Exploring the Multitude of Risk Factors Associated with Early Childhood Caries

Abstract
Context: Despite efforts in restorative therapy, children who experience Early Childhood Caries (ECC) continue to be at a higher risk for new lesions in both the primary and the permanent dentition. Early interventions which disrupt the pathology of caries need identification of all the causative or risk factors. Aims and Objectives: This study dealt with the prevalence and associated risk factors of ECC among preschool children aged 3 to 5 years in Bengaluru city. Materials and Methods: Information regarding risk factors was obtained through a structured questionnaire among a random sample of 1152 children. Clinical examination was performed by a trained dental professional using the modified WHO oral health survey format. Statistical Analysis: Chi-square, one-way ANOVA, correlation, multiple linear regression analysis. Results: The prevalence of ECC among preschool children was 24.39% (P < 0.05), whereas the mean deft was 5.80 ± 8.90. The prevalence of ECC among males and females was 24.92% and 23.81%, respectively. 4.27% of children with ECC showed a history of prolonged breastfeeding beyond 2.5 years (P < 0.05). 50.18% of children had a history of using medications during bedtime/night. History of low birth weight was reported among 23.84% of ECC children. Only 13.52% of mothers claimed of getting a prenatal oral health care/counseling (P < 0.05). Conclusion: The prevalence of ECC was seen in almost a quarter of the population with a high deft. A significant relation was associated only with the feeding duration and lack of prenatal oral health counseling provided to parents.

Keywords: Dietary practices, Early Childhood Caries, pediatric medications, prevalence

Introduction
Caries in infants and young children has been described as “Les dents noire de tout-petits” which means “black teeth of the very young.”[1,2] Despite efforts in restorative therapy, children who experience Early Childhood Caries (ECC) continue to be at a higher risk for new lesions in both the primary and the permanent dentition.[3] Hence, this study was undertaken to determine the prevalence of ECC and to investigate associated risk factors in 3–5-year-old children attending preschools; highlighting the fact that such information may provide a valuable base to setup the effective preventive program in future.

Materials and Methods
The present cross-sectional study involved 1152 preschool children selected using the multiphase sampling method. The sample size, i.e., 1152 was calculated with a confidence level of 95% and a confidence interval of 5 with a relative precision of 10% and anticipated ECC population proportion of 25%.

The preschool children considered in the study were aged 3-5 year old attending preschools maintained by private and government sectors in Bengaluru city. Children with systemic diseases, chronic use of medications, and with any type of enamel hypoplasia were excluded from the study.

This study was approved by the Institutional Ethical Committee. The procedures, possible discomforts, and risks were fully explained to the children and their parents/primary caregivers, and informed consent was obtained before the investigation. Mothers/primary caregivers of the subjects were invited to enter the program voluntarily.

A structured questionnaire was adopted and modified from the WHO II International Collaborative Study of Oral Caries (ECC) continue to be at a higher risk for new lesions in both the primary and the permanent dentition. Early interventions which disrupt the pathology of caries need identification of all the causative or risk factors. 

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Health System (12) for mothers/primary caregivers. The questionnaire comprised the information regarding demographic and socioeconomic status, feeding behaviors, dietary habits, and oral hygiene practices of children and mothers/primary caregivers. Four well-trained dental assistants conducted the interview of the mothers/primary caregivers who were uneducated/illiterate.

The clinical examination survey was exclusively visual and was carried out with the help of the WHO criteria, Community Periodontal Index (CPI) probe and mouth mirror under natural light by well-trained dental professional in the school premises. The data on dental caries in these children were collected with special attention to the presence of noncavitated or cavitated decayed tooth surfaces. The initial carious lesions were included in the deft value. The teeth were considered decayed “d” with any evidence of white spot lesions or cavitations, including filled teeth with recurrent caries. The “e” component included extracted teeth and decayed teeth indicated for extraction due to caries; and “f” component included restored teeth without caries. No missing incisor was recorded as extracted to reduce the error due to early physiological exfoliation. Caries prevalence was defined when the child presented at least one decayed, extracted, or filled tooth.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS Version 10.5, IBM Corp, NY). The data were analyzed by Chi-square, one-way ANOVA, Student’s t-test, correlation, and multiple linear regression analysis. The results were averaged (mean ± standard deviation) for continuous data and number and percentage for dichotomous data. Statistical significance was set at P < 0.05.

Results

The study ascertained the prevalence of ECC among preschool children aged 3–5 years in Bengaluru and measured the involvement of various risk factors through a structured questionnaire.

Prevalence of Early Childhood Caries in each age group followed by deft in each age group

The prevalence of ECC by different age groups, i.e., 3, 4, and 5 years was 20.15, 28.11%, and 27.52%, respectively, with a significant statistical value [Table 1 and Figure 1] but with no gender predilection. The mean deft of children with ECC was 5.80 ± 8.90. The deft was even calculated for individual age groups, i.e., 3-, 4-, 5-year-old which were found out to be 5.38 ± 4.24, 6.88 ± 14.25, and 5.09 ± 3.57, respectively; the highest mean deft seen for the 4-year-old and the lowest for the 5-year-old [Table 2 and Figure 2].

Risk factors associated with Early Childhood Caries

General factors

Low birth weight

A history of low birth weight was reported among 23.84% of children with ECC (P = 0.5740).

Parental knowledge, attitude, and practice toward dental health

47.33% of parents revealed that they took their child to a dentist only if a problem with their child’s tooth arose (P = 0.2220).

Parent’s education

In the present study, mother’s education status revealed a value of significance (P = 0.0361, P < 0.05) unlike father’s education [Table 3].

Feeding behavior

Feeding habits

49.46% children with ECC were exclusively breast-fed and 2.84% were exclusively bottle-fed. The feeding duration was studied, and a statistically significant value was observed. 4.27% of children with ECC were breast-fed beyond

Table 1: Prevalence of Early Childhood Caries by age groups

| Age (years) | ECC | Percentage | Non-ECC | Percentage | Total | Percentage |
|-------------|-----|------------|---------|------------|-------|------------|
| 3           | 104 | 20.15      | 412     | 79.84      | 516   | 44.79      |
| 4           | 95  | 28.11      | 243     | 71.89      | 338   | 29.34      |
| 5           | 82  | 27.52      | 216     | 72.48      | 298   | 25.87      |
| Total       | 281 | 24.39*     | 871     | 75.61      | 1152  | 100.00     |

*P<0.05. ECC=Early Childhood Caries
2.5 years ($P = 0.0005, P < 0.05$) [Table 3]. 67.26% of parents reported of adding extra sugar to the milk ($P = 0.4770$).

### Snacking behavior

24.91% reported of frequent snacking between meals. The highest number of children preferred fresh fruits (50.18%), followed by cookies (47.33%), and the least preferred was dry cereals (14.95%) [Figure 3]. The most frequently consumed drink/beverage was water, followed by milk (61.21%). Fruit drink with sugar was consumed by 29.54%, and the least consumed was fruit drink without sugar, i.e., 3.2% [Figure 4].

### Pediatric medication

50.18% of children had a history of using medications during bedtime/night ($P = 0.3820$), and only 23.13% of them reported of brushing/rinsing the teeth after using it ($P = 0.7060$).

### Horizontal transmission of bacteria

44.84% of parents reported of kissing their children on the lips ($P = 0.8690$), and 72.25% tasted/shared food using the same utensils ($P = 0.7640$). 2.5% of children with ECC even shared their toothbrush ($P = 0.3400$).

### Preventive measures - oral hygiene and fluoride use

82.2% brushed only once a day, and 17.78% brushed twice daily or more ($P = 0.6510$). 43.42% of children reported using fluoridated toothpaste ($P = 0.5380$), and only 11.03% of them used other fluoridated products such as mouth rinse, tablets, or drops ($P = 0.8020$).

### Prenatal oral health counseling

Only 13.52% of mothers claimed of getting a prenatal oral health care/counseling ($P = 0.0030, P < 0.05$).

### Discussion

Greater recognition is now being placed on exploring ways to effectively promote oral health. Preventive interventions

![Figure 2: Bar diagram showing comparison of age groups with mean deft by one-way ANOVA test](image2)

![Figure 3: Pie chart showing preference of foods which children snacked between meals](image3)

![Figure 4: Pie chart showing preference of drinks/beverages which children usually consumed with a snack or between meals](image4)
as with modern treatments are being developed based on current scientific knowledge and understanding.\textsuperscript{[10]} Developing countries, however, are yet to tread this path. Thus, the present study attempted to analyze the changing trends in prevalence and factors causing caries among children, providing new insights to reduce the oral health inequalities across the child population.

The prevalence of ECC in the present study was found to be 24.39%, similar to that reported previously in Bengaluru,\textsuperscript{[5]} but higher as compared to other regions in the vicinity,\textsuperscript{[6, 7]} which might be attributed to the heterogeneous population of different locations. The prevalence of ECC also varied according to the age group examined; highest prevalence seen among 4-year-old children. This might be because of exclusion of toddlers or the day care children where the prevalence of caries is concentrated.\textsuperscript{[9]}

Caries prevalence expressed through the deft index was high, with a mean of 5.80 ± 8.9, in contrast to studies which reported 0.854\textsuperscript{[5]} and 2.9.\textsuperscript{[10]} The high deft clearly reflects the ignorant attitude of masses toward dental health.\textsuperscript{[10]} However, there was no significant difference in between the two genders in the present study, similar to Jose and King\textsuperscript{[11]} and Tyagi.\textsuperscript{[7]}

57.65% children with ECC had a history of bottle-feeding and 33.45% with a night feeding habit, similar to other studies.\textsuperscript{[7, 12]} Results showed that 49.46% children were exclusively breast-fed, 2.84% exclusively bottle-fed, and 47.68% were both breast-fed and bottle-fed; in contrast to a study where it was observed to be 30%, 12.7%, and 57.2%, respectively.\textsuperscript{[5]} The caries prevalence was marginally higher in exclusively breast-fed children similar to Dini et al.\textsuperscript{[13]} and Prakash et al.\textsuperscript{[5]} Striking statistical significance was noted in relation to duration of feeding in our study. However, the available evidence does not support a consistent and strong association between breastfeeding and development of ECC.\textsuperscript{[14, 17]} However, data from these studies cannot be extrapolated to make statements regarding effects of on-demand and at night breastfeeding, and there is still a lack of robust meta-analytical review yet.

24.91% children with ECC reported a high frequency snacking behavior. The results of our study showed that the children with ECC preferred fresh fruits (50.18%), cookies (47.33%), dry fruits (36.65%), candies (34.88%), and chips (33.8). In contrast, a previous study\textsuperscript{[18]} reported of only 16.6% candy usage. The preferences thus point out that the foods that are more retentive might be the cause, apart from being rich in carbohydrates.\textsuperscript{[19, 20]} Fresh fruit juice (31.67%), fruit drink with added sugar (29.54%), and fruit juice without extra added sugar (3.20%) were consumed. This was in contrast to a study\textsuperscript{[14]} that reported consumption of fresh fruit juice by 38.6% and soft drinks by 14.4%.

50.18% of children with ECC had a history of nighttime medication usage which was in accordance to a study that reported 41%.\textsuperscript{[11]} and in contrast to a study, which showed 15.36%.\textsuperscript{[12]} This may be attributed to sugar present in the medicine to make them more palatable to young mouths.\textsuperscript{[21]} Prescribing sugar-free medicines or advising children on rinsing after medication would help in averting the problem.\textsuperscript{[22]}

Sharing utensils while feeding (72.25%), sharing toothbrushes (2.5%), and kissing the child on the lips (44.84%) were reported more in the mother-child pair with caries. Similar results have been observed in other studied interventions\textsuperscript{[22, 23]} highlighting the importance of horizontal transmission of bacteria being a possible causative factor as depicted in the present study.

Observations of the present study revealed that 23.84% among ECC-affected children had a history of low birth weight (weight at birth of <2.5 kg/5.5 lb), which was in accordance to a previous study done in Bengaluru (27%) in 2012.\textsuperscript{[5]} There is also considerable presumptive evidence that malnutrition/under-nutrition during the prenatal and perinatal periods causes hypoplasia.\textsuperscript{[24]} The time span between Mutans Streptococci (MS) colonization and caries lesion development is approximately 13–16 months. In more high-risk children (preterm and/or low-birth-weight infants, with hypomineralized teeth), this duration is likely to be much shorter.\textsuperscript{[25]}

About 86.48% gave a negative history of prenatal oral health care/counseling. However, in one of the studies, the authors opined that it may be due to the fact that, mothers who had dental problems had more chances of visiting a dental clinic than those who did not.\textsuperscript{[13]} A promising approach toward primary prevention of ECC is the development of strategies that target the infectious component of this disease, such as preventing or delaying primary acquisition of MS at an early age by suppressing maternal reservoirs of the organism. Hence, even infant oral health care is said to ideally begin with prenatal oral health counseling for parents\textsuperscript{[26]}, and dental management of the mother can delay infant inoculation.\textsuperscript{[27]}

In most of the cases, a child’s first visit happens only when a problem arises, such as acute pain and never as a preventive measure. The first dental examination is now recommended between 6 months and 1 year of age,\textsuperscript{[28]} but this is often unrealistic, especially among the poor and underinsured.

ECC in particular is more common in children from low socioeconomic groups with lower levels of maternal education.\textsuperscript{[22]} The lower level of dental caries and lower mean deft scores have also been associated with higher levels of education either of both parents or of the mother or father alone.\textsuperscript{[22, 29]} The studies have revealed importance of both parents’ shared roles in maintaining children’s oral health in today’s society.\textsuperscript{[30]} A previous study\textsuperscript{[25]} showed that 38% children whose mothers had no
schooling were affected with caries. This was statistically significant when compared to those children whose mothers had received higher education. In contrast, Schroth et al.[30] reported a lack of association between ECC and educational level of mother. Surprisingly, the parents with the higher educational level had children with lowest incidence of caries lesions (30% of fathers and 23% of mothers had high school education) as observed by Jose and King.[11]

Although various risk factors could be outlined in the study, we may have to scrutinize the clinical scenario to effectively determine the preventive interventions that might provide maximum benefit to the individual child patient. An emphasis on the comparison of some similar research studies in future might help us in understanding more about the changing trends and their underlying changing causes.

**Conclusion**

The prevalence of ECC was similar to other recent studies but with a high deft. High prevalence was seen in the younger age groups. No statistical difference among the genders was noted. When the various risk factors were independently analyzed, the feeding duration span and mother’s education gained significance. Frequent snacking between meals, especially retentive foods were found to be the culprit. Lack of motivation among parents rather than lack of awareness regarding oral health was a concern. Prenatal counseling was found to be an important factor. Low birth weight history was reported in almost a quarter of the ECC children emphasizing further research.

High prevalence of ECC in certain groups shows that information and knowledge do not always translate into appropriate parenting practices. More prevalence studies need to be carried out among diverse populations of the preschool age groups, including the daycare children as the actual association between feeding/nursing habits and eruption pattern of teeth with severity of ECC can be adequately addressed to.

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**Conflicts of interest**

There are no conflicts of interest.

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