

# Infant Dietary Pattern and its Association with Early Childhood Caries in Preschool Children: A Cross-sectional Study

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## ABSTRACT

**Aim:** This study aimed to investigate the associations between feeding and oral hygiene practices during the first year of life and caries prevalence in preschool children.

**Materials and method:** A cross-sectional study was conducted on 420 children between the age-group of 3–5 years in Navi Mumbai, India. Dental caries experience was recorded using WHO criteria. A validated questionnaire with 34 questions was used for collecting information regarding feeding and oral hygiene practices. The data collected were analyzed using the Mann–Whitney *U* test, Kruskal–Wallis test, and Chi-square test.

**Results:** Caries prevalence was high and statistically significant ( $p < 0.05$ ) among those who were breastfed, fell asleep with a bottle in the mouth, fed with additional sugar in bottled milk, those who had a frequent sweet intake, and where infant's teeth were not cleaned soon after eruption.

**Conclusion:** Determining the role of feeding practices on early childhood caries and intervention during early childhood seems to be the most appropriate action to ensure healthy dental habits throughout life.

**Clinical significance:** A future direction for dentists to target preventive interventions in early childhood and incorporate cariogenicity of frequent infant feeding into sound recommendations for parents and caregivers.

**Keywords:** Breastfeeding, Dietary habits, Early childhood caries, Oral hygiene practices, Preschool children.

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## INTRODUCTION

Early childhood caries (ECC), although preventable, still remains one of the most prevalent diseases in children worldwide. Feeding and oral hygiene practices in infancy are plausible contributors to early childhood caries. The possible mechanisms involved with the etiology of ECC can be associated with differences concerning social factors and family and socioeconomic variables, which determine distinct forms of behavior.<sup>1</sup> The infant dietary pattern and oral hygiene practices are often based on tradition rather than recommended guidelines.

The American Academy of Pediatric Dentistry recommends a first dental examination no later than age 12 months, in part to counseling caregivers regarding dietary habits.<sup>2</sup> However, feeding habits, particularly during the first year of life, involve a number of simultaneous and interrelated behaviors, such as breastfeeding, bottle feeding, and the introduction of complementary foods. Some feeding behaviors established at this age like on-demand breastfeeding, frequent or prolonged day or night use of baby bottles that contain fermentable liquids, continued use of a sweetened pacifier, and diet can influence caries development and potentially impact health over the course of life. It has been found that children with caries in their primary teeth are three times more likely to have caries in their permanent teeth than adults.<sup>3</sup>

With that in mind examining the multidimensional dietary pattern in young children may provide more information on feeding habits and the effect of dietary factors on the risk of early childhood caries than the examination of sugar intake alone. Also, a systematic review in 2018 reported a high prevalence of ECC in India with every state showing prevalence above 40%.<sup>4</sup> Therefore, there is a great need of educating and encouraging parents and caregivers about feeding and oral hygiene practices in infancy.

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Thus, this study aims to investigate the relationship between infant dietary patterns in the first year of life and ECC in 3–5-year-old children, with the hypothesis that different dietary patterns in infants up to 1-year results in a difference in the severity of ECC at 3–5 years.

## MATERIALS AND METHODS

### Study Design and Participants

The present investigation was a cross-sectional study conducted over a period of 6 months. The target population was defined as male and female preschool children, aged 3–5 years visiting the Outpatient Department of Pedodontics and Preventive Dentistry at an institution in Navi Mumbai, India.

Only healthy children between the ages of 3–5 years, without any significant medical history and accompanied by their mother were included in the study.

A sample size of 383 was derived. However, an additional 10% were included in the study to compensate for potential refusals. Thus, the sample size for the present study was estimated to be 420 at a 95% confidence interval (Flowchart 1).

### Ethical Considerations

The Institutional Research and Ethical Board, DY Patil University, School of Dentistry, Navi Mumbai approved the present study, which was conducted following all ethical guidelines [IREB/2020/PEDO/06].

Before commencement of the study, informed consent was obtained in English and two local languages (Hindi, Marathi) from all the mothers of the participating children.

### Clinical Examination

A single examiner, blinded to the questionnaire responses, performed the clinical examination. Intraoral examination was carried out using a mouth mirror, blunt probe, and artificial light source, and caries were assessed according to the WHO criteria, 1997. The blunt probe was used only in case of doubt to confirm the absence or presence of a cavity according to Pitts and Ismail, who stated application of slight force with explorer could damage a tooth surface with a white spot lesion.

The mothers of the children, chosen for the study were interviewed face-to-face using a structured questionnaire. The questionnaire was framed in English and translated into two local languages (Hindi, Marathi). The content was validated by seven experts in the field of Pedodontics and Preventive Dentistry. The questionnaire consisted of three domains; feeding practices, dietary habits, and oral hygiene measures.

- The feeding practices—This domain included two parameters; breastfeeding and bottle feeding.
- Dietary habits—This domain recorded the age of introduction of complementary food, sucrose consumption, and presence of in-between snacking habits.
- The oral hygiene practices—This domain included questions regarding all the oral hygiene practices carried out in the first year of life.

### Statistical Analysis

Statistical analysis included both descriptive and analytical tests. Discrete and categorical data were distributed as frequency/percentage distribution. Chi-square analytical test was employed which analyzed the difference in feeding variables with the presence or absence of ECC. Mann–Whitney U test and

Kruskal–Wallis test was used to compare the deft index values in terms of Mean (SD) among responses to various questions.

## RESULTS

The present study was carried out on a total of 420 children (47.35% males and 52.7% females) in the age-group of 3–5 years. (Mean age  $3.85 \pm 0.732$ ) (Fig.1).

**Breastfeeding**—Approximately 50% of the children were breastfed while 41.80% children were bottle-fed. Table 1 shows the mean deft values of the children breastfed and bottle-fed. Those who were breastfed had a mean deft 4.69 which was more than the bottle-fed children and was statistically significant ( $p < 0.05$ ). It was observed that 48.51% of children were breastfed for a duration of 1–1.5 years. Prolonged duration beyond 2 years was observed in 27.78% children. Of the 241 children who were breastfed, a frequency of five times per day during both day and night was observed in 40.59% of children. Nearly 82.17% of children were breastfed to sleep and 68.31% of children were fed during the night on demand.

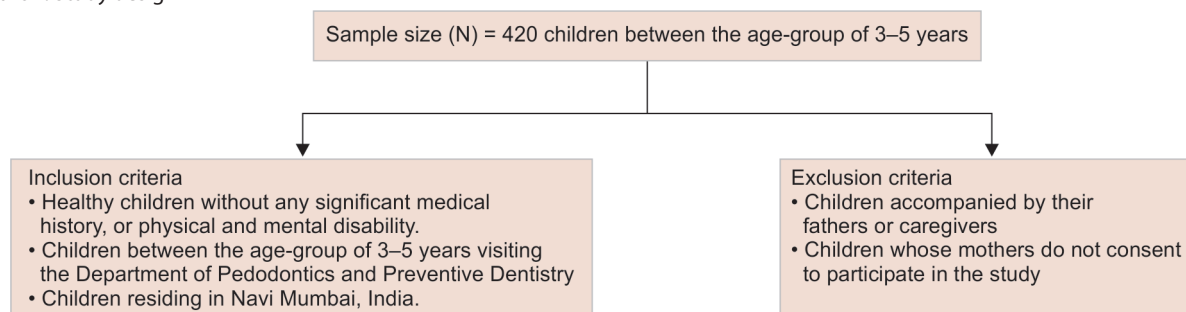
**Bottle feeding**—About 60% of the children were bottle-fed during the night on demand. Children who slept with the bottle in their mouth had a mean deft 4.56 which was significantly more than children who did not sleep with a bottle in their mouth (Table 1). About 40% of the children were fed with additional sugar/sweetener added to the bottled milk and had a statistically significant mean deft score of 4.23 (Table 1). Among these, 83.3% had powdered sugar while 16.6% had either honey or jaggery as an additional form of sugars with bottled milk/infant formula.

**Infant dietary pattern** (Fig. 2)—The frequency of sweet intake in the diet was more than 2–3 times daily in 32.07% of children and had a mean deft score of 5.85 which was statistically significantly higher (Table 1).

**Dummy/Pacifier-sucking habit**—It was observed that 11.11% of children had a pacifier-sucking habit, 70% of which did not have pacifiers sugar-coated.

**Oral hygiene practices** (Figs 3)—Most of the mothers (57.30%) did not clean their infant's teeth as soon as it erupted in the oral cavity. Children whose teeth were not cleaned had a mean deft score of 4.59 which was significantly higher than those who had their teeth cleaned. Mothers (45.50%) introduced their children to toothbrushing around 1.5–2 years with a frequency of brushing once a day. About 84.50% of children were assisted by their mothers/caregivers while toothbrushing. Nearly 55.23% of children used fluoridated toothpaste from the age of 2–3 years.

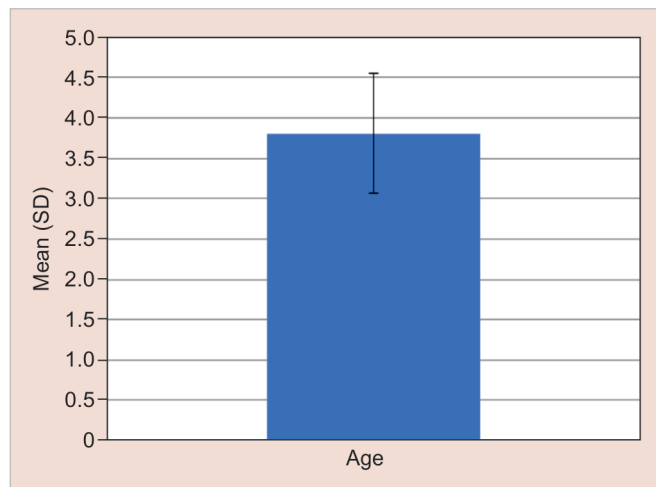
Flowchart 1: Study design



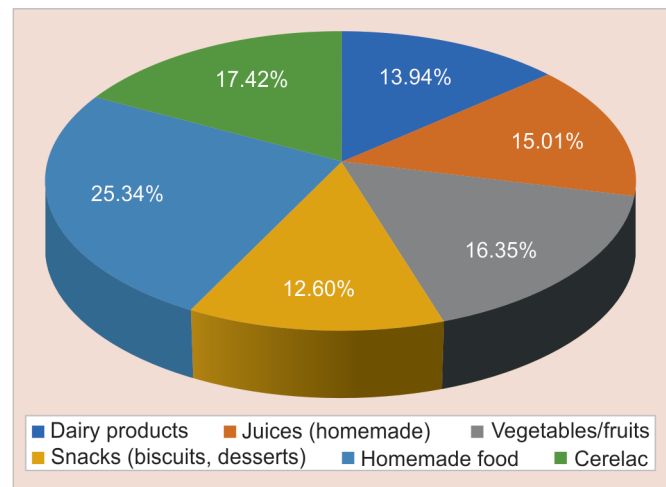
**Table 1:** Mean deft score in the study population in relation to feeding and oral hygiene practices

Items		N	Mean	p value
Was the child breastfed or bottle-fed?	Breastfed	241	4.69	0.011*
	Bottle-fed	100	1.78	
	Both	79	2.85	
Whether the child slept with the bottle in the mouth?	Yes	176	4.56	0.015*
	No	199	1.90	
Was sugar/sweetener added to the bottled milk?	Yes	207	4.23	0.029*
	No	218	1.64	
Was the sweet intake in diet frequent? (More than 2–3 times/day)	Yes	73	5.85	<0.001**
	No	111	2.71	
How often did your child have fruits?	Never	50	4.53	0.020*
	Once a day	218	2.15	
	Twice a day	47	5.00	
	More than twice a day	12	4.56	
Were the infant's teeth cleaned as soon as the teeth erupted in the oral cavity?	Yes	293	2.47	<0.001**
	No	309	4.59	
What was the frequency of tooth brushing?	Never	0	–	0.009*
	Once a day	340	2.86	
	Twice a day	35	5.90	
	More than twice a day	20	1.67	

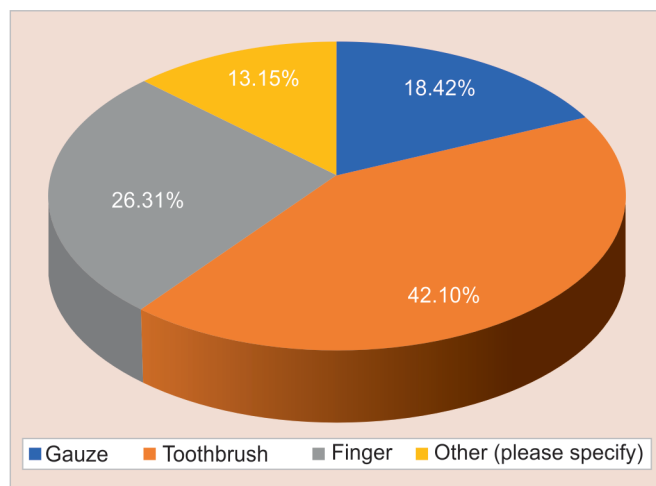
\*p < 0.05–Significant, \*\*p < 0.001–Highly significant



**Fig. 1:** Mean age of the study population



**Fig. 2:** Food items introduced in first year



**Fig. 3:** Methods used to clean the teeth

## DISCUSSION

Severe early childhood caries is a specific form of rampant decay of primary teeth in infants. The lesions progress quickly and occur in surfaces generally considered to be at low risk for caries.<sup>1</sup> The current study has identified several characteristics of feeding habits and oral hygiene practices in association with ECC.

India and a few other countries are characterized by cultural diversity and plurality at many levels. Children grow up in a network of multiple interactions with members from within and extended family influencing the daily food routine of the child. There are various parental beliefs and practices which create the backdrop for the development of the child. Although women may receive guidance from health care professionals, relatives especially grandmothers, have an important influence on breastfeeding practices. The average duration the mothers' breastfed their infants was between 4 and 6 months with firstborn children usually being breastfed for a longer time than second-born children.<sup>5</sup> In the

present study, the average duration was found to be 1–1.5 years while prolonged duration beyond 2 years was observed in 27.78% of children. Mothers who are unable to timely breast-feed their children for various reasons express a feeling of inadequacy and guilt. These children are tended to be fed more and on-demand by their caregivers.<sup>5</sup>

Breast milk is found to contain many protective factors like immunoglobulins, lysozyme, lactoperoxidase, complement components, cells, and lipids. These host resistance factors act against different organisms and provide definite protection to infants from infection. However, concerns about human breast milk's cariogenicity is still questionable. The role of breastfeeding in the development of ECC is complex.

In this current study, 50% of children were breastfed to sleep and 68.31% were breastfed during the night on demand. They had a higher mean deft score (4.12) than those who were not. Thus, breastfeeding during sleep time was associated with early childhood caries. This is in accordance with AAPD 1996 statement which recommends that "ad libitum nocturnal breastfeeding should be avoided after primary tooth begins to erupt." Similarly, caries experience was high in children who slept with the bottle in their mouth ( $p = 0.015$ ). This can be explained by the fact that the breastmilk or bottle contents are constantly in contact with the dental structures, making it the ideal place for acid production and dental caries onset.<sup>1</sup>

Erikson and Mazhari stated that in a breastfed child who also has a sugar-rich diet, human breast milk becomes highly cariogenic. The association of breastmilk with other carbohydrates may become cariogenic and lead to SECC.<sup>1</sup> These findings were similar to the current study where significant results ( $p = 0.029$ ) were seen in children who had sugar/sweetener added to the milk. Shruitha et al. reported 100% caries prevalence in children who had 2–3 tsp sugar added to milk.<sup>6</sup> Likewise, Feldens et al. stated that the potential cariogenicity of breast milk is enhanced with the addition of outside sugars.<sup>7</sup> Consistent with the literature on dietary practices was the finding of a significantly greater proportion of children with caries among those who added sugar or any sweetener to bottled milk every day. This can be attributed to the length of time the fermentable contents of the bottle remain in contact with teeth. The use of baby bottles during the night is associated with the reduction in salivary flow and in capacity of salivary neutralization, which would cause prolonged exposure to fermentable carbohydrates due to stagnation in the teeth (Ribeiro).<sup>8</sup>

Also, in the present study, children whose sweet intake in the diet was more than 2–3 times/day had a mean deft score of 5.85 which was significantly more than children with less sweet intake. King<sup>9</sup> studied patterns of sugar consumption in the early first year of life and concluded that 77% of meals and snacks given to babies contained sugar and received sweet items on an average of 4.3 separate occasions. Sugars are not only used as a foodstuff but are also given for other reasons, such as taste, as a pacifier, and means of showing love and affection.<sup>9</sup>

Results revealed children with a greater mean deft score failed to clean the tooth as soon as it erupted in the oral cavity. Ganesh et al. assessed oral hygiene practices in children and found that only 17% cleaned their gum pads of which 10% used a soft cloth / cotton, 6% used fingers and 1% used soft brush and paste.<sup>10</sup> At an early age, dietary and oral hygiene practices are mostly controlled by parents or caregivers and hence it is really important to educate the parents and caregivers about maintaining oral health as soon as the first tooth erupts in the oral cavity.

In the present study, males were affected more than females ( $p = 0.067$ ). A similar trend was reported by Shruitha et al. who conducted a cross-sectional study in Kanpur District, India.<sup>6</sup> This can be attributed to the gender disparity and cultural advantages to boys especially predominant in certain communities. They tend to get larger and on-demand helpings of food. However, studies conducted by O'Sullivan et al.<sup>11</sup> and Hattab et al.<sup>12</sup> reported no sex difference in caries prevalence. The mean deft in these studies was almost equal and statistically insignificant ( $p > 0.05$ ) inferring that difference in sex is not a risk factor.

Different dietary patterns in infants up to first-year are associated with early childhood caries at 3–5 years of age. Considering the above-discussed factors, after complete evaluation of children, the parents and caregivers were educated regarding good oral hygiene practices and the consequences of deleterious feeding and dietary patterns during infancy. Subsequently, the children exhibiting these feeding habits were targeted for future preventive interventions.

### Limitations of the study

The study being cross-sectional in design, the context and temporal effect of identified risk factors may not be clear. As the feeding history was obtained retrospectively, the possibility of recall bias cannot be disregarded and is common in cross-sectional studies. However, this did not influence the results of the study.

### CONCLUSION

The results of this current study showed the following:

- Prolonged and nocturnal breastfeeding, as well as bottle feeding in first year of life, the addition of sugar to milk, sweet intake, and neglected dental care, appear to be the most important etiological factors.
- There were significant differences in the prevalence of ECC between gender with males being affected more than females.
- Intervention during early childhood and educating the mothers and caregivers must be aligned with the complete nutritional needs of the growing child in consideration of their beliefs and values.

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