1027	91.4
Low birth weight ( $< 2500$ g)	96	8.6
Prematurity		
No	988	88.1
Yes	134	11.9
Head circumference (10th percentile)		
$> 10$ ( $> 32.3$ cm)	1001	89.2
$\leq 10$ ( $\leq 32.3$ cm)	121	10.8
Predominant breastfeeding, mo <sup>b</sup>		
Never	30	2.7
0.1–2.9	533	48.9
3.0–5.9	352	32.3
$\geq 6.0$	175	16.1
Exclusive breastfeeding, mo <sup>c</sup>		
Never	43	3.9
0.1–2.9	725	66.4
3.0–5.9	221	20.2
6.0	104	9.5
Asthma or bronchitis at 24 mo of age		
No	883	79.1
Yes	233	20.9
Use of pacifier until 48 mo of age <sup>d</sup>		
Never or sometimes	600	59.9
All day	401	40.1
Digital sucking at 12 mo of age		
Never	703	64.9
Partially	331	30.6
Always	49	4.5
No. of teeth at 24 mo		
20	124	11.4
$< 20$	961	88.6

<sup>a</sup> US \$1.00 = Reais \$2.89 (currency in September 2004).

<sup>b</sup> Breastfed children who were also fed other fluids, such as water or tea, but who were not fed solid or semi-solid foods.

<sup>c</sup> Breastfed children who were not fed any other fluids or solid food.

<sup>d</sup> Variable that presents the greater number of missing data ( $n = 122$ ).

predominant breastfeeding and malocclusions. In the unadjusted analysis, predominant breastfeeding was associated with a lower prevalence of malocclusions among those who were breastfed at 3 months old (model 1) compared with those who were not breastfed. This effect was still significant even after adjustment for demographic, socioeconomic, anthropometric, respiratory disease, and oral health-related covariates (model 2). However, when pacifier use until 48 months was added into the model, the statistical significance was lost (model 3).

Table 3 displays the results of unadjusted and adjusted Poisson regression models between exclusive breastfeeding and malocclusions. Exclusive breastfeeding was associated with lower levels of malocclusions in the unadjusted analyses (model 1) when all types of malocclusion were taken into account. The association remained significant between short duration of exclusive breastfeeding with the presence of anterior open bite and moderate and severe malocclusion after adding pacifier use into the model (model 3). The prevalence of anterior open bite was, respectively, 32.0% and 43.0% lower among children who were exclusively breastfed between 3.0 and 5.9 months and among those breastfed up to 6 months of age compared with those who were not breastfed. In addition, the longer the exclusive breastfeeding, the lower the prevalence of moderate or severe malocclusion (41.0% and 72.0%, breastfeeding between 3 and 5.9 months and up to 6 months, respectively).

A dose–response effect of the number of risk factors (only breastfeeding  $< 6$  months, only pacifier use throughout the study period, or both) on the prevalence of anterior open bite was observed, particularly when the exclusive breastfeeding group

**TABLE 2** Unadjusted and Adjusted Poisson Regression Models Between Predominant Breastfeeding and Malocclusions, 2009 Pelotas Birth Cohort Study (*N* = 1123)

Malocclusion	Predominant Breastfeeding: Prevalence Ratio (95% CI)		
	0.1 to 2.9 mo	3.0 to 5.9 mo	≥6 mo
Overjet			
Model 1	0.72 (0.49–1.03)	0.57 (0.38–0.84)	0.43 (0.27–0.77)
Model 2 <sup>a</sup>	0.84 (0.57–1.24)	0.64 (0.42–0.97)	0.51 (0.32–0.88)
Model 3	0.85 (0.54–1.37)	0.74 (0.45–1.20)	0.62 (0.37–1.10)
Anterior open bite			
Model 1	0.79 (0.56–1.12)	0.60 (0.40–0.84)	0.40 (0.26–0.61)
Model 2 <sup>b</sup>	0.89 (0.63–1.27)	0.69 (0.48–1.00)	0.46 (0.30–0.73)
Model 3	0.98 (0.65–1.48)	0.89 (0.58–1.37)	0.66 (0.40–1.10)
Posterior crossbite			
Model 1	0.57 (0.20–1.33)	0.59 (0.25–1.40)	0.44 (0.27–1.16)
Model 2 <sup>c</sup>	0.54 (0.24–1.20)	0.54 (0.23–1.22)	0.41 (0.16–1.10)
Model 3	0.62 (0.27–1.47)	0.68 (0.28–1.47)	0.58 (0.21–1.57)
MSM (WHO classification)			
Model 1	0.64 (0.42–0.98)	0.46 (0.29–0.98)	0.29 (0.16–0.51)
Model 2 <sup>d</sup>	0.78 (0.51–1.20)	0.62 (0.39–0.99)	0.36 (0.20–0.64)
Model 3	0.86 (0.52–1.44)	0.83 (0.48–1.44)	0.53 (0.27–1.02)

Never breastfed was the reference category for all models. Model 1: unadjusted prevalence ratios; Model 2: adjusted prevalence ratios for confounder variables; and Model 3: adjusted prevalence ratios for variables in model 2 and pacifier use. CI, confidence interval; MSM, moderate/severe malocclusion.

<sup>a</sup> Adjusted for children's skin color, weight at birth, prematurity, head circumference, number of teeth at 24 months of age, and asthma at 24 months of age.

<sup>b</sup> Adjusted for gender, mother's schooling, family income, weight at birth, prematurity, head circumference, number of teeth at 24 months of age, and asthma at 24 months of age.

<sup>c</sup> Adjusted for gender and mother's schooling and asthma at 24 months of age.

<sup>d</sup> Adjusted for gender, mother's schooling, family income, weight at birth, prematurity, head circumference, number of teeth at 24 months of age, and asthma at 24 months of age.

was considered. Concomitant presence of exclusive breastfeeding duration <6 months and use of pacifier up to 48 months of age increased the prevalence of moderate/severe malocclusions (*P* value of interaction term = .019). However, exclusive breastfeeding of 6 months was sufficient to protect the dentition from the harmful effects of pacifier use (Fig 2A). Similar findings concerning a dose-response relationship was identified for overjet, anterior open bite, and severity of malocclusion among children breastfed predominantly. Conversely, the use of a pacifier throughout the study period modified the association between short duration of predominant breastfeeding and any type of malocclusion (Fig 2B).

## DISCUSSION

Findings from this prospective study reinforce the notion that exclusive breastfeeding reduces the risk of

moderate or severe malocclusion on primary dentition regardless of the use of a pacifier and that the protective effect varies according to the levels of exclusive breastfeeding exposure. In addition, some protective effect of predominant breastfeeding on overjet and anterior open bite, as well as on moderate and severe malocclusion, were identified, however, depending on the duration of pacifier use.

The protective effect of exclusive breastfeeding may be explained as the result of various mechanisms. First, children who are exclusively breastfed for a longer period are more likely to develop proper muscular tone than those who have been exposed to bottle feeding precociously.<sup>20</sup> Second, the brachycephalic mandibular arch format is more easily reached when the child is breastfed, which in turn allows appropriate tooth eruption position.<sup>21</sup> Finally, exclusive breastfeeding is strongly and inversely associated with the

frequency, intensity, and duration of pacifier use, which in turn may lead to severe malocclusion.<sup>8,10</sup> A systematic review regarding the risks and benefits of pacifier use highlighted the negative impact of pacifier use on breastfeeding.<sup>9</sup>

A search of PubMed conducted in March 2014 by using the terms "breastfeeding," "malocclusion," and "primary dentition" found 22 publications. Exclusive breastfeeding was identified as a protective factor for posterior crossbite in 4 of these studies,<sup>10,22–24</sup> which is similar to our findings. However, the duration of exclusive breastfeeding varied from 3 to 12 months; a cross-sectional design was adopted in 3 of these studies; and potential confounders were not taken into consideration.<sup>22–24</sup>

The present study is the first to investigate the influence of exclusive breastfeeding on malocclusion by using data from a population-based birth cohort study. Our findings reinforce the WHO message, which strongly recommends exclusive breastfeeding up to 6 months, both in low-middle and high-income countries.<sup>2</sup>

The main strength of the present article is its investigation of breastfeeding duration at short time intervals between follow-up visits, thus minimizing recall bias, which is a core issue in this type of study. We highlight the high examiner's reproducibility and the use of a large and representative sample with a high statistical power to identify associations. The mean duration of breastfeeding and the proportion of children who were breastfed up to 3 months of age in our study were similar to those found in the general cohort study,<sup>14</sup> suggesting that selection bias may not have occurred. Moreover, biological traits<sup>10,12</sup> such as cephalic perimeter and birth weight, as well as respiratory diseases,<sup>25</sup> which may play an important role on the adequate

**TABLE 3** Unadjusted and Adjusted Poisson Regression Models Between Exclusive Breastfeeding and Malocclusions, 2009 Pelotas Birth Cohort Study (N = 1123)

Malocclusion	Exclusive Breastfeeding: Prevalence Ratio (95% CI)		
	0.1 to 2.9 mo	3.0 to 5.9 mo	6 mo
<b>Overjet</b>			
Model 1	0.74 (0.53–1.04)	0.57 (0.39–0.84)	0.57 (0.39–0.84)
Model 2 <sup>a</sup>	0.87 (0.61–1.25)	0.63 (0.41–0.95)	0.53 (0.32–0.89)
Model 3	0.87 (0.58–1.30)	0.69 (0.44–1.10)	0.66 (0.39–1.14)
<b>Anterior open bite</b>			
Model 1	0.78 (0.57–1.06)	0.53 (0.37–0.76)	0.53 (0.37–0.76)
Model 2 <sup>b</sup>	0.82 (0.61–1.11)	0.60 (0.41–0.86)	0.43 (0.26–0.69)
Model 3	0.86 (0.62–1.21)	0.68 (0.46–0.99)	0.57 (0.34–0.97)
<b>Posterior crossbite</b>			
Model 1	0.63 (0.29–1.36)	0.53 (0.23–1.26)	0.25 (0.07–0.84)
Model 2 <sup>c</sup>	0.67 (0.31–1.42)	0.61 (0.26–1.42)	0.28 (0.08–0.92)
Model 3	0.75 (0.34–1.64)	0.70 (0.28–1.69)	0.38 (0.11–1.29)
<b>MSM (WHO classification)</b>			
Model 1	0.61 (0.43–0.87)	0.39 (0.25–0.61)	0.17 (0.08–0.36)
Model 2 <sup>d</sup>	0.68 (0.47–0.97)	0.50 (0.32–0.77)	0.21 (0.10–0.45)
Model 3	0.70 (0.47–1.10)	0.59 (0.36–0.96)	0.28 (0.12–0.64)

Never breastfed was the reference category for all models. Model 1: unadjusted prevalence ratios; Model 2: adjusted prevalence ratios for confounder variables; and Model 3: adjusted prevalence ratios for variables in model 2 and use of pacifier. CI, confidence interval; MSM, moderate/severe malocclusion.

<sup>a</sup> Adjusted for children's skin color, weight at birth, prematurity, head circumference, number of teeth at 24 months of age, and asthma at 24 months of age.

<sup>b</sup> Adjusted for gender, mother's schooling, family income, weight at birth, prematurity, head circumference, number of teeth at 24 months of age, and asthma at 24 months of age.

<sup>c</sup> Adjusted for gender and mother's schooling, dental caries, and asthma at 24 months of age and dental visit.

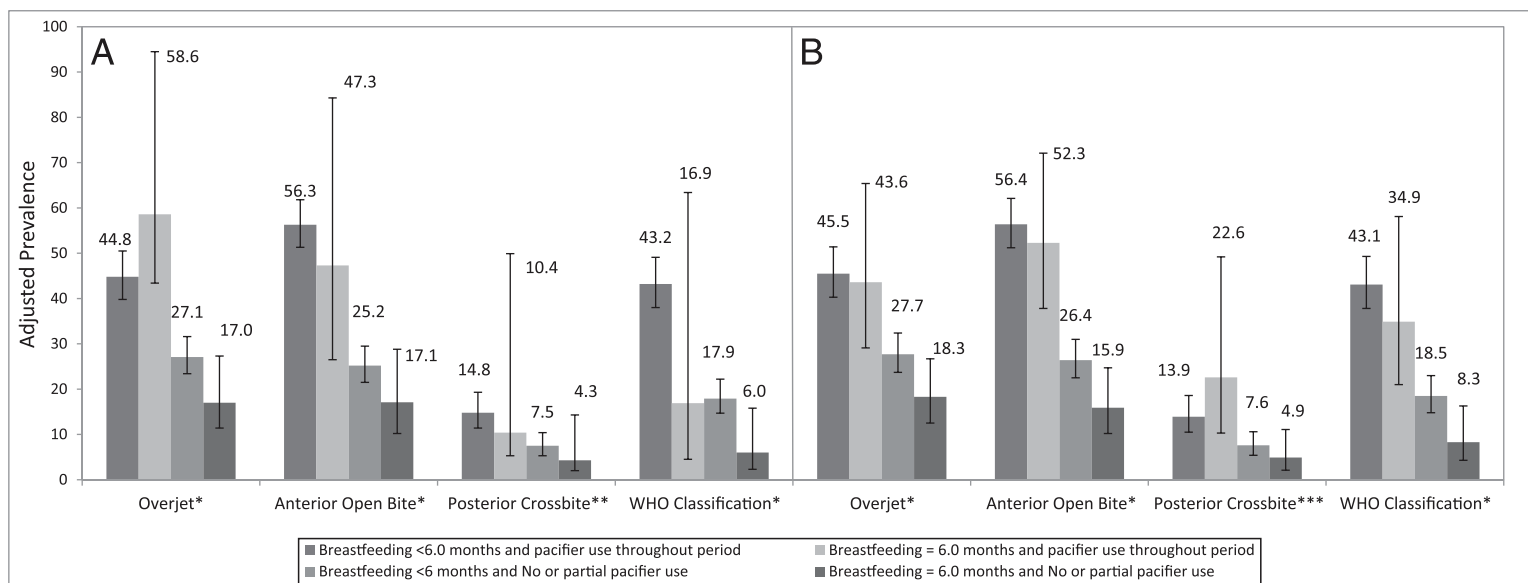
<sup>d</sup> Adjusted for gender, mother's schooling, family income, weight at birth, prematurity, head circumference, number of teeth at 24 months of age, and asthma at 24 months of age.

development of the dental arches, are sparsely investigated in these studies. Finally, we were able to adjust the association between malocclusion and breastfeeding for some socioeconomic measures as well as for biological characteristics. We believe the study results may be

extrapolated to different populations with similar figures of breastfeeding and pacifier use.

However, our study is not free of limitations. We experienced some difficulties in analyzing the intensity and duration of pacifier use. The pattern of pacifier use varied between

the follow-up visits. Some children who did not suck on a pacifier in 1 period were full-day pacifier users in the subsequent period and vice versa. How those children should be considered with regard to pacifier use was therefore not straightforward. Spending more time sucking a pacifier during the same period may lead children to a higher risk of malocclusion than those who use a pacifier less often. In this study, it is reasonable to suppose that the pacifier use in children who are breastfed is less intense even if the same duration is taken into account. The effect of pacifier exposure throughout the life on open bite and severe malocclusion risk was modified by the presence of exclusive breastfeeding up to 6 months; in those children, the prevalence of malocclusion was lower than among those who were breastfed <6 months of age. The detrimental effect of the pacifier seemed higher among children who received predominant breast milk compared with those receiving exclusive breast milk on malocclusion, except for overbite, whose prevalence was 2.5 times higher for both receiving exclusive or predominant breast milk and concomitant use of a pacifier.



**FIGURE 2** Adjusted prevalence of malocclusion according to interaction between pacifier use and breastfeeding (A, exclusive breastfeeding; B, predominant breastfeeding) in the 2004 Pelotas Birth Cohort. \*P value of interaction, <.001; \*\*P value of interaction, = .019; and \*\*\*P value of interaction, = .030.

The prevalence of malocclusion in primary dentition varies in the literature. Studies conducted in 5- to 6-year-old children found that the prevalence of open bite ranged from 13.3%<sup>8</sup> to 46.3%<sup>10</sup> and crossbite from 10%<sup>24</sup> to 18.2%.<sup>10</sup> Despite a notable variation in the prevalence of malocclusion, there is some evidence that malocclusion in primary dentition may be a predictor of permanent dentition malocclusion and later orthodontic treatment needs.<sup>26</sup> Facing the lack of scientific evidence that early orthodontic or orthopedic interventions are effective in correcting malocclusion in permanent dentition,<sup>27,28</sup> we believe that oral health promotion is the best way to avoid occlusal disorders in adolescence given that the presence of malocclusion is

associated with later poor quality of life.<sup>29</sup> Therefore, not only malocclusion but also several diseases such as overweight, obesity, and high systolic blood pressure could be avoided with the promotion of breastfeeding.<sup>30</sup> The adoption of a common risk approach may be the most effective strategy in terms of public health.<sup>31</sup>

## CONCLUSIONS

The present study found that exclusive breastfeeding per se protected against anterior open bite and severe malocclusion in children aged 5 years but that the protective effect of predominant breastfeeding on any type of malocclusion was nullified by the use of pacifiers. An effective strategy to

improve oral health may be to encourage health professionals to work together to promote the potential benefits associated with breastfeeding and the risks associated with frequent pacifier use.

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## ABBREVIATION

WHO: World Health Organization

Address correspondence to Karen Glazer Peres, BDS, PhD, Australian Research Centre for Population Oral Health, School of Dentistry, The University of Adelaide, 122, Frome St, Adelaide, Australia 5000. E-mail: karen.peres@adelaide.edu.au

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