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Early Feeding Practices and Severe Early Childhood Caries in Four-Year-Old Children from Southern Brazil: A Birth Cohort Study

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Key Words
Cohort study · Dental caries, risk factors · Diet · Early childhood caries, severity · Nutrition ·

Abstract
The aim of this study was to investigate the relationship between feeding practices in the first year of life and the occurrence of severe early childhood caries (S-ECC) at 4 years of age. A birth cohort study (n = 500) was conducted in children who were born within the public health system in São Leopoldo, Brazil. Feeding practices were assessed using standardized methods at 6 and 12 months of age. A total of 340 children were examined at 4 years of age. S-ECC was defined as recommended by an expert panel for research purposes: ≥1 cavitated, missing or filled smooth surfaces in primary maxillary anterior teeth or d_{1+} mfs ≥5. Poisson regression with robust variance was used in order to determine the early feeding practices which represent risk factors for the occurrence of S-ECC at 4 years of age. The multivariable model showed a higher adjusted risk of S-ECC for the following dietary practices at 12 months: breastfeeding ≥7 times daily (RR = 1.97; 95% CI = 1.45–2.68), high density of sugar (RR = 1.43; 95% CI = 1.08–1.89), bottle use for liquids other than milk (RR = 1.41; 95% CI = 1.08–1.86), as well as number of meals and snacks >8 (RR = 1.42; 95% CI = 1.02–1.97). Mother's education ≤8 years was also associated with the outcome. The present study identified early feeding practices which represent risk factors for caries severity in subsequent years. These findings may contribute to developing general and oral health interventions, with special attention to families with low maternal education.

Severe early childhood caries (S-ECC) refers to a more progressive and acute pattern of childhood caries, and the term was developed to identify the children with the highest level of disease in each population [Drury et al., 1999]. Children with S-ECC are those who are more likely to present pain, chewing difficulties, speech problems, general health disorders and psychological problems [Ismail, 1998; Ramos-Gomez et al., 2002]. Furthermore, children with high severity of caries attend dental services with more treatment need, which is expensive, difficult to access in most developing countries and may require general anesthesia [Ismail, 1998; Peres et al., 2005].

The etiology of childhood caries is complex and involves interactions between social, behavioral and mi-

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crobiological factors [Peres et al., 2009; Thitasomakul et al., 2009; Warren et al., 2009; Stephenson et al., 2010]. While some risk factors have been identified, their effects on younger children have not yet been adequately investigated. Therefore, scientific evidence on which to base public health interventions to prevent the disease is still insufficient [Ismail, 1998; Ramos-Gomez et al., 2002; Pine et al., 2004; Hallett and O'Rourke, 2006; Finlayson et al., 2007; Peres et al., 2009]. The WHO has indicated dietary guidance as one of the major challenges to reduce obesity and other outcomes such as coronary heart disease, stroke, diabetes, cancers and dental caries [WHO, 2000]. Although dietary behavior is a crucial element in the causality of dental caries [Harris et al., 2004], especially in very young children, few cohort studies have assessed the effects of early dietary factors on dental caries in the subsequent years [Thitasomakul et al., 2009; Warren et al., 2009] and none of them initiated at birth. Recognizing feeding practices in the early years of life that may pose a risk for the future occurrence of S-ECC can be beneficial to oral health and significantly contribute to the improvement of programs targeted at reducing the disease burden in different populations [Finlayson et al., 2007; Mohebbi et al., 2009; Peres et al., 2009].

Therefore, the aim of the present study is to investigate feeding practices in the first year of life associated with S-ECC at the age of 4 years.

Methods

Subjects and Study Design

This prospective cohort study is part of a randomized trial which recruited 500 infants at birth in São Leopoldo, southern Brazil. The overall project consisted of 2 components: (1) the effectiveness of an intervention based on nutritional advice on diarrhea, respiratory disease symptoms, anemia, low height for age and ECC at 12 months and 4 years of age; (2) the investigation of risk factors for these general and oral health outcomes.

São Leopoldo has a population of about 200,000 inhabitants and almost all households have access to public water supply with a fluoride level of 0.7 ppm, but restorative or preventive dental care is not provided through public services for young children. The mothers were recruited from the maternity ward of the city's only publicly funded hospital, which serves mainly the low-income population. From October 2001 to June 2002, all mothers who gave birth to an apparently normal, single, full-term (≥37 weeks) baby with normal birth weight (≤2,500 g) were invited to take part in the study. The exclusion criteria were: impediment to breastfeeding (HIV/AIDS) or congenital malformation. Mothers who had agreed to take part in the study were sequentially incorporated in a list based on time of delivery, grouped in blocks of 5, and their names were separated and placed in opaque envelopes. Two mothers of each block were assigned to the intervention group while the other ones were allocated to the control group, and this process was repeated for consecutive blocks. The intervention group received dietary advice during home visits in the first year of life, based on the 'Ten Steps to Healthy Feeding', a Brazilian national health policy for primary care, supported by the WHO. Details on the outcomes when children were 1 and 4 years old, including dental caries, were previously published [Vítolo et al., 2005; Feldens et al., 2007; Vítolo et al., 2008; Feldens et al., 2010].

The present study investigated feeding practices in the first year of life associated with S-ECC at the age of 4 years. Socioeconomic factors and hygiene practices were also assessed, given the possibility of confounding the association between feeding practices and S-ECC. A new sample size was calculated based on the following parameters: 95% confidence interval (CI), power of 80%, unexposed (maternal schooling >8 years) to exposed (maternal schooling ≤8 years) ratio of 1:2 and prevalence of outcome in children from mothers with higher and lower levels of education of 30 and 50%, respectively [Peres et al., 2005]. These parameters determined the need to examine 233 children. This required sample size was increased by 30%, thus resulting in a minimum sample size of 303 children, for the sake of the multivariate analysis. The mother-child pairs that participated in the original study were invited for the fourth-year assessment. The final sample in this study comprised 340 children, followed from birth to 4 years of age.

Research Assessment Questionnaires

Nutrition undergraduate students not involved in the intervention program carried out face-to-face structured interviews with the mothers in their homes when their children were 6 and 12 months old. Socioeconomic variables (mother's education, mother's and father's occupation status and family income) were investigated in the sixth-month assessment. Dietary behavior variables were assessed at 6 and 12 months, using face-to-face structured interviews of the beginning, and duration and frequency of the feeding practices during the previous 6 months. These interviews investigated, separately for each month, breast and bottle feeding during day and night, frequency and composition of complementary foods, as well as use of sugar, honey, sweetened beverages, biscuits, chocolate and salty snacks. At 12 months, a 24-hour dietary recall was used by fieldworkers for obtaining data about the number of meals and snacks, frequency of breastfeeding, cow's milk volume, bottles for liquids other than milk (generally fruit juices, beverages or teas) and nighttime bottle use. The sum of the number of times an infant was breastfed during the day and night determined the breastfeeding frequency. At 12 months the mothers were also asked about the intake of foods with high density of sugar and lipids in the past month. High density of sugar was regarded as a proportion >50% of simple carbohydrates in 100 g of food (e.g. candies, soft drink, sugar and honey), whereas high density of lipids referred to a fat content >30% in 100 g of food (e.g. salty snacks, filled cookies and chocolate) [Drewnowski, 2005]. Brushing with fluoride toothpaste was also investigated at 12 months.

The questionnaires were tested in a pilot study of 16 mothers of children aged 6 and 12 months attending primary care services and modified accordingly. In order to warrant methodological quality of data collection fieldworkers were submitted to: (a) a training program (12 h), which included simulated questions and answers using a standardized questionnaire and a 24-hour dietary recall; (b) blinding to the child's group status (intervention or control group); (c) supervision during fieldwork and checking of data by an experienced nutritionist.

Clinical Dental Examination

Dental examinations at the fourth-year assessment were performed at a municipal health center by the same examiner of the first-year follow-up, with the child seated in an ordinary chair. Teeth were brushed and dried with gauze and each dental surface was inspected with the help of a mouth mirror. The examinations were conducted at the d_{1+} caries threshold (including noncavitated lesions). The outcome in this study was S-ECC according to NIH case definition [Drury et al., 1999]: ≥1 cavitated, missing or filled smooth surfaces in primary maxillary anterior teeth, or decayed (d_{1+}), missing or filled surface (dmfs) values ≥5. The examiner was blinded to the children's independent variables and intraexaminer reproducibility was previously assessed in 2 dental examinations 14 days apart in 20 children aged 3–5 years (κ score = 0.90). The number of teeth at 12 months had been assessed at the first-year dental examination.

Statistical Analysis

This study examines the effects of dietary practices in the first year of life on the occurrence of S-ECC at 4 years of age. The following feeding practices were investigated: nighttime bottle use, bottle use for drinks other than milk, frequency of breastfeeding, high frequency of daily meals/snacks, high density of sugar, high density of lipids and among those who do not eat family meals at 12 months.

The statistical analyses were performed using SAS [SAS Inc., 2003]. Unadjusted and adjusted relative risks of developing S-ECC were estimated in robust Poisson regression models fit using PROC GENMOD of the SAS software. First, the relative risks and 95% CI of each variable were estimated separately. Since the effects of dietary practices on S-ECC may be confounded by child's age and gender, maternal schooling, per capita income, toothbrushing with fluoride paste and number of teeth at 12 months, these variables were included in the analysis. We performed multivariable modeling starting with all available risk factors and confounders for S-ECC using backward elimination if the Wald p value was >0.05, except for the variable that represent the intervention (child's group status), which remained in the models as a possible confounder irrespective of the statistical significance. Interactions were evaluated by Wald tests in the final model.

Comparisons between children who were lost in the follow-up and those who remained in the cohort regarding baseline variables (weight and length at birth, maternal level of education and family income) were also performed using χ^2 and t tests for independent samples.

Ethical Aspects

This study was approved by the ethics committee of Universidade Federal do Rio Grande do Sul. A parent gave written informed consent for the various research procedures. Both groups received routine assistance by their pediatricians. In the fourth-year assessment, the 2 groups had a nutritional evaluation (anthropometric measurements, blood hemoglobin measurement), child development and dental examinations, and their dwellings were assessed for risk factors for childhood injuries. Children with dental caries were referred for pediatric dental treatment. Children with anemia, overweight, wasting, stunting or developmental problems were referred to their primary care doctors for further assessment and treatment.

Results

Oral examinations were carried out in 68% (n = 340/500) of the initially recruited children. The children's age varied from 48 to 53 months (mean = 50.5; SD = 1.7), 195 (57.4%) were boys, the maternal level of education varied from 1 to 13 years of schooling, with 71.2% of the mothers having ≤ 8 years of schooling, and the family income was low for most families, of which 82% had an income per capita below 1 national monthly minimum wage (R$ 180.00; approximately USD 80.00). The losses comprised 122 children at the first-year dental examination (24.4%) and 38 additional children in the fourth-year assessment (7.6%). Reasons for losses between birth and the fourth-year assessment were: family moved to another city (n = 67), refusal to participate (n = 45), address not found (n = 41), infant given up for adoption (n = 1), genetic illness (n = 2), child's death (n = 2), severe illness of the mother (n = 1) and maternal death (n = 1).

Of the 340 children examined in the fourth-year assessment, 126 (37%) were caries free, 88 (26%) presented dental caries but not S-ECC and 126 (37%) presented S-ECC. The dmft index ranged from 0 to 20 (mean = 3.78; SD = 4.46) and the median was 2.0 (interquartile range = 6); the dmfs index ranged from 0 to 75 (mean = 5.79; SD = 8.7) and the median was 2.0 (interquartile range = 8). Among the children with S-ECC, 50% (63/126) presented both conditions which define the disease (dmfs ≥5 and at least 1 maxillary anterior tooth with cavitation) and the others presented just 1 condition: in 36.5% (46/126) of the children S-ECC was defined by dmfs ≥5 and in 13.5% (17/126) of them S-ECC was defined by at least 1 maxillary anterior tooth with cavitation.

The results of the univariable Poisson regression analysis are shown in table 1. Significant associations were observed between the occurrence of S-ECC at 4 years of age and the following feeding practices: breastfeeding duration, frequency of breastfeeding, nighttime bottle use, bottle use for liquids other than milk, high density of sugar and high density of lipids. Both socioeconomic variables – maternal schooling and per capita income – and number of teeth at 12 months were also associated with

Table 1. Sociodemographic factors, dietary and oral hygiene behaviors, number of teeth and S-ECC among children aged 4 years (n = 340)

Variables	N[a]	S-ECC[b] n	S-ECC[b] %	RR[c]	95% CI	p
Gender						0.868
Male	195	73	37.4	1.02	0.77–1.36	
Female	145	53	36.6	1.00		
Age						0.594
48–50 months	171	61	35.7	1.00		
51–53 months	169	65	38.5	1.08	0.82–1.42	
Maternal schooling						0.007
≤8 years	244	102	41.8	1.67	1.15–2.44	
>8 years	96	24	25.0	1.00		
Per capita income (BMW)[d]						0.027
<1.0	279	111	39.8	1.84	1.07–3.17	
≥1.0	51	11	21.6	1.00		
Age at which sugar was introduced						0.303
≤6 months	292	111	38.8	1.28	0.80–2.03	
>6 months	47	14	29.8	1.00		
Daily breastfeeding frequency at 12 months						0.000
0–2	192	52	27.1	1.00		
3–6	31	13	41.9	1.55	0.96–2.49	
≥7	117	61	52.1	1.92	1.44–2.57	
Breastfeeding duration						0.001
<12 months	164	46	28.0	1.00		
≥12 months	176	80	45.5	1.62	1.21–2.17	
Nighttime bottle use at 12 months						0.007
Yes	197	61	31.1	0.68	0.52–0.90	
No	141	64	45.4	1.00		
Bottle use for other drinks at 12 months						0.032
Yes	129	57	44.2	1.35	1.03–1.78	
No	205	67	32.7	1.00		
Number of daily meals and snacks at 12 months						0.175
<7	136	52	38.2	1.00		
7–8	114	35	30.7	0.80	0.57–1.14	
>8	90	39	43.3	1.13	0.82–1.56	
High density of sugar at 12 months						0.010
Yes	91	43	47.3	1.45	1.10–1.93	
No	240	78	32.5	1.00		
High density of lipids at 12 months						0.036
Yes	158	67	42.4	1.36	1.02–1.81	
No	173	54	31.2	1.00		
Eating family meals at 12 months						0.315
Yes	286	108	37.8	1.00		
No	47	14	29.8	0.79	0.50–1.25	
Toothbrushing with fluoride paste						0.799
Yes	285	106	37.2	1.00		
No	46	18	39.1	0.95	0.64–1.40	
Number of teeth at 12 months						0.007
>6	202	87	43.1	1.54	1.12–2.11	
≤6	136	38	27.9	1.00		

[a] The total was smaller for some variables due to missing information.
[b] Defined as ≥1 cavitated, missing or filled smooth surfaces in primary maxillary anterior teeth or dmfs ≥5.
[c] Relative risk (crude).
[d] 1 BMW = Brazilian monthly minimum wage (worth of R$ 180.00 or USD 80.00).

Table 2. Final model: association of early dietary practices, maternal schooling and number of teeth at 12 months with S-ECC at 4 years of age (n = 331)

Variables	RR[a]	95% CI	p
Maternal schooling			0.034
≤8 years	1.50	1.03–2.19	
>8 years	1.00		
Daily breastfeeding frequency at 12 months			0.000
0–2	1.00		
3–6	2.04	1.22–3.39	
≥7	1.97	1.45–2.68	
Daily meals and snacks at 12 months			0.025
<7	1.00		
7–8	0.99	0.70–1.39	
>8	1.42	1.02–1.97	
Bottle use for fruit juices/soft drinks at 12 months			0.025
Yes	1.41	1.08–1.86	
No	1.00		
High density of sugar at 12 months			0.003
Yes	1.43	1.08–1.89	
No	1.00		
Teeth at 12 months			0.005
>6	1.50	1.12–2.03	
≤6	1.00		

[a] Relative risks adjusted for the other variables in the model and child's group status (intervention or control group).

the outcome. No association was found in the univariable analysis between S-ECC and child's age, gender, age at which sugar was introduced, number of daily meals or eating family meals at 12 months and toothbrushing with fluoride paste.

Table 2 presents the final multivariable model for the effects of feeding practices at 12 months on S-ECC. The risk of S-ECC was higher for children currently being breastfed ≥7 times daily (RR = 1.97; 95% CI = 1.45–2.68) or 3–6 times a day (RR = 2.04; 95% CI = 1.22–3.39) compared to those breastfed once or twice a day or not breastfed, for those currently using a bottle for drinking other liquids besides milk (RR = 1.41; 95% CI = 1.08–1.86) as well as for those with consumption of high-density sugar (RR = 1.43; 95% CI = 1.08–1.89). Although the frequency of dietary intake was not associated in the univariable analysis, the adjusted model showed that the risk of S-ECC was higher for children having >8 daily meals or snacks (RR = 1.42; 95% CI = 1.02–1.97) compared to those who had <7 meals or snacks. This model also shows that the risk of S-ECC was higher when maternal schooling was ≤8 years (RR = 1.50; 95% CI = 1.03–2.19) and for children presenting >6 teeth at 12 months (RR = 1.42; 95% CI = 1.50–1.12). Per capita income, breastfeeding duration, nighttime bottle use and high density of lipids lost their significance after adjusting for the confounding effect of the other variables. No statistically significant interactions were found between the variables.

No difference was found between the children who were lost in the follow-up and those who remained at 4 years of age regarding potential risk factors for childhood outcomes: weight at birth (p = 0.871), length at birth (p = 0.122), maternal level of education (p = 0.423) and family income (p = 0.477). The proportion of nonrespondents at the age of 4 in the intervention (29.5%) and control groups (33.6%) were similar (p = 0.327).

Two additional analyses were performed to investigate the effects of loss to follow-up on the results. First, we carried forward the results from the first-year clinic exam for children lost subsequently, assuming that all children who had dental caries at the age of 1 year were presumed to have S-ECC at the age of 4. This analysis produced an RR for daily breastfeeding ≥7 times of 2.01 (95% CI = 1.57–2.78), an RR for bottle use for juices/soft drinks of 1.37 (95% CI = 1.06–1.78), an RR for >8 daily meals and snacks of 1.51 (95% CI = 1.10–2.06), and an RR for high density of sugar of 1.37 (95% CI = 1.06–1.79). Second, a worst-case scenario in which the 38 children who were lost to follow-up from the first-year assessment to the age of 4 were all presumed to have S-ECC produced an RR for daily breastfeeding ≥7 times of 1.78 (95% CI = 1.39–2.28), an RR for bottle use for juices/soft drinks of 1.30 (95% CI = 1.03–1.63), an RR for >8 daily meals and snacks of 1.35 (95% CI = 1.02–1.78), and an RR for high density of sugar of 1.30 (95% CI = 1.03–1.65). These relative risks were adjusted for the other variables in the final model and the children's group status, demonstrating that the results remained stable.

Discussion

Dietary practices during the first year of life in a birth cohort were assessed to answer the central question of this study: 'What are the feeding practices in the first year of life associated with S-ECC at 4 years of age?' The results confirmed the hypothesis that some early-life feeding practices have an influence on the severity of dental caries in subsequent years.

High frequency of breastfeeding at the age of 1 year was shown to increase the risk of S-ECC as reported in previous research [Dini et al., 2000; Valaitis et al., 2000; Sayegh et al., 2002; van Palenstein Helderman et al., 2006], but breastfeeding duration lost its significance after adjustment. WHO guidelines recommend breastfeeding up to ≥2 years, with appropriate solid food being introduced after the age of 6 months to complement the nutrients supplied by breast milk [WHO, 1998]. Our finding suggests that prolonged breastfeeding per se is not a risk factor if it occurs once or twice a day. However, most children in this population who continued to be breastfed after 12 months were breastfed several times a day. Prolonged contact of human milk with teeth has been shown to result in acidogenic conditions, since the re-/demineralization equilibrium is shifted toward demineralization, and increasing the time per day that fermentable carbohydrates are available may lead to softening of enamel [Thomson et al., 1996; van Palenstein Helderman et al., 2006]. One should argue that high frequency of breastfeeding might be related to other cariogenic dietary factors, but the association remained statistically significant after adjustment for other dietary practices in the first year of life. On the other hand, exposure to sugars before 12 months in practically all children in this study possibly contributed to increased levels of *Streptococcus mutans,* a variable not investigated in the present study and which is strongly associated with childhood caries [Wan et al., 2003; Ge et al., 2008; Seow et al., 2009; Warren et al., 2009]. This characteristic might have increased the cariogenic effect of high frequency of breastfeeding and should be taken into account when extrapolating this finding to other populations.

The association between S-ECC and using a bottle for drinking liquids other than milk is also in line with other longitudinal studies and may be explained by the low pH of fruit juices and beverages and their frequent use in bottles as a child pacifier [Marshall et al., 2003; Seow et al., 2009; Thitasomakul et al., 2009]. Providing fruit juices in the bottle allows them to drink them constantly during the day, which is also a problem from the nutritional standpoint [Marshall et al., 2003]. Despite the recommendation that children should use glasses or cups for consumption of liquids after the exclusive breastfeeding period [Department of Health, 1994; Brazilian Health Ministry, 2002], the bottle is still widely used by a remarkable number of preschoolers [Azevedo et al., 2005; Davies et al., 2005]. The hypothesis that the risk of S-ECC increases with nighttime bottle use at 12 months was not confirmed in our findings. Interestingly, as reported by Milgrom et al. [2000], the crude point estimate, in this study, for sleeping with the bottle suggests that this factor may be protective against caries severity. In fact, this association was clearly confounded by breastfeeding frequency (children without nighttime bottle use were more likely to breastfeed) and lost significance after adjustment.

Some studies found an association between S-ECC and high frequency of food intake, whereas others described weak or no associations [Jin et al., 2003; Tiberia et al., 2007]. Although the distinct characteristics of populations may explain the differences obtained, some methodological aspects should be considered. It is quite likely that directly asking how many times the child consumes sugar or feeds throughout the day is not sensitive enough to determine a high frequency of food intake. In addition, significant changes in the estimates of this variable occurred after adjusting it for confounding factors, showing how complex it is to analyze interdependent feeding practices. The association observed suggests that, regardless of their contents, there should be intervals between meals, confirming that this general health recommendation [Brazilian Health Ministry, 2002] also offers benefits to oral health in very young children.

The amount and frequency of sugar as well as the time of consumption have been found to be significantly related to childhood caries [Harris et al., 2004; Thitasomakul et al., 2009]. The present study assessed 'high density of sugar', which is especially relevant to general health. As sugar consumption is associated with obesity and type 2 diabetes, the WHO has cautioned against the excessive consumption of energy-dense foods, notably those high in sugar and fat [Drewnowski, 2005]. The results of this study demonstrate that, regardless of the frequency of food intake, high density of sugar at 12 months is a risk factor for S-ECC at the age of 4 years. Therefore, besides the benefits to general health, reduction in the consumption of sugar in the first year of life is a protective measure in terms of oral health in subsequent years.

The effect of maternal education on S-ECC was attenuated by the mediating effect of dietary practices. This finding suggests that dietary practices represent a possible pathway by which maternal education is protective against dental caries. Fatalistic health beliefs, inadequate knowledge of children's needs and living in deprived neighborhoods have been shown to be associated with childhood caries [Willems et al., 2005; Finlayson et al., 2007] and probably represent other ways whereby maternal schooling plays a role. Although the exact mechanism remains incompletely explained [Finlayson et al., 2007; Declerck et al., 2008] and more comprehensive models are needed to investigate how socioeconomic conditions may affect childhood caries, our results reinforce the need to promote equity in education for reducing oral health outcomes [Willems et al., 2005]. The finding that toothbrushing with fluoride dentifrice was not associated with S-ECC may be partly explained by the general quality of brushing in children younger than 12 months. Also, it is possible that toothbrushing habit at the age of 1 year may not predict oral hygiene practices in subsequent years, just as with the consumption of sugar. Similar results have already been described in young children [Milgrom et al., 2000].

Some aspects of the methodology of this investigation need to be commented on. First, the losses were fairly high, especially between birth and the first-year assessment. This is a common problem in cohort studies, chiefly in populations with high mobility. Although identification data were extensively collected by researchers at the beginning of the study to minimize this problem, a significant number of families moved away within the first weeks after the child's birth without letting the research staff know about it or refused to participate in the study. However, selection bias is unlikely to be a major problem, considering the similarity in baseline characteristics between those lost and those not. In addition, the results did not change substantially with the sensitivity analysis to investigate the effect of losses in the subsequent years.

The possibility of information bias has to be considered in studies that investigate dietary practices, since investigators have to rely on participants' memories. In the present study, the period between the feeding practices and data collection was never longer than 6 months, thus limiting the bias. Furthermore, the effects of the variables may be attenuated rather than increased by this phenomenon [Rothman and Greenland, 1998]. A particular methodological aspect of the present study concerns the rigor with which data on feeding practices were collected, including an intensively trained staff supervised by an experienced nutritionist in order to reduce information bias, a common problem in studies of this type [Harris et al., 2004]. In addition, the variables were collected where the families lived, which possibly contributed towards the report of actual feeding behavior by the mothers.

The results of the present study can be generalized for populations with similar levels of exposure, such as low socioeconomic status, poor access to professional healthcare and early introduction of sugar in children's diet. The estimates might be smaller in populations with a healthier eating behavior or with better access to early preventive care.

In conclusion, based on the early dietary variables identified as risk factors for S-ECC, general and health promotion programs targeted at infants and toddlers should emphasize the need (1) to avoid/reduce the consumption of foods with high density of sugar and (2) to keep intervals between meals. These are simpler and more objective implementation recommendations to which new mothers are especially sensitive [Feldens et al., 2007]. On the other hand, further studies are recommended to develop strategies that can positively interfere in more complex feeding practices, such as bottle use for the consumption of fruit juices, soft drinks and other beverages. Mothers should be advised mainly in the first months of life, before children make transitions from the exclusive milk diet to a variety of foods, representing an important time to exert positive influence on eating habits [Birch and Fisher, 1995]. Finally, these recommendations should also include improvement in educational level, a crucial policy for reducing a whole gamut of childhood diseases.

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