

## Original Article

# Effect of feeding practices on dental caries among preschool children: a hospital based analytical cross sectional study

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Feeding practices during early childhood play an important aetiological role in early childhood caries (ECC). The role of feeding practices in causation of ECC is debated. The objective of this study was to assess the aetiological role of feeding practices on ECC. A descriptive cross sectional study was conducted at a paediatric unit in Sri Lanka. Two hundred and eighty-five children between 36 to 60 months, admitted to the unit were randomly selected for the study. An interviewer administered questionnaire asked about socio-demographic characteristics and feeding practices. The mouths of children were examined for dental caries. Out of 285 children, 61% had exclusive breast feeding up to six months, 69% continued breast feeding beyond two years and 82% had overnight feeding after two years of age. One hundred and thirty-six children (47.7%) had dental caries with a mean deft score of 1.81. Overnight feeding with any type of milk beyond two years significantly increased dental caries incidence and severity. Children exclusively breast fed for six months or had breast feeding beyond two years had a higher prevalence of caries than children not exclusively breast fed or who were not breast feed beyond two years, but the difference was not significant. Overnight feeding with any type of milk beyond two years should be discouraged.

**Key Words:** early childhood caries, overnight feeding, breast feeding, sugar, formula milk

## INTRODUCTION

Early childhood caries (ECC) is a common but neglected public health problem in Sri Lanka. Lack of awareness among parents on preventing and treating dental caries has resulted in very high prevalence of dental caries among Sri Lankan preschool children.<sup>1</sup> The American Academy of Paediatric Dentistry defines ECC as 'the presence of caries in one or more primary teeth (cavitated or non-cavitated) in a child 71 months of age or younger'.<sup>2</sup> According to Sri Lanka National Oral Health Survey 2002/03, ECC prevalence among five years old was 65%.<sup>3</sup> It is important to prevent ECC because without intervention they will rapidly destroy primary dentition resulting in pain, acute infections, feeding difficulties and speech problems.<sup>4</sup> ECC is a predictor of caries in permanent dentition.<sup>5-6</sup> There are many successful public health programmes in Sri Lanka, but there is no such programme to promote oral health among preschool children.

ECC has complex and multifactorial aetiology.<sup>7</sup> Bacteria-induced dental plaque formation is the first step. Bacteria produce acid by fermenting carbohydrates causing demineralisation of the enamel.<sup>8</sup> Feeding practices during infancy play a major role in causation of ECC because teeth are more vulnerable for caries immediately after eruption. Night feeding during sleep provides fermentable carbohydrates. This, along with diminished salivary flow

at night, increases the risk of ECC. There is evidence in the medical literature to conclude night feeding with formula milk, adding sugar to formula milk and excessive consumption of sweets will promote ECC.<sup>8-9</sup> Lida et al found no evidence to suggest breast feeding or its duration are independent risk factors for early childhood caries.<sup>10</sup>

Present recommendations on infant feeding are, exclusive breast feeding up to six months with complimentary feeds added after that. Breast feeding is to be continued up to two years and beyond. However, breast feeding after two years should be only after main meals.<sup>11</sup> In Sri Lanka, the exclusive breast feeding rate is very high and a large percentage of mothers continue breast feeding beyond two years with overnight feeding.<sup>12</sup> In contrast to high ECC prevalence, practices related to tooth brushing

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are good among Sri Lankan preschool children.<sup>1</sup> The main objective of this study was to assess the influence of feeding practices on ECC, among Sri Lankan preschool children.

## MATERIAL AND METHODS

### *Study setting*

A descriptive cross sectional study was conducted between September and December 2011, at the university paediatric unit of Teaching Hospital Ragama. This unit along with two other units in the hospital provides paediatric care to a community living within about 5 km radius from the hospital. The majority of the paediatric patients admitted are with an acute illness, but some follow-up patients are also admitted. The study was based on guidelines issued by the World Health Organization (WHO) on conducting research on dental caries, but some modifications had to be made to suit the circumstances.

### *Sample size calculation and subject selection*

According to our preliminary survey on children admitted to Teaching Hospital Ragama, it was observed about 80% children were fed overnight. A sample size of 246 was required to study overnight feeding within 5% (prevalence 80% and 95% confidence interval 75%-85%). As our objective was to study the relationship between feeding practices and ECC, only children between 36 months to 60 months were included. To avoid confusion related to missed teeth due to caries and natural exfoliation which usually starts around 60 months, the upper age limit was set at 60 months. Every other child admitted to the university paediatric unit irrespective of the reason for admission was considered for the study. Immediate next child was considered when the selected child was not in the target age group, too ill to be examined or when the mother was not available to provide information about feeding. Informed written consent was obtained from the mothers and none of them refused to consent.

### *Training of investigators and pilot test*

Two medical graduates were trained in identifying dental caries and data collection. A pilot study was conducted with thirty five children admitted to Teaching Hospital Ragama. A dental mirror was used to examine the oral cavity, but this was abandoned as the majority of children resisted its use and mothers expressed concern about possible injury. A disposable wooden spatula and a torch, the standard method used in the unit to examine the oral cavity and throat, were used instead. This provided adequate visibility of the oral cavity to identify dentinal caries, but was not adequate to exclude enamel caries. Thus, the study was restricted only to dental caries. Though the risk for proximal caries is very high in this study population, bite view radiographs for the diagnosis of proximal caries were not taken because bite view radiographs were not freely available in the study setting and it is unethical to expose children to radiation for research purposes. Thirty one children included in the preliminary study were examined for dental caries by investigators. Another four children had to be excluded as they were not cooperative. Both investigators were involved in examining each child. To avoid inter-observer variation, the same investigator

examined the oral cavity, while the other assisted.

### *Data collection*

A pretested, validated, interviewer administered questionnaire was used to collect socio-demographic characteristics and feeding practices. Each child's mouth was examined, in presence of the mother, under good light. Teeth with visible cavitations, filled or missing due to decaying were recorded separately. All three categories from each child were added to obtain the number of teeth affected with caries. The age of the child was defined as age in completed months. Feeding a child during the night on demand or letting the child sleep with a feeding bottle or nipple in the mouth was reported as overnight feeding. Children who were fed only with breast milk even without water up to six months was reported as exclusively breast fed.

### *Ethical issues*

A committee of experts from Sri Lanka College of paediatricians reviewed the research proposal and Ethics Committee of Sri Lanka College of paediatricians granted ethical approval for the study. Participation in the study was voluntary and the mother reserved the right to withdraw from the study at any time, without facing any consequences. In this study, any child not cooperative during examination was replaced with another child. Children with dental caries were referred to the dental clinic at Teaching Hospital Ragama.

### *Data analysis*

Descriptive statistics and frequency tabulations were generated using SPSS version 16. The deft score was calculated for each child. The deft score is a reliable indicator of dental health status of children in a population. The deft score is calculated by adding teeth which are decayed, extracted due to caries or filled. Odds ratio with 95% confidence interval was used to compare prevalence of ECC between two groups, while independent student t test was used to compare deft scores of two different groups.

## RESULTS

Three hundred children were initially recruited for the study, out of which only 285 (138 boys, 147 girls) allowed complete examination of the oral cavity. Out of 285 children, 130 were between three and four years and 155 between four to five years. The distribution of the study population according to monthly family income and maternal education is given in Table 1.

### *Feeding practices*

One hundred and seventy-seven children (62%) had exclusive breast feeding up to six months. Out of them, 126 (71.6%) continued breast feeding beyond two years. One hundred and ninety-seven (69.1%) children had breast feeding beyond two years, and out of them 194 had overnight feeding. Out of babies not exclusively breast fed up to six months, 65.1% continued breast feeding beyond two years. Thus a higher percentage of children exclusively breast fed for six continued breast feeding beyond two years.

Out of 285 children, 250 had formula milk at some stage,

with 69 having formula milk commenced before one year of age. Of the 250 children given formula milk, 236 had sugar added to formula milk and 28 had sugar added before one year.

Overnight feeding after two years of age was reported from 234 (82.1%) children. Out of them 142 (60.6%) had only breast milk, 42 (18%) had formula milk and 50 had (21.4%) both. Of the babies exclusively breast fed up to six months, 53.4% had an overnight breast feeding beyond two years, while babies not exclusively breast fed had a rate of 41.2%. Out of 197 babies who had breast feeding beyond two years, 194 (98.5%) had overnight breast feeding.

### Dental caries

Out of 285 children, 137 (48%) had dental caries. The mean deft score for the study population was 1.81 with a

standard deviation of 2.61. The mean deft score among children exclusively breast fed up to six months was 1.9 compared with 1.6 among children not exclusively breast fed. The difference was not statistically significant ( $p=0.28$ ). Children exclusive breast fed had a caries prevalence of 50% compared with 44% among non-exclusively breast fed (OR=1.27, 95% CI 0.79-2.05).

Children fed overnight with any type of milk had a caries prevalence of 52%, whereas prevalence among children not fed overnight was 29% (OR=2.61, 95% CI 1.37-5.0). Overnight fed children also had a higher deft score than others ( $p=0.002$ ). Children fed overnight only with breast milk had a caries prevalence of 51.4%, compared with children not fed overnight (OR=2.54, 95% CI 1.29-5.01) and had significantly higher mean deft score ( $p=0.001$ ). A similar pattern was evident with overnight formula feeding, where caries prevalence was 59.5% (OR=3.53, 95% CI 1.5-8.28), and a higher mean deft score ( $p=0.09$ ) compared with children not fed overnight. The association observed between overnight feeding and dental caries is depicted in Table 2.

Children breast fed beyond two years of age had a caries prevalence of 51% compared with 39.7% among children not breast fed beyond two years (OR=1.59, 95% CI 0.96-2.65). Prevalence of caries among children who had formula milk was 47.6%, while prevalence among children who never had formula milk was 51.4% (OR=1.08, 95% CI 0.59-1.96). Children who had sugar added to formula milk under one year had a caries prevalence of 85.7%, while children who had sugar added after one year had a prevalence of 43.7%. (OR=1.96, 95% CI 1.08-3.55). The effects of formula milk and adding sugar to formula milk under one year towards caries are shown in Table 3. Prevalence and deft scores for different feeding practices were independently calculated for children between three to four years and four to five years to

**Table 1.** Distribution of the sample according to family income and maternal education

Characteristic	Frequency
Maternal education (grade)	
0-5	5 (1.8%)
6-11	160 (56.1%)
12-14	105 (36.8%)
University	15 (5.3%)
Monthly family income (SLR) <sup>†</sup>	
<5,000	2 (0.7%)
5001-10,000	24 (8.4%)
10,001-15,000	102 (35.8%)
15,001-30,000	106 (37.2%)
30,001-50,000	27 (9.5%)
>50,000	24 (8.4%)

<sup>†</sup> 1 US\$ = 110 SLR at present currency rate.

**Table 2.** Association between overnight feeding and dental caries

Overnight feeding practice	Caries present	Caries absent	Mean deft per type of feeding practice
Fed with any type (n=234)	122 (52%) OR=2.61*	112 (48%)	3.3 SD=2.75 $p=0.002^*$
With breast milk only (n=142)	73 (51%) OR=2.54*	69 (49%)	2.04 SD=2.78 $p=0.001^*$
With formula only (n=42)	25 (60%) OR=3.53*	17 (40%)	1.59 SD=2.39 $p=0.09^*$
Not fed overnight (n=51)	15 (29%)	36 (71%)	0.84 SD=1.82

\* When compared with children not fed over night.

**Table 3.** Effects of formula milk and sugar in causation of early childhood caries

Feeding pattern	Caries present	Caries absent
Formula milk given (n=250)	119 (48%)	131 (52%)
Formula milk not given (n= 35)	18 (51%)	17 (49%)
Sugar added to formula milk under one year (n=28)	24 (86%)	4 (14%)
Sugar added to formula milk after year (n=208)	91 (44%)	117 (56%)

OR=1.08  
OR= 1.96

ascertain the influence of age. Though prevalence and deft scores increased with advancing age, influence of feeding practices on ECC was similar.

## DISCUSSION

Our study reveals strong support for a causal relationship between overnight feeding with any type of milk and ECC. Overnight feeding with formula milk seemed to have a higher risk than breast milk. Prakash et al have shown an increased risk of caries with 'on demand night feeding' with breast milk or formula.<sup>13</sup> Bankel et al also found a causal relationship between on demand breast feeding at night.<sup>14</sup> Overnight feeding with substances containing fermentable carbohydrates facilitates ECC, especially in upper maxillary incisors, because salivary flow is less at night. Overnight breast or formula feeding will provide fermentable carbohydrates, thereby increasing the risk of ECC.

Although causal role of overnight feeding on ECC is not controversial, existing evidence in medical literature is divided with regard to other feeding practices and ECC. In a study in United States, Lida et al did not find a significant causal relationship between dental caries and duration of breast feeding.<sup>10</sup> According to Lida et al, children breast fed more than one year had higher prevalence of caries, but the difference was not significant. Lida et al did not assess the effects of breast feeding beyond two years or effects of night feeding on caries. Hong et al, Tanaka et al and Sankeshwari et al have all shown an increase in dental caries with increased duration of breast feeding.<sup>15-17</sup> Our study also revealed an increased prevalence of caries among children breast fed beyond two years, but the increase was not statistically significant. In our study almost all babies who were breast fed beyond two years were fed overnight as well. Thus, we suggest the increased prevalence noted among prolonged breast fed babies is due to effects of overnight feeding rather than the duration of breast feeding.

Our study also revealed an increased risk of ECC among children exclusively breast fed up to six months, but the increase was not statistically significant. We could not find any evidence in medical literature indicating a causal relationship between ECC and exclusive breast feeding. Compared with children who were not exclusively breast fed for six months children exclusively breast fed had higher prevalence of overnight feeding. As with breast feeding beyond two years, increased prevalence of ECC among exclusively breast fed babies may be due to this.

William & Ruth have reported that human breast milk is more cariogenic than cow's milk.<sup>9</sup> Our study also showed a slightly lower prevalence of caries among children receiving formula milk than not. However, children fed overnight with formula milk had 3.5 times higher risk of caries compared with 2.5 times risk with overnight breast feeding. Adding sugar to formula milk will explain this because 94% of the children who had formula milk had sugar added. Adding sugar to feeds during first year is not recommended because it affects child's taste adaptations. It is worrying to find that out of children who had formula during first year, more than 40% had sugar added. The very high prevalence of ECC among children, who

had sugar added to formula milk during infancy, further supports the recommendation on adding sugar to infant feeds.

Correct feeding practices during early childhood play an important role in physical growth, cognitive development, immunity, prevention of obesity and protection from atopic conditions & cardio-vascular problems in later life.<sup>18</sup> Breast milk is the best food for a child and exclusive breast feeding during first six months helps to improve wellbeing of children. WHO recommends exclusive breast feeding up to six months and continuing breast feeding up to two years and beyond. Breast feeding after two years should be only after main meals. Many Sri Lankan mothers continue breast feeding throughout the day including the night.<sup>12</sup> Findings of this study are in accordance with the WHO recommendations on breast feeding. While exclusive breast feeding during first six months and continuing breast feeding thereafter should be promoted, overnight feeding beyond two years with any type of milk should be strongly discouraged.

## Limitations

The main limitation of this study was including only dental caries. Children in this age category usually resist even routine clinical examination. Use of a dental mirror was not tolerated by most of the children. Another limitation was not using bite view x-rays due to unavailability in the study setting. Inclusion of a hospital base sample has the limitation in generalization of the results to the population, but as the Teaching Hospital Ragama is the largest hospital in the area it attracts a mixture of children from different socio-economic backgrounds. As the feeding history was obtained retrospectively, possible recall bias is a limitation. However, most of the mothers had no difficulty in recalling the dietary history.

## Conclusions

Overnight feeding with any type of milk increases the prevalence and severity of dental caries among preschool children. Exclusive breast feeding or continuing breast feeding beyond two years had no statistically significant causal relationship to ECC. Adding sugar to formula milk, especially during infancy increased the risk of ECC, though this was not statistically significant.

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## AUTHOR DISCLOSURES

All authors declare no competing interests.

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### 喂养方式对学龄前儿童龋齿的影响：一项以医院为基础的横断面研究

幼儿期的喂养方式对幼儿龋齿发挥着重要的病因学作用。喂养方式与幼儿龋齿的因果关系存在争议。本研究的目的是评估喂养方式对幼儿龋齿的病因学作用。这是在斯里兰卡儿科病房完成的一项描述性的横断面研究。住院的 285 名月龄在 36-60 个月之间的儿童被随机选入该研究。面试人员采用问卷调查的方法询问儿童的社会人口学特征和喂养方式，检查了儿童的龋齿情况。在 285 个儿童中，有 61% 的幼儿完全母乳喂养到六个月，69% 继续母乳喂养超过两年，82% 两岁之后仍存在夜间喂养。136 个有龋齿的儿童(47.7%) 平均龋齿活动度得分为 1.81。夜间喂养任何类型的奶超过两年都显著增加龋齿的发生率和严重程度。完全母乳喂养六个月或母乳喂养超过两年的儿童，龋齿的发生率高于不完全母乳喂养或母乳喂养不超过两年的儿童，但这种差别不显著。任何类型奶的夜间喂养都不应该超过两年。

**关键词：**幼儿龋齿、夜间喂养、母乳喂养、糖、奶粉