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Early childhood caries in children aged 6–19 months

Thongchai Vachirarojpisan[1], Kayoko Shinada[1], Yoko Kawaguchi[1], Pimolphan Laungwechakan[2], Tewarit Somkote[3] and Palinee Detsomboonrat[3]

[1]Department of Oral Health Promotion, Graduate School, Tokyo Medical and Dental University, Tokyo, Japan, [2]Dental Division, U-thong Community Hospital, Suphan Buri, [3]Department of Community Dentistry, Chulalongkorn University, Bangkok, Thailand

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Abstract – *Objectives:* To investigate the relationship between socioeconomic factors, behaviors and the severity of early childhood caries (ECC) in 6–19 month-old Thai children. The severity of ECC was estimated using the proportion of ECC teeth to erupted teeth. This was termed the 'Intensity of ECC' (I-ECC) index. *Methods:* Cross-sectional questionnaire survey, dental examinations, and mutans streptococci counts were obtained from children and mothers/caregivers who participated in the ECC prevention program. *Results:* The 520 children from rural areas were categorized into four age groups by the mean number of erupted teeth. In the 15–19-month-old children, the prevalence of ECC was 82.8% (cavitated caries, 40.8%; noncavitated caries, 42.0%) with a mean ECC teeth score of 4.18 ± 3.19. The mean I-ECC severity score was 0.45 ± 0.30 in these toddlers. Children from low-income families, those with low education, and mothers/caregivers with decayed teeth had higher I-ECC scores ($P < 0.05$). Children who were breast fed or had high counts of mutans streptococci also had higher I-ECC scores ($P < 0.05$). The logistic regression model revealed that only children's mutans streptococci level was a statistically significant predictor of ECC, with an odds ratio = 4.5 (95% CI = 1.8, 11.7). *Conclusions:* ECC is not only a public health problem but also a social problem in Thailand, because it relates to family income and education level. The community development approach to assisting disadvantaged Thai children should be combined with an effective preventive program at a very young age. Future longitudinal research should be performed to improve the I-ECC for measuring the severity of ECC.

Key words: early childhood caries; epidemiology; infants; mutans streptococci; socioeconomic factors

Dr Thongchai Vachirarojpisan, Department of Oral Health Promotion, Graduate School, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo-ku. Tokyo 113-8549, Japan
Tel: +81 3 5803 5476
Fax: +81 3 5803 0194
e-mail: vthongch@yahoo.com

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Dental caries in primary teeth of children in Thailand has shown a marked increase during the past two decades. The proportion of caries-free 5–6-year-old children decreased from 25.6% in 1984 to 12.5% in 2001 (1). Moreover, national data collected in 2001 showed that 3-year-old children had a high prevalence of dental caries (65.7%) and high severity, with a mean of 3.6 dmft. The situation was worse in the rural areas, where a prevalence rate of 70.3% and a mean severity of 3.9 dmft were reported. A provincial oral health survey also showed a high prevalence and severity of dental caries (up to 88.7% and 5.5 dmft in some provinces) (2). Hence, dental caries in young children is a major health issue in Thailand, as well as in other developing countries (3–5).

Early childhood caries (ECC) is a term that describes dental caries in primary teeth (6). ECC has been defined as the presence of one or more decayed (noncavitated and cavitated lesions), missing (because of caries), or filled tooth surface in any primary tooth (7). With this definition, the ECC prevalence and mean dmft in 3-year-old Thai children may be worse than the national/provincial survey data because the criteria for these surveys included only cavitated carious lesions (8).

Information regarding noncavitated carious lesion in very young children, provide important additional components of understanding the caries process in infants and toddlers (9). Several studies of dental caries in Thai children have not recorded noncavitated carious lesions in primary teeth. Further, caries-preventive programs usually start in kindergarten with 3-year-old or older children. A survey of the early stages of caries development is necessary to set up an appropriate preventive program for ECC. Hence, this study is focused on

noncavitated and cavitated carious lesions in very young children, namely those aged 6–19 months.

The aim of this study was to investigate the severity of ECC, which developed in 6–19-month-old Thai children and the factors related to its presentation such as socioeconomic factors, oral health behavior, and the presence of mutans streptococci in saliva. Such information would provide a valuable base to set up an effective preventive program in the future.

Methods

Characteristics of the study area

The district of U-thong, Suphan Buri province in Thailand was selected as the study area as previous data demonstrated a high dental caries prevalence and severity in 3-year-old children (69%, 5.1 dmft) (10). The population of U-thong district is about 127 500 and there are 1 urban and 12 rural subdistrict administrations. The urban subdistrict area was excluded from this study. Most of the inhabitants of the rural subdistrict were rice and sugarcane farmers. Total monthly family income in the rural area was similar to the Thai average income. Health facilities in the area included one government hospital, two private hospitals, and one private dental clinic. The total dental workforce was made up of two dentists in the private sector, and one dentist and four dental nurses in the government hospital. All of these facilities were located in the urban area and none were in the rural area. Each subdistrict had its own one or two health centers, depending on the population size and area. All 21 health centers in the study area participated in this survey. The total number of children who were born between March 2000 to April 2001 in the study area was 646. The oral health survey examination was conducted in October 2001 when these children were 6–19 months old.

Water supplies were scarce in this study area. While there were varying concentrations of fluoride in ground water (11), it is Thai custom to drink rainwater instead of ground water.

Subjects

Mothers/caregivers of the 6–19-month-old children who lived in the study area were invited to enter the program voluntarily. Mothers/caregivers were contacted directly by volunteer health care workers and asked to bring their children to the health centers for dental examinations. The participant rate was 80.5% (520/646) of children who lived in the area.

Questionnaire interview

The structured questionnaire was modified from the World Health Organization second international collaborative study of oral health systems (ICS II) (12) for mothers/caregivers. The questionnaire encompassed information regarding demographic and socioeconomic status, feeding behavior, dietary habits, and oral hygiene practices of children and mothers/caregivers. For the bottle-feeding behaviors, we asked mothers/caregivers two questions considered specifically related to ECC: (i) Does your child go to sleep with a bottle? and (ii) If your child wakes in the night, is he/she given a bottle of milk? Four well-trained dental assistants conducted the interviews, as some mothers/caregivers were illiterate.

Clinical examination

The dental examination of the children was conducted by two dentists. The mothers/caregivers of these children were also examined by another two dentists at health center offices. Mothers/caregivers were examined with the modified WHO criteria (8) with CPI probe, mouth mirror, and under natural light.

The data on dental caries in these children were collected with special attention to the presence of noncavitated and cavitated decayed tooth surfaces, as recommended by the workshop on diagnosing and reporting ECC for research purposes (7).

Before each clinical examination, wet gauze pads were used to clean the tooth surface. The examination was conducted with a visual and nontactile technique. This method is known as 'lift the lip' technique. No dental probing was performed on these children and the mouth mirror was used for indirect vision in lingual areas of the teeth.

A 2-day meeting and calibration session took place before the clinical examinations were performed. The interexaminer reliability, kappa score, of noncavitated carious lesions in children was 0.68, and the intraexaminer scores were 0.73 and 0.88 at the tooth level. The reliability tests were conducted only in subjects with noncavitated lesions, because cavitated caries was rare in this age group. On the other hand, for mothers/caregivers, only cavitated caries were examined, and the inter- and intraexaminer reliability at tooth level were both higher than 0.80.

Microbiologic examinations

Mutans streptococci level was investigated in 164 pairs of mothers and children, from 8 health centers chosen at random among the 21 health centers.

Mutans streptococci in saliva was collected and assessed using Dentocult® Strip Mutans (Orion Diagnostica, Helsinki, Finland) according to the manufacturer's instructions. Paraffin-stimulated saliva samples of mothers and the nonstimulated saliva of children were collected and incubated for 48 h at 37°C. After incubation, the number of colonies adhering to the strips was compared. Accordingly, mutans streptococci estimates were based on a score of 0–3, corresponding to the following number of colony forming units as described by Jensen & Bratthall (13).

Measurement of severity of ECC

In studies of dental caries in children less than 3 years old (14–17), the numbers of dmfs, dmft, noncavitated, and/or cavitated carious teeth/surfaces have been used to show the severity of ECC. However an early lesion in a 1-year-old child is more severe than a single lesion found in a 5-year-old child (7). Therefore, the dmft index does not discriminate between degrees of severity, especially in the children who do not have all their erupted teeth. Hence, the ratio of affected teeth (noncavitated or cavitated) to erupted teeth, called here the intensity of ECC (I-ECC) index, is used in this study to investigate the degree of severity of ECC in infants and toddlers. This I-ECC index can be computed for an individual by dividing the number of carious teeth (cavitated or noncavitated) by the number of erupted teeth. The I-ECC of large populations, or community I-ECC, is the mean of I-ECC that is calculated from summation of I-ECC/number of subjects.

Statistical methods

Data were analyzed using the Statistical Package for Social Science (SPSS version 10). Because of the non-normal (skewed) distribution of I-ECC, nonparametric tests (Kruskal–Wallis and Mann–Whitney *U*-test) were performed to compare I-ECC values with independent variables. Multivariate analyses, stepwise logistic regression models, were used to estimate the independent effect on the presence or absence of ECC. The model entered the variables that the bivariate analysis had shown as statistically significant. Age and number of teeth were included in the regression models to control for confounding factors, while children with no teeth present were excluded from this analysis.

The Ethical Review Committee for Research in Human Subjects, Ministry of Public Health in Thailand, and the Ethical Committee for Human Research at Tokyo Medical and Dental University in Japan approved the conduct of this study. Participants were recruited by health care workers who requested mother's/caregiver's consent for the children to receive a dental examination and to participate in the prevention program.

Results

Tooth eruption and ECC pattern

A total of 520 children, 272 boys (52.3%) and 248 girls (47.7%), were enrolled in the study. There was great variability in a number of teeth among the 6–19-month-old children. The means and distribution of erupted teeth is shown in Table 1. Four age groups

Table 1. The mean number of erupted teeth and distribution of children by the teeth present in the mouth

Age (months)	*N*	Average of erupted teeth: Mean number of teeth	SD	Distribution of children in percentage by number of teeth present: 0	1–2	3–4	5–6	7–8	>8
6	33	0.18	0.58	90.9	9.1	0	0	0	0
7	43	0.26	0.66	86.0	14.0	0	0	0	0
8	29	0.62	1.32	79.4	10.3	10.3	0	0	0
9	41	1.85	1.88	39.1	34.1	19.5	7.3	0	0
10	41	1.90	2.01	43.9	24.4	22.0	9.7	0	0
11	41	4.37	2.40	9.7	17.1	22.0	36.6	12.2	2.4
12	40	4.60	2.49	7.3	17.5	25.0	27.5	22.5	0
13	51	5.98	1.90	2.0	3.9	19.6	33.3	41.2	0
14	44	6.23	2.76	2.3	4.5	27.3	22.7	34.1	9.1
15	48	7.33	2.56	0	4.2	8.3	22.9	50.0	14.6
16	31	8.10	3.47	0	3.2	9.7	22.6	45.2	19.3
17	27	9.41	3.51	0	0	7.4	14.8	37.0	40.7
18	41	11.24	3.83	0	0	2.4	7.3	21.9	68.3
19	10	9.60	3.66	0	0	0	30.0	20.0	50.0
Total	520	4.89	4.20	133	57	71	88	109	62

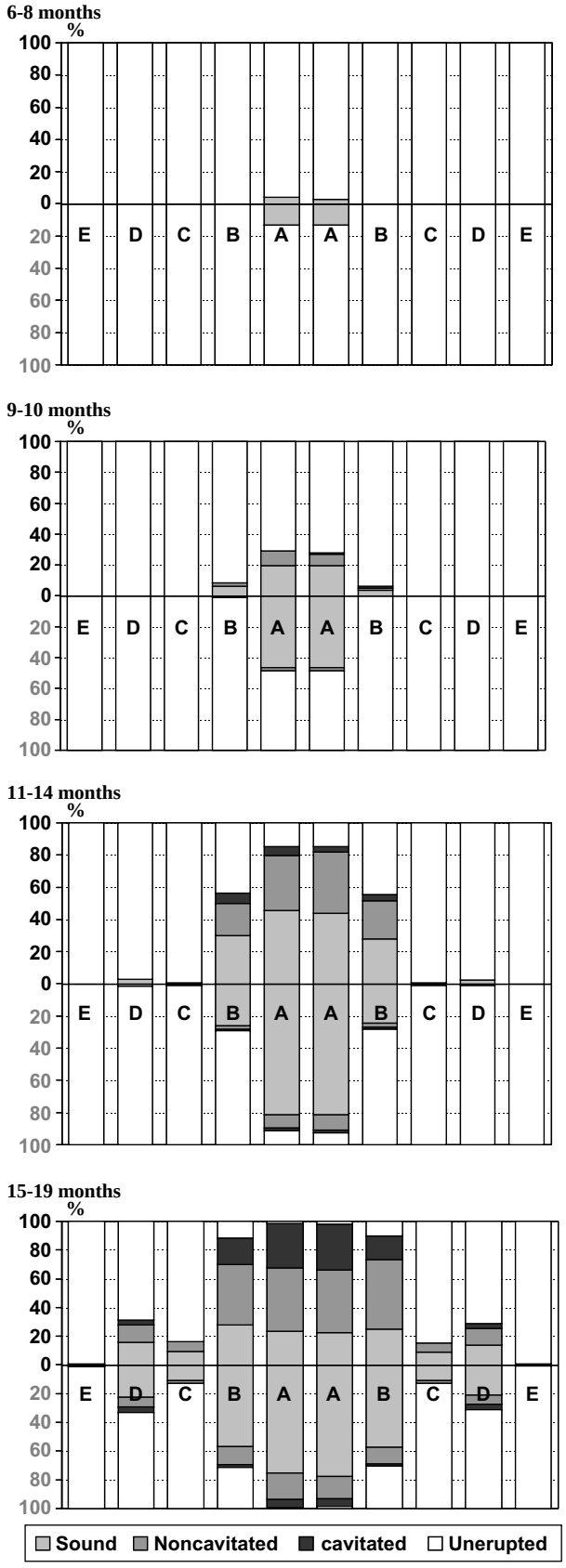

Fig. 1. The number of sound, noncavitated and cavitated carious teeth by age group.

were categorized on the basis of the number and pattern of erupted teeth: 6–8 months old with a mean of 0.3 ± 0.9 teeth; 9–10 months old with a mean of 1.9 ± 1.9 teeth; 11–14 months old with a mean of 5.4 ± 2.5 teeth, and 15–19 month old with a mean of 9.0 ± 3.6 teeth. The caries pattern of these age groups is shown in the Fig. 1.

The first erupted teeth in the mouth were the mandibular central incisors. In 6–8-month-old children, 11.4% of subjects had either one or two teeth present. At 9 months of age, the first noncavitated carious lesions appeared in the maxillary central incisor. The first cavitated carious lesions also appeared in the maxillary central incisors at the age of 10 months. For noncavitated carious lesions, 42.3% of erupted maxillary central incisors, and 39.1% of erupted maxillary lateral incisor had these lesions in the 11–14-month-old group. A marked increased proportion of cavitated caries, in maxillary anterior teeth, was found in 15–19-month-old children. In that age group, 44.5% of maxillary central incisors had noncavitated lesions and 24.5% had cavitated lesions.

The lower anterior teeth first presented noncavitated carious lesions in the 9–10-month-old group, and the first cavitated carious lesions appeared in the 11–14-month-old children. Carious lesions appeared in the upper and lower posterior teeth as soon as the molars erupted in 15–19-month-old children.

ECC prevalence and intensity

The ECC prevalence was calculated for the children who had teeth. In 9–10-month-old dentate children, the prevalence of ECC was 20.8% (cavitated 2.1% and noncavitated 18.7%). The number of ECC affected teeth increased rapidly in the older age groups. The ECC prevalence in 11–14- and 15–19-month-old dentate children was 57.5 and 82.8%, respectively. The distinctions between noncavitated and cavitated carious lesions at each age group are shown in Table 2.

For all the dentate children, the mean number of ECC teeth was 2.50 ± 2.89 with a mean of 6.58 ± 3.56 erupted teeth. About one-third of erupted teeth demonstrated noncavitated or cavitated dental caries. The I-ECC was calculated as 0.11 ± 0.25, 0.27 ± 0.32, 0.45 ± 0.30 in 9–10-, 11–14-, and 15–19-month-old children, respectively (Table 3). The overall I-ECC mean for all dentate children in the survey was 0.31 ± 0.32.

The ECC and I-ECC index showed a strong positive relationship ($P < 0.01$, $r = 0.86$). The I-ECC

Table 2. The percentage of children by dental caries status

Age group (months)	*N*	Number of children with erupted teeth	Children's dental status (percentage of those with teeth)			
				Dental caries		
			Caries free	Noncavitated lesion only	Both noncavitated and cavitated lesions	Cavitated lesion only
6–8	105	15 (14.3)	15 (100)	0	0	0
9–10	82	48 (58.5)	38 (79.2)	9 (18.7)	0	1 (2.1)
11–14	176	167 (94.9)	81 (48.5)	68 (40.7)	16 (9.6)	2 (1.2)
15–19	157	157 (100)	27 (17.2)	66 (42.0)	56 (35.7)	8 (5.1)
Total	520	387 (74.4)	161 (41.6)	143 (37.0)	72 (18.6)	11 (2.8)

Percentage values are given in parentheses.

Table 3. The mean number of teeth present, sound teeth, noncavitated and cavitated carious lesions, and ECC intensity

Age group (months)	*N*	Mean number of teeth				Early childhood caries	
		Teeth present	Sound teeth	Noncavitated carious teeth	Cavitated carious teeth	Total ECC	I-ECC
6–8	15	2.33 (0.90)	2.33 (0.90)	0	0	0	0
9–10	48	3.21 (1.44)	2.73 (1.33)	0.44 (0.99)	0.04 (0.29)	0.48 (1.17)	0.11 (0.25)
11–14	167	5.64 (2.23)	3.92 (2.28)	1.47 (1.82)	0.26 (0.92)	1.72 (2.12)	0.27 (0.32)
15–19	157	9.01 (3.64)	4.82 (3.13)	2.90 (2.52)	1.27 (1.99)	4.18 (3.19)	0.45 (0.30)
Total	387	6.58 (3.56)	4.07 (2.65)	1.87 (2.24)	0.63 (1.50)	2.50 (2.89)	0.31 (0.32)

SD values are given in parentheses.

index was categorized into four groups: low (scores $\leq$0.25), medium (scores 0.26–0.50), high (scores 0.51–0.75) and very high intensity (scores $\geq$0.76). Figure 2 illustrates the relationship between the children who had a low number of ECC teeth and a low or medium I-ECC score, and children who had a high number of ECC teeth and a high or very high score.

Children's mutans streptococci

There were 103 (62.8%) children who did not have mutans streptococci recorded in their mouths. However, one-third of these children were in the group with no erupted teeth. Mutans streptococci was generally more common in children in the older age categories. There were statistically significant ($P < 0.01$) correlations between mutans streptococci and: children's age; I-ECC; and the number of erupted teeth. Pearson's correlation coefficients were 0.45, 0.47, and 0.37, respectively. There was no correlation between children and mothers' mutans streptococci.

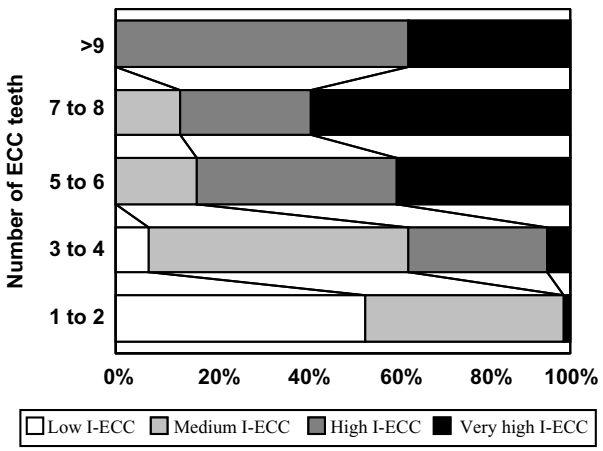

Fig. 2. The percentage of children by number of ECC teeth and I-ECC score.

Child rearing and oral health behavior

Breast feeding was the norm in this community with bottle feeding initiated right after birth in only 43 children (8.2%). There were 423 mothers (81.3%) who started breast feeding their children, but 173 mothers (41%) switched to bottle feeding later, at the average children's age of 4.5 ± 3.6 months. Some mothers (10.5%) used both methods simultaneously.

At the time of the interviews, there were 259 children who were still being bottle fed, 185 children (71.3%) fell asleep with bottles and 224 children (86.5%) had nighttime bottle feeding. Almost all children (239) used infant formula. There were 100 children (38.6%) who occasionally had sweeteners in their milk. The major sweeteners were fresh fruit juice and soymilk.

For the children aged more than 12 months, only 6.7% (17/252) were weaned prior to the study. The average weaning age was 13.8 ± 1.9 months. The rest of the children were still bottle feeding and/or breast feeding. Their average age was 15.34 ± 1.84 months.

Consumption of snacks and sweet drinks or foods was very common in the study children. Only 47 (9.0%) children were reported not to eat such food, and 36 of these were less than 1 year old. The most popular food among these children was packaged carbohydrate snack food, recorded in 437 (84.0%) children. The others were Thai desserts, candies, and soft drinks (38.3, 16.6, and 14.4%, respectively).

Of the 387 dentate children, 136 (35.3%) children had never had their teeth cleaned at all, and 159 (41.4%) children only had their teeth wiped with a piece of cloth, even in their toddler years. Tooth brushing behavior was very low with only 90 (17.3%) children who brushed or had their teeth brushed for them. Fifty-nine of these children were in the 15–19-month-old group. Fluoride toothpaste was used by 41.1% (37/90) of those who did brush.

Demographic and dental caries data of mothers

Most of the caregivers, 447 of 520 participants, were mothers. The others were grandmothers and relatives. Forty-three per cent of mothers (194/447) had employment and 43.3% (84/194) of mothers worked outside the home. The mean age of mothers was 27.5 ± 6.5 years. The education levels of mothers were: 321 with primary school education only (71.8%); and 126 persons above primary school (28.2%). The average number of household family members was 5.5 ± 2.1 persons, with an average of 1.8 ± 0.9 children per family. Most of the families (277, 53.3%), had an income between 1000 and 3999 Baht (US $24–95)/month. One hundred and thirty-seven families (26.3%) had an income between 4000 and 6999 Baht (US $96–166)/month. (Thailand's average monthly household income was US $290 in all households and US $116 in farm workers.)

The mean DMFT of mothers was 3.86 ± 4.10, composing decayed teeth (DT) $= 1.5 \pm 2.31$, missing teeth (MT) $= 1.39 \pm 2.31$, and filled teeth (FT) $= 0.97 \pm 1.94$.

Bivariate analysis of I-ECC and ECC-related factors

Bivariate analyses were conducted between I-ECC and family income, and variables related to mothers, i.e. education level, occupation, presence of DT, caries experience, and mutans streptococci. Variables specific to the children included in the bivariate analyses were gender, snacking habits, methods of feeding, falling asleep with bottle, night time bottle feeding, tooth cleaning method, fluoride toothpaste use, and mutans streptococci level of the child. The results of the mean I-ECC indices displayed large SDs; hence, nonparametric analysis was performed. The 6–8- and 9–10-month-old groups were excluded from analysis because of the small numbers of subjects affected. Table 4 shows the factors that influence I-ECC that were statistically significant. In the 15–19-month-old group, lower family income, mother's low education level, mother's DT, breast feeding and high mutans streptococci level in children each showed a high relationship with I-ECC at a statistically significant level ($P < 0.05$).

For the bottle-fed children, and the children who fell asleep with bottles, the I-ECC was higher than that in those who occasionally used a bottle. The everyday nighttime bottle-feeding group showed a higher I-ECC score than the occasional feeding group, but these factors did not reach a statistically significant level. Frequency of snacking was related to high I-ECC, but again was not statistically significant. Furthermore the cleansing method and fluoride toothpaste usage showed no relationship with I-ECC. Boys showed a higher I-ECC score than girls did but not at a significant level, the same was also true of the mothers' caries experience (DMFT).

Multivariate analysis of related factors

The logistic regression models previously described were evaluated for predictor variables, controlling for age and number of teeth present. When all children were included in the model, mutans streptococci level and number of erupted teeth were statistically significant at $P < 0.01$, the cumulative probability of ECC was therefore estimated to be 37.7%. The children who showed the presence of mutans streptococci had an odds ratio probability of ECC 4.5 times that of children without mutans streptococci (95% CI = 1.8, 11.7). The odds ratio for the relationship of 'number of erupted teeth' with ECC was 1.4 (95% CI = 1.2, 1.7).

Discussion

This cross-sectional study examined factors related to early childhood dental caries in children aged

Table 4. The relationship between I-ECC and related factors

Factors	11–14-month group ($N = 140$)				15–19-month group ($N = 132$)			
	N	Mean	SD	*P*-value	*N*	Mean	SD	*P*-value
Mother's education level								
Primary school or less	97	0.28	0.34		101	0.48	0.30	
Secondary school or more	43	0.30	0.32	0.636	31	0.36	0.30	0.042*
Mother's occupation								
Housewife (did not work)	57	0.33	0.35		76	0.46	0.30	
Working	83	0.26	0.32	0.233	56	0.45	0.31	0.902
Mother's DT								
DT = 0	59	0.25	0.30		49	0.36	0.28	
DT = 1 or more	81	0.32	0.35	0.361	83	0.51	0.30	0.010*
Mother's DMFT								
DMFT = 0 (caries free)	30	0.23	0.32		23	0.35	0.28	
DMFT = 1 or more	110	0.30	0.34	0.281	109	0.48	0.30	0.078
Family income/month								
3999 Baht (US $95) or under	68	0.33	0.36		76	0.50	0.30	
4000 Baht (US $96) or over	72	0.24	0.30	0.176	56	0.39	0.29	0.016*
Gender of children								
Male	70	0.32	0.34		63	0.48	0.30	
Female	70	0.26	0.32	0.376	69	0.43	0.30	0.346
Snacking								
Everyday	63	0.31	0.34		70	0.49	0.26	
Sometime or never	73	0.28	0.32	0.494	55	0.44	0.34	0.350
Method of feeding								
Breast feeding	75	0.30	0.33		68	0.51	0.29	
Bottle feeding or mixed feeding	62	0.26	0.32	0.477	62	0.39	0.31	0.018*
Falling asleep with bottle								
Every time	23	0.34	0.39		24	0.43	0.32	
Sometime or never	39	0.20	0.27	0.220	39	0.36	0.31	0.289
Night-time bottle feeding								
Everyday	45	0.27	0.33		55	0.39	0.31	
Sometime or never	17	0.23	0.32	0.574	8	0.35	0.36	0.661
Fluoride toothpaste usage								
No	13	0.26	0.36		30	0.52	0.27	
Yes	8	0.23	0.33	0.934	21	0.50	0.36	0.992
Mutans streptococci in children								
0 bacteria/ml saliva	31	0.23	0.29		20	0.27	0.26	
$<10^5$ bacteria/ml saliva	8	0.26	0.39		6	0.48	0.34	
10^5–10^6 bacteria/ml saliva	8	0.70	0.26		17	0.58	0.30	
$>10^6$ bacteria/ml saliva	6	0.60	0.33	0.003**	8	0.57	0.27	0.015*

Calculated only for children with teeth present.
*$P < 0.05$, **$P < 0.01$ with Mann–Whitney *U*-test and Kruskal–Wallis test.

6–19 months. There was a high prevalence of ECC, with 82.8% of children 15–19 month old having ECC, 42.0% with noncavitated carious lesions only, and 40.8% with cavitated lesions (with or without non-cavitated lesions). This study confirms also the high prevalence of childhood dental caries in this district (10).

Many studies of ECC in infants report only the prevalence of DT (3); however, some studies count the number of white spot lesions or cavitated surfaces (18), other studies use the def index (14, 15, 17, 19, 20). Prevalence of DT is simply the number of persons in a population with existing dental caries experience. In areas with low prevalence of caries, counting the number of persons with the disease is most useful, but in areas of high prevalence, this method becomes less useful (21). Use of the def index in ECC studies also shows some limitations. The def score does not directly indicate the intensity of disease attack in any individual. A def score of 4.0

in 3-year-old children is more severe than the same score in 6-year-old children. Hence, the def score has little meaning unless age is also stated. Even when age is stated, the def or dmft score is not suitable in those under 2.5 years who usually have fewer than 20 teeth. For example, a def score of 2.0 in 6-month- and in 2.5-year-old children shows differences of caries intensity because of the unequal number of erupted teeth. The denominator, erupted teeth, is used as part of the measure of early childhood caries in this study to better describe the intensity of early childhood caries experience. I-ECC represents the dental caries (cavitated and noncavitated lesions) related to erupted teeth and demonstrates the intensity of caries attack in the individual. For example, the children who have one carious tooth may have I-ECC score of 0.5 or 0.1 depending on the number of erupted teeth (2 or 10 erupted teeth). The I-ECC score can therefore discriminate the degree of intensity of disease, i.e. the higher the value the higher the intensity.

The method for calculating I-ECC was similar to that described by O'Sullivan et al. (22) in Navajo preschool children. This study calculated the severity based on available surfaces affected in a specific cavitated caries pattern; maxillary anterior, fissure caries, and posterior proximal caries pattern. The Navajo children less than 2 years of age had 19% of available maxillary anterior teeth surface affected with caries, and did not had proximal and fissure caries yet. However, in the present study, the ECC problem was more severe than in Navajo study. Some children already had posterior caries, and the prevalence and severity of ECC problem in all subjects was 31% (I-ECC = 0.31) of available teeth affected with noncavitated and cavitated carious lesions.

This I-ECC is different from the 'severe early childhood caries' (S-ECC) index that was recommended by the ECC workshop in 1999 (7). The S-ECC refers to children with atypical, progressive, acute, or rampant caries patterns, and to children who experience dental caries (cavitated or noncavitated) in any smooth surface before the age of 36 months. In the Drury et al. study, most of the caries in children occurred on the labial surface of teeth, which would mean that all of these ECC children are classed as S-ECC. The S-ECC index therefore may not represent the variations of intensity of dental caries, especially in areas with a high prevalence of ECC.

However, the I-ECC index still poses some points for consideration. First, the same I-ECC score may not represent the same intensity of disease. For example, an I-ECC score at 0.5 may represent 1 carious lesion per 2 erupted teeth or 10 carious lesions per 20 erupted teeth. Caries in the early years of life should be considered more problematic than when dental caries occurs in the older individuals, even though the proportion of disease is the same. Second, the I-ECC index had a high correlation with ECC teeth, because it is a modified form of the ECC score. Longitudinal studies of I-ECC are needed to investigate and improve its use to grade the severity and intensity of early childhood caries in the future.

Epidemiologic studies clearly document the increased risk of ECC associated with lower socioeconomic status such as low-income family, social class, and mothers' education (19, 23, 24). This study also supported such findings. The reasons for this may be that mothers from lower socioeconomic levels may have material, social, and financial disadvantages that render them less able to care for themselves as well as their children. Moreover, the mothers with untreated DT themselves had high I-ECC children. These findings support the role of both economic barriers and the oral health concern of mothers in relationship to their children's oral health. However, the knowledge and attitudes of mothers were not specifically studied in this research. The improvement of these social factors however may have an impact on the oral health of children (25).

Tooth brushing and fluoride toothpaste usage in this study was very low compared with other studies. Two studies, in the UK and in Sweden, reported tooth brushing with fluoride toothpaste as high as 90–95% in 18-month-old children (26, 27). For infants and toddlers with inadequate muscle ability, tooth brushing by parents/caregivers can remove dental plaque more effectively (26), and such children are more likely to be caries free (16) than those who brush by themselves. Parents/caregivers assisting tooth brushing with a fluoride toothpaste would appear to be a practise to be encouraged in future preventive programs in Thailand.

Strong associations between the levels of mutans streptococci with dental decay in the primary dentition of preschool children have been reported (28). In the present study also, the same association was demonstrated in the multivariate analysis. Two previous studies using logistic regression models found that children with high levels of mutans streptococci were 4.9 and 5.3 times more likely to have dental caries than children with lower levels of mutans streptococci (18, 27).

There was a limitation of caries examination and diagnosis in this study. It was difficult for the examiners to detect noncavitated carious lesions in crying children by using ambient light indoors. However, the kappa values for noncavitated lesion in this study was acceptable (0.68) at the tooth level, compared with the previous study's low score of 0.24 (29).

In conclusion, the present study shows that the prevalence of ECC is extremely high, and has become a significant health issue in Thai infants and toddlers. The early and rapid caries development seen in these young children calls for initial preventive programs, before or soon after tooth eruption. Mutans streptococci levels may represent a good screening method for the high-risk children. Increasing tooth brushing with fluoride toothpaste should be the main preventive methods with a focus on the disadvantaged (low income/rural) groups. Future longitudinal research is required in order to improve the I-ECC used for grading the severity of ECC.

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