

Complementary Feeding as a Risk Factor for Early Childhood Caries in 18-48 Month Old Children - A Case Control Study

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Abstract: ***Aim:** The aim of the present study was to evaluate the association between complementary food introduction time and pattern among children suffering from early childhood caries (ECC). **Methodology:** A sample of 394 child-mother pairs were included in this study. 18-48 month old school children were divided into cases and controls based on the presence of ECC. A validated questionnaire was used to find the association between complementary feeding practices and ECC. **Results:** Analysis of data demonstrated that the mean deft score of the cases to be 4±2.9. An association between ECC and complementary food introduction time (P=0.75), complementary feed along with breast feeding (P=0.15), sharing utensils (P=0.68), Frequency of complementary food (P=0.73), type of complementary food (P=0.56) and additional sugar (P=0.32) was found. **Conclusion:** Complementary feeding practices were not found to be a potential risk factor for ECC. However, the importance of the complementary feeding practices and oral health cannot be overlooked.*

Keywords: Early childhood caries, complementary feeding, association

1. Introduction

The American Academy of Paediatric Dentistry (AAPD) defines early childhood caries as the presence of one or more decayed (non-cavitated or cavitated), missing (due to caries) or filled tooth surfaces in any primary tooth in children less than or equal to 71 months of age [1]. Prevalence of ECC ranges from 28% to 82% depending on the population studied. These figures therefore suggest that ECC is a widespread public health concern [2].

Prolonged exposure of teeth to breastfeeding, bottle-feeding and feeding at night has been identified as risk factors of early childhood caries (ECC) [3]. It is a universally known fact that mother's milk is essential for the health as well as nutritional, immunological and psychological growth of the child. But the energy demands of the child are met with mother's milk only till 3 months of age and after that increasing energy demands can only be met with high density complementary food along with breast milk. Various guidelines have been put forth for the time, frequency and type of complementary food. The recent guidelines by American Academy of Pediatrics (AAP, 2013) states that complementary food has to be given by around 4-6 months of age and by WHO guidelines (2013) is after 6 months of exclusive breast feeding [4].

As with the controversy about breast versus bottle feeding and ECC [5], for which the conclusion had been drawn, the association between the optimal age for semisolid food introduction and oral health is a topic not explored sufficiently. There is no clear evidence that infants need

semisolid food before age of four to six months. The most important additional nutrient required at this age particularly for bottle-feeding infants, is iron and the major source of iron is infant cereal. Also, there is no clear evidence whether early introduction of semisolid food is harmful or useful for the oral health.

The efforts to quantify child feeding practices and to gauge the strength of their association with ECC have been hampered by methodological problems. This is because feeding practices encompass interrelated behaviours that must be considered simultaneously. Feeding practices in the first 3 years are also age specific within narrow age ranges, which adds to the complexity of measurement [6].

Hence, the current study was undertaken with an aim to evaluate the complementary food introduction time and pattern among children suffering from early childhood caries (ECC). We hypothesized that complementary food introduction time has negative association with ECC.

2. Materials and Methods

Ethical clearance was obtained from institutional ethical committee before the commencement of the study.

Target population: Play School children aged 18 - 48 months from urban middle and high class sociodemographic groups from North Bangalore were targeted in this study.

Sample size and sampling method: Tanaka *et al* [7] have observed that the proportion of caries among children who

were introduced early complementary food was 19% and who were introduced complementary food 6 months and later were 29%. In the present study expecting similar results and to get a precision of 75% power, 5% of significance and 95% confidence level, the sample size has been determined as 197 subjects in each group.

A one-stage cluster sampling method was used. Private schools of North Bengaluru were listed and randomly selected from a sampling frame of possible schools stratified by socio-demographic status. Study was conducted in the selected schools after permission being granted by the school administration. All children aged 18-48 months who were present on the day of the survey were invited to participate. The process was continued until the desired sample size was obtained.

Recruitment of sample: This survey was conducted in 2014-2015. At schools where permission was granted, a participant information statement written in English was provided to the class teachers prior to the day of the survey. Consent for participation was given by the school principals on behalf of the children and their parents. It was made clear that participation was voluntary.

Children who had ECC i.e., 18-48 month old children with deft score ≥ 1 were included as cases. Children who were free from i.e., 18-48 month old children with deft score 0. Uncooperative children who did not allow oral examination and children with any syndrome conditions or any other systemic diseases were excluded from the study.

Study Phases: The study was carried out in two phases
PHASE I- Structuring and Validation of the instrument i.e., the questionnaire
PHASE II- Oral examination of the children and data collection from the mothers using the validated questionnaire

Phase I- Structuring the questionnaire:

In accordance with the recommendations suggested by WHO, AAP, Infant and Young child Feeding (IYCF) and Ministry of Health and Family Welfare (MOHFW) guidelines a questionnaire was developed on complementary feeding practices. Content validity was done with the subject experts and after obtaining CVR (Content Validity Ratio) modifications were made in the questions with CVR < 0.5 and the final questionnaire was then subjected to face validation for the level of understanding of the study subjects. The face validation results suggested that 71.7% of the subjects agreed that the level of understanding of the questionnaire was appropriate.

Phase II-Dental examination: All children with informed consent were clinically examined for dental caries experience utilizing the WHO recommended deft index (1997). The examination was carried out by a single examiner using mouth mirrors, explorers under natural light/torch as per guidelines of American Dental Association (ADA) for Type 3 examination. A trained assistant recorded the findings on data collection forms.

Data Collection

- The pre-structured, closed ended questionnaire structured and validated was used for data collection. This validated questionnaire was given to the parents to report the feeding habit of the children
- Questions regarding confounding factors like breast feeding, bottle feeding and to oral hygiene were also included in the tool

3. Statistical Analysis

Content validity was assessed by using content validity ratio (developed by Lawshe [8]) as a measure of agreement between experts about questions to be included in the questionnaire to assess the infant feeding practices. Face validity was assessed by using a Likert scale to obtain the understanding of the instrument. Obtained data was entered in Microsoft Excel and analysed using SPSS statistics package software, Version 20.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics of proportion of caries was analysed and presented in terms of percentage. Chi square test was used to find the association between complementary feeding practices and ECC. In all the above tests "p" value less than 0.05 was accepted as indicating statistical

4. Results

Analysis of data demonstrated that the mean deft score of the cases to be 4 ± 2.9 . An association between ECC and complementary food introduction time ($P=0.75$) (**Table 1**), complementary feed along with breast feeding ($P=0.15$) (**Table 2**), sharing utensils ($P=0.68$) (**Table 3**), frequency of complementary food ($P=0.73$) (**Table 4**), type of complementary food ($P=0.56$) (**Table 5&6**), and additional sugar ($P=0.32$) (**Table 7**) was found.

5. Discussion

Early childhood caries is one of the most common dental conditions found in young children and its prevalence appears to be increasing [9]. It is a disease that can never be completely eradicated because of its complex aetiology like interaction of cultural, social, behavioural, nutritional and biological risk factors that are associated with its initiation and progression [10]. There is enough evidence to support the association between feeding practices and ECC [11] such as:-

- 1) Inappropriate use of milk bottle has a central role in the aetiology and severity of ECC.
- 2) Breast feeding provides perfect nutrition for the infant. However, frequent and prolonged contact of tooth enamel with milk has been shown to result in cariogenic conditions.
- 3) Prolonged and nocturnal breast feeding is associated with an increased risk of ECC, especially beyond 12 months of age.
- 4) Fermentable carbohydrates and the duration of exposure of the teeth is a principle factor in the aetiology of the dental caries.
- 5) Non milk extrinsic sugars are widely implicated as the cause of caries while milk sugars are not.

The role of complementary food has remained a controversial topic in children's nutrition. Various global guidelines differ in the time of introduction of complementary feeding. WHO has proposed the guidelines for complementary food introduction by 6 months of age with continued breast feeding till 2 years of age [5], hygienic and proper food handling, to start with small amount of foods and increase the quantity, consistency and frequency of feeding gradually, to feed variety of nutrient rich foods and increase food intake during illness with soft and easily digestible foods. IYCF guidelines by MOHFW [12] are a set of recommendations for appropriate feeding of new-born and young children and that includes the following care practices:

- Initiation of breastfeeding immediately after birth, preferably within one hour.
- Exclusive breastfeeding during the first six months of life (allows infant to receive drops, syrups of vitamins, minerals and medicines)
- Timely introduction of complementary foods (semisolid or soft food) at 6-8 months
- Age appropriate complementary food for children aged 6-23 months, while continuing breastfeeding.
- Children should receive food from 4 or more food groups and should be fed for a minimum number of times
- Active feeding of children during and after illness

AAP Committee on Nutrition [12] states that 'The complementary foods can be introduced between 4 and 6 months of age based on the developmental readiness and nutritional needs of the child'. The AAP recommendation on IFPS II data collection was that solid foods can be introduced no earlier than 4 months of age. Notably, with the 2012 revision of this recommendation by the AAP, the recommended age for introduction of solid foods was increased from 4 to 6 months.

Mothers should adopt appropriate complementary feeding practices in order to provide adequate nutrition to the child to make it healthy and well nourished [14, 15]. Little is known about current patterns of feeding among Indian infants during their first year of life. A community based, cross-sectional study conducted by Parashar et al [14] revealed maximum mothers provided minimal dietary diversity in food and initiated complementary food at 6 months of age. Similar study done by Ashwini S et al [15] revealed that complementary feeds were initiated when the infant was less than 6 months old and the type of food given were inappropriate and the amount and frequency of feeding were inadequate.

Similar results were found in the present study, that correct age of introduction of complementary food was noticed in 21% of controls and 17% of cases (Table 1).

However, the studies regarding the association between ECC and complementary feeding practices were lacking. Early feeding habits help in the normal development of oro-motor skills and function. Hence, inappropriate feeding practices at the early infancy will result in the adverse oral health. Tanaka et al⁷ studied the association between infant feeding practices and the development of ECC and concluded that the introduction of solid foods at six months old or later

were positively associated as a risk of ECC, whereas a study done by Sankeshwari et al [16] on infant feeding practices found no association between ECC and complementary food introduction time. Similarly in the present study, statistically significant association was not established between ECC and complementary feeding practices.

Importance of frequency of complementary food and ECC was found to be that increased frequency of complementary food decreases the ad libitum breast feeding by Singh et al [17] however no significant association was found in the present study (Table 2).

It is a well-established fact that colonization of *S. mutans* occurs early in life. The mothers being the main source of bacterial transmission are not completely established. This maybe because the mothers usually enjoy frequent and intimate contact with their infants for the first 2 years of life, when *S. mutans* is initially getting transferred. A clinical study done by Thakur R et al [18] showed the possible influence of food tasting and sharing of utensils on the initial acquisition of *S. mutans* in the oral cavity of infants. However, the present study found no significant correlation between ECC and utensil sharing (Table 3).

In contrast to mother's milk, infant milk formulas are a complex synthetic combination of nutrients including fermentable carbohydrates of various types such as lactose, sucrose and glucose. Manufacturers of infant formula are constantly refining their products to more closely resemble human milk. Bowen et al, 1997; Erickson et al, 1998 have previously reported milk based formula foods to be cariogenic, but less cariogenic than soy-based and protein hydrolysate formulas. Cariogenic potential of infant and natural food was researched by Bhat S and Madan [19] and concluded that commercial formula feeds are found to be more cariogenic than the home made complementary foods supported on the basis of the fact that homemade food has higher fibre content and less of carbohydrate in comparison to commercial food. Similarly, cariogenicity of the commercial infant formulas studied by Bowen et al [20] showed that 5% sucrose is highly cariogenic. Although some infant formulae are less cariogenic than sucrose they have some cariogenic potential. Contrary to this, no significant association was found between commercial complementary food and ECC (Table 5&6).

It is well-established by Stephan, Bowen et al [21] that after the intake of fermentable sugars, the pH in plaque falls rapidly, from around neutrality to pH 5.0 or below. In addition, De Stoppelaar et al., Dennis et al., Staat et al., gave that frequent carbohydrate consumption increases the proportions of mutans streptococci and lactobacilli, with a concomitant decrease in levels of *S. sanguinis* and other oral streptococci²¹. However, in the present study no association was found between additional sugar to complementary food and ECC (Table 7).

The statistical conclusions of the present study should be viewed with caution that there is no significant association with ECC and it was a case control study, where recall bias can be expected and Individual's practical difficulty in

understanding and answering the questionnaire should also be considered.

6. Conclusion

The following conclusions were drawn from the present study:

- A difference in practice of introduction of complementary food was noticed between cases and controls. However, statistically significant association was not found. Similarly, no association was found between the practice of introduction of complementary food along with or without breastfeeding.
- No significant association was found between the ECC and type of complementary food introduced and also added sugars to complementary food.

What this paper adds?

The present study highlights the appropriate guidelines complementary feeding practices, the importance of which should be in par with the mother's feeding for the child's overall and oral well being

Pediatric Significance of the Paper:

- The transition of exclusive mother's milk to semisolid energy dense diet around 6 months of age is very important for the child growth and development and also for normal development of their oro-motor skills
- The appropriate complementary feeding should be practiced by the mother's for the better oral health of the children

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Table 1: Table presenting time of introduction of complementary food and its association with ECC

	Age of introduction of complementary food					Total	χ^2 Value	'p' value
		2-3 months	3-6 months	6-12 months	After 1 year			
Control	N	3	42	137	18	200	1.069	0.785
	%	1.5	21	68.5	9	100		
Case	N	3	34	145	18	200		
	%	1.5	17	72.5	9	100		

Table 7: Table presenting added sugar to the complementary food and association with ECC

	Added sugar or any sweetening agents to complementary Food					Total	χ^2 Value	'p' value
		Yes	No	Sometimes	Always			
Control	N	50	106	43	1	200	3.487	0.322
	%	25	53	21.5	0.5	100		
Case	N	43	104	48	5	200		
	%	21.5	52	24	2.5	100		

Table 2: Table showing introduction of complementary food along with breast feeding

	Complementary feed along with breast feeding				Total	χ^2 Value	'p' value
		Yes	No	Uncertain			
Control	N	167	27	6	200	3.792	0.150
	%	83.5	13.5	3.0	100		
Case	N	174	25	1	200		
	%	87	12.5	0.5	100		

Table 3: Table presenting sharing of utensils and association with ECC

	Sharing of utensils			Total	χ^2 Value	'p' value	
		Yes	No				Sometimes
Control	N	33	140	27	200	0.745	0.689
	%	16.5	70	13.5	100		
Case	N	38	132	30	200		
	%	19	66	15	100		

Table 4: Table displaying frequency of complementary food given when the child was 6months old and its association with ECC

	Frequency of complementary Food given					Total	χ^2 Value	'p' value
		Once in a day	2 times in a day	3 times in a day	More than 3 times in a day			
Control	N	54	95	44	6	199	1.258	0.739
	%	27.1	47.7	22.1	3	100		
Case	N	46	103	43	8	200		
	%	23	51.5	21.5	4	100		

Table 5: Table presenting type of complementary food given and association with ECC

	Type of complementary food			Total	χ^2 Value	'p' value	
		Commercial Food	Home Made				Not known
Control	N	41	155	4	200	1.128	0.569
	%	20.5	77.5	2	100		
Case	N	47	151	2	200		
	%	23.5	75.5	1	100		

Table 6: Table displaying type of commercial complementary food given and association with ECC

	Type of commercial food given		Total	χ^2 Value	'p' value	
		Ready to feed				Mixed before feeding
Control	N	6	35	41	0.065	0.799
	%	14.6	85.4	100		
Case	N	6	41	47		
	%	12.8	87.2	100		

Author Profile



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