



Early Childhood Caries Lesions in Preschool Children in Kerala, India

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Abstract

Purpose: No data are available on possible risk indicators or the prevalence of caries lesions for preschool children under 4 years of age in Kerala, southern India. Therefore, the aims of this study were: (1) to gather data on caries lesion frequency and distribution; (2) to determine any possible associations with feeding habits and oral health care practices.

Methods: A sample of 530 children, aged from 8 to 48 months (mean=2.5±0.96 years), who attended 13 day care centers were clinically examined for caries lesions using a disposable mouth mirror, tongue spatula, and a torch light. There were 513 dentate children. The caregiver of each child then completed, by interview, a structured questionnaire.

Results: Among the group of 252 girls and 278 boys, the dmft was 1.84±2.87 with 56% of the children being caries-lesion free. Fifty-nine (12%) were considered to have early childhood caries (ECC), based on the criteria that smooth surface caries lesions on all 4 maxillary incisor teeth indicated severe ECC. Breast-feeding was practiced by 99% of the mothers, and 5% did so exclusively. Generally, breast-feeding was on demand. Statistically significant correlations were found between caries lesions and the child's dental condition, as perceived by the mother or caregiver ($P<.0001$), the dental status of the caregiver ($P=.0417$), consumption of snacks ($P=.0177$), giving of sweets as a reward ($P<.0001$), cleaning of the child's mouth ($P<.0001$), oral hygiene status of the child ($P<.0001$) and low socioeconomic status, as measured by income ($P<.0001$).

Conclusion: From the results of this study of preschool children in Kerala, the groups at high risk from dental caries lesions are: (1) those with poor oral hygiene status; (2) those who consume snacks and are given sweets as rewards; (3) those belonging to a lower socioeconomic class. (*Pediatr Dent.* 2003;25:594-600)

KEYWORDS: EARLY CHILDHOOD CARIES, KERALA, INDIA

Received July 9, 2002 Revision Accepted June 23, 2003

Early childhood caries (ECC) is a serious sociobehavioral and dental problem that afflicts infants and toddlers.^{1,2} The first sign of dental caries lesions in infants who develop ECC is the appearance of white demineralization areas in the cervical regions of the maxillary anterior teeth. This serves to indicate high caries lesion activity in children.³ The appearance of a single caries lesion on any tooth surface in an infant or toddler must be considered a serious health problem. It has been stated that ECC can be defined as the occurrence of any sign of dental caries lesions on any tooth surface during the first 3 years of life.⁴ When a 3-year-old child has a decayed, missing, or filled score of 4 or more, the condition is considered

to be severe early childhood caries (S-ECC).⁵ ECC has a complex etiology, and there are still several unexplained interactions among factors such as infection with *mutans streptococci* (MS), the educational status of mothers, dental knowledge, stress, self-esteem, social status, family structure, and the use of baby bottles or nursing on demand.⁶

The prevalence of caries lesions is a multifactorial disease. These factors include susceptible tooth and host, fermentable carbohydrates in the diet, cariogenic microorganisms, and time.⁷ Children with caries lesions in the primary dentition have a greater chance of developing caries lesions in the permanent dentition than children who are caries lesion-free in the primary dentition.⁸ Initial primary incisor caries

lesions before 4 years of age is a risk factor for future dental caries lesions.⁹ Therefore, caries lesion preventive initiatives can be planned and implemented for preschool children who are identified as being at risk.

India, with a population that exceeded 1 billion in 2001, is the second most populous nation in the world. Eighty percent of the population lives in rural areas. The oral health care system consists of medical research institutes with departments of dentistry, more than 120 dental schools spread throughout its 27 states, medical colleges with departments of dentistry in cities and district headquarters, and private dental clinics. The majority of dental care is provided in the latter.

Kerala is a southwestern state with an area of 39,000 km² and a population of 31 million. The state has universal primary education, near total literacy, high life expectancy, low birth rates, and low infant mortality rates comparable to developed countries.¹⁰ Preschool children attend both government-sponsored and private day care centers. The drinking water, which is not fluoridated, is supplied through a public water supply. The other main sources for drinking water are from wells.

Currently, no data are available on the caries lesion prevalence or possible etiological factors for preschool children in Kerala, southwestern India.

Therefore, an investigation to gather information on the caries lesion prevalence and any possible associations with feeding habits and oral care practices was undertaken.

Methods

The study had the approval of the District Medical Officer. The sample consisted of children attending both government-sponsored and private day care centers who were below the age of 48 months. Thirteen day care centers were stratified and randomly selected by an administrative assistant for inclusion in the sample. The caregivers of the children attending these centers were informed of the nature of the investigation through pamphlets and notices. Informed consent was obtained prior to enrolment in the study. An interview with the caregiver was conducted by a trained nurse using a structured questionnaire, which included questions about the infant's dietary, feeding, and oral hygiene habits along with the oral health knowledge and attitudes of the caregiver. The interview was followed by an oral examination by a sole examiner using a disposable mirror, wooden tongue spatula, and a torch light. Ninety-seven percent of the caregivers who were approached to participate in the study actually participated. Radiographs were not taken due to practical reasons. The modified WHO criteria¹¹ for caries lesions were used to diagnose caries lesions. No attempt was made to use a dental probe to confirm cavitation of the lesions due to the young age of the children.

Intraexaminer calibration was carried out using Cohen's kappa coefficients¹² by the administrative assistant, randomly selecting 10% of the sample for re-examination.

Statistical analysis

GraphPad InStat version 3.00 for Windows 95 (GraphPad software, San Diego, Calif; www.graphpad.com) was used for the statistical analysis. Tests of the association between caries lesion status and single variables were carried out using a chi-square test and Fisher exact test, with the probability level of 0.05 set to be highly statistically significant. A two-sided *P* value was calculated for each statistical test along with the relative risk and 95% confidence interval using the approximation of Katz.

Table 1. Caries Lesion Status of 513 Dentate Children Who Had a Snacking Habit*

Caries status	Snacking habit	
	Snacks	No snacks
	N (%)	N (%)
Caries	197 (38)	28 (5)
Caries-free	229 (45)	59 (12)

*Statistically significant association between having caries lesions and the consumption of snacks; *P* = .0177.

Table 2. Caries Lesion Status of 513 Dentate Children Who Received Sweets as a Reward*

Caries status	Consumption of sweets	
	Sweets	No sweets
	N (%)	N (%)
Caries lesions	214 (42)	11 (2)
Caries-free	216 (42)	72 (14)

*Statistically significant association between having caries lesions and the giving of sweets as a reward; *P* < .0001.

Results

Determination of the intraexaminer variability was done by randomly selecting 10% of the sample (children) for re-examination, and Cohen's kappa value for intraexaminer variability was 0.96.

Caries lesion prevalence

In the sample of 278 boys and 252 girls whose ages ranged from 8 to 48 months (mean age = 2.5 ± 0.96 years), the caries lesion prevalence was 44%. The caries lesion group included 125 boys and 100 girls. There was no statistically significant difference in the caries lesion prevalence between boys and girls (*P* = .3147). Maxillary central incisors were the teeth most often affected by caries lesions. Of the 932 teeth with caries lesions, only 4 had been restored. The earliest caries lesion experience in the sample was for an 11-month-old child. Fifty-nine of the infants were considered to have S-ECC, based on the criteria that all 4 maxillary incisor teeth exhibited caries lesions. Even though ECC is defined as the occurrence of any sign of dental caries lesions on any tooth surface during the first 3 years of life, different studies have cited different definitions for ECC, and this makes comparisons difficult between studies.

Table 3. Caries Lesion Status of 298 Children Who Had a Tooth-brushing Habit*

Caries status	Tooth-brushing	
	Aided tooth-brushing	Unaided tooth-brushing
	N (%)	N (%)
Caries lesions	115 (39)	55 (18)
Caries-free	67 (23)	61 (20)

*Statistically significant association between caries lesions and the tooth-brushing of the child; $P=0.0084$.

Table 5. Caries Lesion Status and Toothpaste Usage of 117 Children Who Brush Their Own Teeth*

Caries status	Toothpaste usage	
	Toothpaste	No toothpaste
	N (%)	N (%)
Caries lesions	23 (20)	29 (25)
Caries-free	49 (42)	16 (13)

*Statistically significant association between caries lesions and the toothpaste use by the child who brushed his/her own teeth; $P=0.0010$.

Feeding habits

In the sample of 530 children, 99% were breast-fed, and 55% of the children were breast-fed up to 2 years of age. On-demand breast-feeding had been practiced by 99% of the children and was still being practiced by 33% of them.

Formula milk was consumed by 20% of the children in addition to breast milk. Traditional preparations along with breast milk were given to 74% of the children. Only 5% of the children were exclusively breast-fed.

A nursing bottle was used by only 21% of the infants, and sugar was regularly added to the feeding bottle for 75% of these children. Bedtime use of a baby feeding bottle occurred for 40% of the bottle-fed children. The bedtime bottle was taken away after the child fell asleep in 53% of the cases. The mean age of weaning for the children who had been weaned was 9 ± 5 months.

Consumption of snacks

Snacks were consumed by 83% of the dentate children (Table 1). Sweets were given as rewards to 84% of the children (Table 2). Statistically significant positive correlations were found between caries lesions and consumption of snacks ($P=0.0177$), and the giving of sweets as a reward ($P<0.0001$). Nonnutritive digit sucking habits were prevalent in 8% of the children, and over one third (37%) of these children still continued the habit.

Oral hygiene and oral hygiene habits

The caregivers cleaned the mouths of 90% of the children. However, only 6 reported that they started cleaning the

Table 4. Caries Lesion Status and the Use of Toothpaste by 298 Children Who Brushed Their Teeth Out of a Group of 513 Dentate Children*

Caries status	Toothpaste usage	
	Toothpaste used	No toothpaste used
	N (%)	N (%)
Caries lesions	52 (17)	118 (40)
Caries lesion-free	65 (22)	63 (21)

*Statistically significant association between caries lesions and the use of toothpaste; $P=0.0005$.

child's mouth soon after birth. A statistically significant association was found between cleaning of the child's mouth by the caregiver and caries lesions in the child ($P<0.0001$).

A total of 298 of the 513 dentate children had a tooth-brushing habit; of the 298, 61% had an adult brush their teeth (Table 3). Toothpaste was used by 39% of the children who brushed their teeth (Table 4). A statistically significant association was found between caries lesions and the use of toothpaste ($P=0.0005$). Toothpaste usage by the 117 children who brushed by themselves was 62%, of which 32% had caries lesions (Table 5). A statistically significant association was found between caries lesions and the toothpaste use by the child who brushed his/her own teeth ($P=0.0010$).

Plaque accumulation was seen in 328 of the 513 children, 52% of whom had caries lesions. A statistically significant association was found between caries lesions and plaque accumulation ($P<0.0001$).

Socioeconomic, education status of the parents, and health status of the children

All of the children were born and raised in Kerala. Basically, the parents with the higher educational level had children with the lowest incidence of caries lesions. Only 11 out of 31 children whose fathers had tertiary education had caries lesions, compared to 161 out of 374 fathers who had a high school education (Table 6). Similarly, of the 56 children whose mothers had a tertiary education, 21 had caries lesions, compared to 125 children with caries lesions out of the 285 children with mothers possessing a high school education (Table 7). The higher the income of the parents, the lower the incidence of caries lesions experienced by the child. Of the 34 children with parents having the highest incomes in the sample, only 7 had caries lesions, compared to 57 children with caries lesions out of 121 who were of lower income status. In this study, a statistically significant correlation ($P<0.0001$) was found between caries lesions and low socioeconomic status as measured by income.

The caregivers reported that 139 of the children had been sick for more than 2 weeks at least once during infancy and that 43% of these children had experienced dental caries lesions. Moreover, 126 of the caregivers reported that the child

Table 6. Caries Lesion Status of 530 Children According to the Educational Status of Their Fathers

Education status of the Father	Caries lesions (N ₁ =225)	Caries-free (N ₂ =305)
	N (%)	N (%)
No schooling	2 (1)	0 (0)
Primary school	37 (7)	42 (7)
High school	161 (30)	213 (40)
Pre-degree	14 (3)	30 (5)
Degree	9 (2)	16 (3)
Postgraduate	2 (1)	4 (1)

Table 7. Caries Lesion Status of 530 Children According to the Educational Status of Their Mothers

Education status of the Mother	Caries lesions (N ₁ =225)	Caries-free (N ₂ =305)
	N (%)	N (%)
No schooling	2 (1)	0 (0)
Primary school	28 (5)	35 (7)
High school	125 (23)	160 (30)
Pre-degree	49 (9)	75 (14)
Degree	18 (3)	31 (6)
Postgraduate	3 (1)	4 (1)

Table 8. Caries Lesion Experience of Children Who Had a Caregiver with an Above-average Dental Condition in the Group of 530 children*

Caries status	Dental condition	
	Above average	Below average
	N (%)	N (%)
Caries lesions	86 (16)	139 (26)
Caries-free	144 (27)	161 (31)

*Statistically significant association between the dental status of the caregiver and the caries lesion experience of the child; $P=.0417$.

had taken longterm medication for more than 2 weeks during infancy and that 41% of these children had caries lesions.

Oral health knowledge and attitudes of the caregivers

The majority of the caregivers (79%) knew about the causes of dental caries lesions and 85% of them knew ways to prevent caries lesions. However, 59% were not sure whether primary teeth needed to be restored. There was no necessity for a dental checkup for children before the age of 1 year according to 19% of the caregivers, and 76% indicated that they would visit the dentist only if a dental problem arose.

The child's dental and oral condition was reported as good by 53% of the 530 caregivers. However, 21% of the children in this group had caries lesions. An above-average dental condition was reported for 43% of the caregivers, and there was a statistically significant association ($P=.0417$) between the dental status of the caregiver and the caries lesion experience of the child (Table 8). More than 90% of the caregivers reported that they were not provided with any antenatal and/or postnatal oral health-related messages. The caregivers that had never visited a dentist before amounted to 47%, while 50% reported that they had visited a dentist for some type or form of treatment.

Discussion

The day care centers used in this study were stratified randomly and selected by a nondental administrator to enhance the representivity of the sample. The advantage of involv-

ing health care workers closely linked to the district medical offices was that it ensured extensive propaganda regarding the investigation through pamphlets and notices. This, in turn, resulted in a high level of participation in the study. The caregivers' compliance was 97%. Since there were no invasive procedures involved in the investigation, this raised the level of compliance of the caregivers.

All strata of the society attended the selected day care centers; however, the sample for this investigation was slightly biased towards the middle-class families. Children from middle-class families comprised 58% of the sample, compared to 19% from the higher-income group. There was a caries lesion experience of 44% of the 513 dentate children and a mean dmft of 1.84. Socioeconomic status measured by income has been shown, at least in Hong Kong children, to be inversely related to dmft scores.¹³ Of the 34 Keralite children with parents in the highest income bracket in the sample, 7 had caries lesions; compared to 57 out of 121 children with caries lesions that had the lowest income status. Thus, the findings of this study confirm those of Chan¹³.

The education level of parents has been reported to be inversely related to the dmft score of their children.¹² In this study, the parents with the higher educational level had children with the lowest dmft scores; for example, only 11 out of 31 children whose fathers had received a tertiary education had caries lesions, compared to 161 out of 374 children whose fathers who had only attained a high school education.

As caries lesions were diagnosed entirely on a visual examination, this certainly resulted in an underscoring of the actual caries lesion status; hence, the true caries lesion prevalence could have been slightly higher than reported in this study. This highlights the need for care to be practiced when comparing data from different studies. While epidemiological evidence indicates that noncavitated caries lesions are more prevalent than cavitations during the first 18 months of life,¹⁴ it should be remembered that the clearer the diagnostic criteria, the higher the level of reproducibility and reliability that can be achieved. This is important when dealing with young children so as to ensure their compliance with

the examination and not to adversely affect their cooperation and behavior in the dental environment in the future.

The acquisition of MS in young children most likely takes place during a "window of infectivity" from 19 to 31 months of age.¹⁴ A recent study by Wan et al,¹⁶ indicates that MS may be found in the mouth as early as 6 months of age and prior to tooth eruption. Since caries lesion risk increases with the earlier acquisition of MS, this finding may be a significant factor with regard to the etiology of ECC. In this study, the earliest caries lesion experience was seen on the primary maxillary incisors in an 11-month-old child, which confirms the finding by Douglass et al, that maxillary anterior caries lesions can develop as early as 10 to 12 months of age.² Thus, it is apparent that, given the ideal predisposing conditions, caries lesions can be initiated within a relatively short period of time after tooth eruption and can rapidly progress to cavitation. The latter characteristic was also found by researchers¹⁷ who reported that incipient caries lesions could progress to cavitation within 6 to 12 months. This rapid rate of progression is consistent with the evidence from an *in vitro* study, which suggested that dental caries lesions could progress from enamel to dentin in 3.4 weeks.¹⁸

Even though the state of Kerala has a place of pride in India due to its achieving near total literacy, the importance of infant oral health has been overlooked. The importance of educating caregivers to perceive the consequences of ECC is evident from various studies that have shown that individuals with a better understanding of the etiology of dental caries lesions will make a more concerted effort to prevent dental caries lesions. Therefore, educating the child caregivers in Kerala on the preventive aspects of dental caries lesions must be stressed.

In this study, it was found that a high level of breast-feeding is practiced in Kerala, and yet the caries lesion level is high. This could be due to the addition of sugar in local snack food preparations and the increasing frequency of snacking. Furthermore, this may have been a factor that has affected data from other studies where breast-feeding was high; in other words, this may serve as a warning to communities that the good practice of breast-feeding may be counteracted by adverse factors that are not reported by caregivers, and these factors may be cultural or social in nature. These findings support the notion that further investigations are required to:

1. determine the prevalence of ECC in exclusively breast-fed children;
2. clarify whether or not other practices, such as eating snacks could contribute to caries lesions in breast-fed children.¹⁹

Fluoride is one of the most effective methods of caries lesion prevention available for ECC.²⁰ The public water supplies are not fluoridated in Kerala. The major source of fluoride for children in this study was toothpaste. However, only 117 out of 298 children with a tooth-brushing habit used toothpaste; consequently, this may be one of the

reasons for the high prevalence of caries lesions in this group of preschool children, possibly because in Ayurveda, where the practice of traditional Indian medicine is prevalent, the use of fluorides is considered to be harmful.

Children with ECC generally have a high frequency of sugar consumption, not only from fluids given in the nursing bottle,²¹⁻²³ but also from sweetened solid foods.²⁴ This dietary characteristic cannot be ignored as being one of the most significant caries lesion risk factors in ECC. This association was established long ago.²⁵ In this study, statistically significant correlations were seen between caries lesions and the consumption of snacks ($P=.0177$), and the giving of sweets as a reward ($P<.0001$). Mothers constituted the majority of caregivers in this study, and sweets were frequently given as a reward (14%) or even on demand by the child. This practice is predominantly culturally based.

High parental educational attainment has been found to be related to lower caries lesion experience; conversely, low parental income has been related to higher caries lesion experience.²⁶ Social class may influence caries lesion risk in several ways. Individuals from the low socioeconomic strata experience financial, social, and material disadvantages that compromise their ability to care for themselves, obtain professional health care services, and live in a healthy environment,²⁷ all of which lead to a reduced resistance to oral and other diseases.²⁸ If oral hygiene is less than satisfactory, children can develop subsurface demineralization, enamel lesions, and even frank caries lesions by the age of 2 years. In this regard, a statistically significant correlation was found in the present study between caries lesions and cleaning of the child's mouth ($P<.0001$) and the oral hygiene status of the child ($P<.0001$).

A tooth-brushing habit was identified in 58% of the children, 43% of whom brushed twice daily. Several studies have shown that increased tooth-brushing frequency and parental involvement can decrease the occurrence of caries lesions on smooth surfaces.²⁹ A major problem confronting the investigation of the relationship between tooth-brushing and ECC is the methodological issue of assessing the frequency of brushing, quality of plaque removal, and actual levels of oral hygiene. The questions regarding tooth-brushing were answered by the primary caregiver, and these answers may be subject to recall bias as well as social desirability response bias. Mothers are known to be the primary promoters of oral hygiene practices.³⁰ Also, there is evidence to indicate that positive changes in oral health status of infants are linked to changes in the oral health behaviors and dietary practices of the mothers.³⁰

A mother's motivation to engage in preventive dental behavior is inversely associated with the mean dmfs scores of their children, and interdental cleaning by the mothers is the strongest determinant of interdental cleaning of infants.³¹ Therefore, programs designed to prevent ECC must provide support for involvement of the mothers or caregivers.

Sadly, the influence of community-based oral hygiene education on long-term oral hygiene practices is “small and temporary.”³² There is evidence from a longitudinal study of 19-month-old infants that the accumulation of dental plaque on the maxillary central incisors is a good predictor of caries lesion development within the next 18 months.³³ Infants who have a plaque-free dentition and regularly use fluoridated toothpaste are less likely to develop dental caries lesions by the age of 3 years.³⁴ These positive oral health practices may be indicators of overall healthy dietary and feeding habits and are associated with higher income and education levels. The current evidence does not indicate that dietary counseling or oral hygiene instructions are effective in changing habits and preventing ECC.³⁵

Conclusions

In Kerala, the preschool children at high risk from dental caries lesions are those with poor oral hygiene status, who consume snacks and are given sweets as rewards, also, those who belong to a lower socioeconomic class, as measured by income.

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ABSTRACT OF THE SCIENTIFIC LITERATURE



PEDIATRIC DENTAL TREATMENT USING GENERAL ANESTHESIA

Consumer satisfaction is an important outcome of health care services and it can potentially affect the utilization and compliance regarding a treatment modality. Few studies are available which survey parental perceptions and satisfaction regarding dental care for children under general anesthesia and its impact on their quality of life. This survey study involved 45 physically and mentally healthy children, ranging in age from 2 to 5 years, whose parents chose dental treatment using general anesthesia (GA) after being informed of the risks, benefits, and options. The survey, completed at the postoperative follow-up visit, consisted of a 10-item questionnaire covering: (1) satisfaction with GA and perceptions of the impact of GA on the children's quality of life related to (2) physical health and (3) social well-being. Sociodemographic and independent variables of the test group were compared to a representative sample who did not participate, with no significant differences found. Results indicated a 100% satisfaction with GA, which was in agreement with previous studies. The majority reported positive effects on their child's overall health, indicated by the statistically significant predictors which included the absence of pain, looked better, smiled more, and were more socially interactive.

Comments: Two of the more interesting findings of this study were how many of the parents did not correlate or fully appreciate the importance of oral health on their children's overall health, and the significance these same parents placed on social issues, especially aesthetic dental needs for the young female patient. This study further strengthens previous findings that dental rehabilitation using GA has a strong impact on many young children's overall health and should be a fundamental option for practitioners when appropriate criteria are met. ET

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White H, Lee J, Vann W. Prenatal evaluation of quality of life measures following pediatric dental treatment using general anesthesia. *Anesth Prog*. 2003;50:105-110.

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