Associated Factors of Early Childhood Caries (ECC) Among 24–42-Month-Old-Children in Jakarta: A Cross-Sectional Study

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Abstract

This study aimed to obtain early childhood caries (ECC) prevalence and analyze the associations between its risk factors and ECC. A cross-sectional study with a purposive sampling method was carried out with 218 children (24–42 months old) through interviews with their mothers. Intraoral examination of the children was performed by two calibrated examiners to obtain the Silness and Löe index of plaque and Caries Assessment Spectrum and Treatment (CAST) index.

The prevalence of ECC was 79.8%, with primarily dentinal lesions with cavities (2.2 teeth/child) observed, followed by enamel lesions (1.73 teeth/child). There were associations between ECC and oral health and hygiene practices, including plaque index, children's toothbrushing supervision, tooth brushing after drinking milk or meal, and tooth brushing before going to bed.

There were no statistically significant associations between demographic factors, breastfeeding, complementary feeding patterns, and ECC, but cariogenic snack consumption frequency showed a significant association toward ECC. There were associations between ECC, plaque index, tooth brushing supervision, tooth brushing habits after drinking milk or meal and before going to bed, and cariogenic snack consumption frequency.

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Introduction

Early childhood caries (ECC) is one of the most common chronic infections in infants and pre-schoolers globally. According to the World Health Organization (WHO), ECC is still a pandemic disease globally with different prevalence in each country.[1] In Indonesia, only 9.9% of children aged five years old were free of caries with a mean dmft index of 8.1.[2] These important issues suggest that the prevalence of ECC increased over the study period from 2007 to 2018. Children aged 3-4 years old significantly contribute to the high prevalence of ECC, and caries severity almost increased a third in 3-5-year-old-children.[3]

If ECC is left untreated, it could progress into the dental pulp, causes dental pain and severe infection, so extensive treatment will be required.[4] ECC not only negatively affect the immediate and long-term quality of life of the children but also a financial burden to the family.[5,6] Moreover, ECC might inhibit the physical and growth development of the children due to difficulty of sleeping, eating, and impacts in the lost school days, leading to poor school performance and reduced the ability to learn.[7,8] Such problems are potentially serious; therefore, it is important to determine the risk indicators of ECC. Hence caries development can be prevented earlier and choose the appropriate treatment strategy. Many factors contributed to the development of ECC. Dietary, microbial, and environmental factors are known as the main risks. The other risk indicators are inappropriate feeding patterns, socioeconomic background, lack of parental education, limit access to dental care, poor oral hygiene, and malnutrition.[4]

Several indices are used to assess dental caries status at the community or national level. The most widely used and known is the Decay-Missing-Filled (dmf/DMF) index, recommended by WHO.[9] However, there are still some limitations since the DMF index does not distinguish the severity of the caries lesions.[10]

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More recently, the Caries Assessment Spectrum and Treatment (CAST) index was developed to detect a wide range of caries statutes from sound to advanced enamel and dentinal lesions, including pulp involvement and abscess/fistula.[11] This index has been used widely to report the prevalence in oral epidemiological studies.[12,13]

Jakarta, the capital city of Indonesia, has a diverse population with numerous ethnic groups and socioeconomic strata, thus representative of the Indonesian population. It has more than 10 million residents as of 2020, making it the largest urban in Indonesia.[14] Due to the potential for ECC could affect the quality of life in children and families, the prevalence and etiology of ECC should be further examined as information for clinical management and policies. To our knowledge, a few studies demonstrated the prevalence and associated risk factors related to ECC in Jakarta.[15,16] Therefore, the present study was designed to report and analyze the prevalence and severity of ECC according to the CAST index and associated risk factors among 24–42-month-old children in East Jakarta.

Materials and methods

This cross-sectional study was conducted in Matraman Sub-District, East Jakarta, from July to October 2018. East Jakarta has the highest prevalence of ECC and the lowest oral health access for school-aged children.[17] The target of the population was children aged 24–42 months, and the sample size estimation suggested 221 children should be recruited with 80% power, the statistical significance level (α= 5%), and the non-response rate (15%). A purposive sampling method was employed in this study. Mothers or primary caregivers were asked to provide written informed consent. Ethical approval was obtained from the research ethics committee, Faculty of Dentistry, Universitas Indonesia (No. protocol 010570618), and followed the principles of the Declaration of Helsinki.

Two trained and calibrated examiners collected the clinical examination data using sterilized dental mirrors, pocket probes, and artificial light. Intra- and inter-examiner agreement coefficient was assessed of 15% of the sample. Cohen Kappa analysis and Interclass Correlation Coefficient were calculated. The dental examination was done using the CAST index.[11] Dental caries experience was classified based on CAST codes 2 – 8, while codes 0 – 1 represent the functional dentition. The modified Silness and Löe plaque index was applied to measure the oral hygiene status, and then the result was divided into four categories.[18,19] We also assessed the first weight recorded after birth and the anthropometric measurement.[20,21] A valid and reliable structured questionnaire was completed by the mother or primary caregiver, who was interviewed one-by-one by a trained interviewer. The questionnaire addressed the following characteristics: sociodemographic, oral health care behavior, breastfeeding pattern, breast milk substitute, and complementary food pattern.[17] All data obtained were entered into Microsoft Excel 2010 and analyzed in IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA). Univariate and bivariate analyses were performed. $p < 0.05$ was considered statistically significant, and the confidence interval was set at 95%.

Results

In total, 253 children participated in the dental examination and answered the questionnaire. Thirty-five samples with missing information were excluded in the entry data process, so a total of 218 samples were included in the final data analysis (response rate = 98.6%). For CAST, the Interclass Correlation Coefficient analysis for inter-examiner ranged from 0.78 to 0.95, and those for intra-examiner were 0.80 and 1.00. The kappa coefficient for inter-and intra-examiner reliability of oral hygiene status was 0.65 and 1.00, respectively. The parent's sociodemographic status and children's characteristics are shown in Table 1.

The prevalence of caries was 79.8%, with the highest mean value among all CAST scores was sound teeth (13.78 ± 4.4), followed by children who had caries dentin (2.20 ± 2.9). There were no children with the characteristics of abscess/fistula and missing teeth due to caries (Table 2).

In table 3 presents that there were no significant differences between the demographic factors and dental caries in the primary dentition. However, this study found that the children's plaque index, parental supervision when toothbrushing, and the habit of tooth brushing

after eating or drinking milk were associated with ECC (Table 4).

Subject Characteristics	N	%
Parents' Demographics		
Age (mean ± SD)		
Mother (years)	31.46 ± 6.2	
Children (Months)	32.47 ± 5.6	
Mother's education		
High	34	15.6
Moderate	124	56.9
Low	60	27.5
Mother's employment status		
Working	41	18.8
Non-Working	177	81.2
Family's income[a]		
≥ Provincial Minimum Wage	121	55.5
< Provincial Minimum Wage	97	44.5
Children's characteristics		
Gender		
Male	88	40.4
Female	130	49.6
Birth weight		
Normal (> 2500 g)	199	91.3
Low birth weight (≤ 2500 g)	19	8.7
Children's age group (months)		
24 – 39	75	34.4
30 – 35	71	32.6
36 – 42	72	33
Nutritional status		
Very good	7	3.2
Good	186	85.3
Lacking	20	9.2
Malnutrition	5	2.3
Oral hygiene status		
Excellent	6	2.8
Good	98	45
Fair	89	40.8
Poor	24	11

Table 1. The parent's sociodemographic status and children's characteristics.
[a]DKI Jakarta Minimum Wage.

Codes	Characteristics	Mean (SD)	Median	Min–Max	95% CI
0	Sound	13.78 (4.4)	14.0	0–20	13.18–14.37
1	Sealed	0.33 (1.1)	0	0–8	0.18–0.47
2	Restored	0.02 (2.4)	0	0–2	0–0.05
3	Distinct visual changes in enamel	1.73 (1.5)	1.0	0–13	1.42–2.05
4	Internal caries related to discoloration in dentine	0.61 (1.5)	0	0–7	0.41–0.80
5	Distinct cavitation in dentine without pulpal	2.20 (2.9)	0	0–11	1.82–2.58
6	involvement Involvement of the pulp chamber	0.49 (1.85)	0	0–16	0.24–0.74

Table 2. The average score of the CAST index.

	Dental caries		*p*-value
	N (%)	Median (Min-Max)	
Birth weight			
Normal	199 (91.3)	4 (0-20)	0.490
Low birth weight	19 (8.7)	4 (0-9)	
Nutritional status			
Very good	7 (3.2)	6 (0-20)	0.517
Good	186 (85.3)	4 (0-20)	
Lacking	20 (9.2)	4 (0-20)	
Malnutrition	5 (2.3)	7 (0-9)	
Child age group (months)			
24-29	75 (34.4)	3 (0-19)	0.185
30-35	71 (32.6)	4 (0-20)	
36-42	72 (33)	5 (0-20)	
Mother's education			
High	34 (15.6)	4 (0-14)	0.136
Moderate	160 (73.4)	4 (0-20)	
Low	24 (11.0)	5,5 (0-20)	
Family's income			
≥ Provincial minimum wage	121 (55.5)	4 (0-20)	0.058
< Provincial minimum wage	97 (44.5)	5 (0-20)	

Table 3. The association between demographic factors and dental caries in primary dentition.

	Dental Caries		*p*-value
	N (%)	Median (Min-Max)	
Plaque index			
Good	104 (47.7)	2 (0-20)	0.001*†
Average	89 (40.8)	6 (0-20)	
Poor	24 (11.0)	10 (3-20)	
Age of start brushing/cleaning babies' teeth (months)			
≤ 12	168 (77.1)	4 (0-20)	0.945
≥ 13	50 (22.9)	5 (0-20)	
Current tooth brushing technique	188 (86.2)	4 (0-20)	0.140
Toothbrush + toothpaste	30 (13.8)	4 (0-20)	
Others			
Parental supervision in children's toothbrushing			
With only supervision/assisted by parents/caregiver	207 (95)	4 (0-20)	0.025*†
Without supervision	2 (0.9)	5,5 (2-9)	
Never been cleaned	9 (4.1)	10 (0-20)	
Toothbrushing after eating/drinking milk	21 (9.6)	2 (0-10)	0.006*‡
Yes	197 (90.4)	4 (0-20)	
No			
Toothbrushing before going to bed	83 (38.1)	3 (0-14)	0.05
Yes	135 (61.9)	4,5 (0-20)	
No			

Table 4. The association between oral hygiene behavior and dental caries in primary dentition.
* Significant $p < 0.05$
† Kruskal-Wallis; ‡ Mann-Whitney

Table 5 shows that there was no significant difference in the association between breastfeeding patterns and dental caries. According to their mothers' statements, six of the children were not breastfed from birth.

	Dental Caries		*p*-value
	N (%)	Median (Min-Max)	
Exclusive Breastfeeding Duration			
≥ 6 months	127 (58.3)	4 (0-20)	0.617
No exclusive breastfeeding	91 (41.7)	4 (0-20)	
Frequency of Breastfeeding			
0-2 times/ day	7 (3.2)	2 (0-20)	0.669
3-6 times/ day	46 (21.1)	4 (0-20)	
≥ 7 times/ day	22 (10.1)	4,5 (0-15)	
Ad libitum	143 (65.6)	4 (0-20)	
Period of Breastfeeding (months)			
< 12	67 (30.7)	5 (0-20)	0.471
12-23	38 (17.4)	3,5 (0-15)	
≥ 24	113 (51.8)	4 (0-20)	
Method of Breastfeeding			
No breastfeeding	181 (85.8)	4 (0-20)	0.902
Only breastfeeding	1 (0.5)	-	
Breastfeeding + others	30 (13.8)	4 (0-14)	
Duration of Breastfeeding			
Several minutes	72 (34.0)	5 (0-20)	0.232
Until the child is asleep	140 (66.0)	4 (0-20)	
Frequency of Breastfeeding Until Child Fell Asleep			
Never	22 (10.1)	5,5 (0-20)	0.578
Several times a day	73 (33.5)	4 (0-14)	
Every night / before going to sleep	123 (56.4)	4 (0-20)	

Table 5. The association between feeding patterns and dental caries in primary dentition.
Statistical method: Kruskal-Wallis and Mann-Whitney.

The results of breast milk complementary food and substitute feeding pattern analysis for dental caries are shown in table 6. Only frequency of cariogenic snack feeding was associated with dental caries. Table 7 presents statistically significant differences between the type of breast milk complementary food with dental caries in primary dentition by 36-42months.

	Dental caries			*p*-value
	Total	ECC N (%)		
	N = 72	No	Yes	
Type of breast milk complementary food				
Breast milk and formula	29 (40.3)	6 (8.3)	23 (31.9)	0.026*
Breast milk and sweet liquid	19 (26.4)	1 (1.4)	18 (25)	
Breast milk and solid foods	7 (9.7)	3 (4.2)	4 (5.6)	
Formula	15 (20.8)	0	15 (12.9)	
Sweet liquid and solid foods	0	0	0	
Solid foods	2 (2.8)	0	2 (2.8)	

Table 7. Type of breast milk complementary food with primary teeth caries status association by age group (36–42 months).
* Significant $p < 0.05$.

	Dental Caries		*p*-value
	N (%)	Median (Min-Max)	
Type of breast milk complementary food			
Breast milk and formula	83 (38.1)	4 (0-14)	0.128
Breast milk and sweet liquid	54 (24.8)	4 (0-20)	
Breast milk and solid food	22 (10.1)	6 (0-20)	
Formula	56 (25.7)	5 (0-20)	
Sweet liquid and solid food	1 (0.5)	-	
Solid food	2 (0.9)	5,5 (5-6)	
Initial age of breast milk complementary food feeding (months)			
≥ 6	61 (28.0)	4 (0-20)	0.747
< 6	157 (72.0)	4 (0-20)	
Breast milk substitute feeding method			
Without bottle	91 (41.7)	4 (0-20)	0.103
With bottle	127 (58.3)	4 (0-20)	
Frequency of breast milk substitute feeding			
Seldom (< 3 times/day)	59 (27.1)	4 (0-20)	0.896
Often (≥ 3 times/day)	159 (72.9)	4 (0-20)	
Feeding breast milk substitute with a bottle before going to sleep			
Never	127 (58.3)	4 (0-20)	0.176
Ever	9 (4.1)	5 (0-11)	
Up until now	82 (37.6)	3.5 (0-19)	
Consistency of breast milk complementary food			
Pureed, closed to liquid	16 (7.3)	4 (0-13)	0.960
Pureed, thicker consistency	11 (5.0)	4 (0-14)	
Soft-solid	49 (22.5)	4 (0-20)	
Solid	142 (65.1)	4 (0-20)	
Frequency of breast milk complementary food feeding			
Seldom (< 3 times/day)	85 (39.0)	4 (0-20)	0.916
Often (≥ 3 times/day)	133(61.0)	4 (0-20)	
Eating method			
Not holding in the oral cavity	151(69.3)	4 (0-20)	0.610
Holding in the oral cavity	67 (30.7)	4 (0-20)	
Frequency of Cariogenic Snack Feeding			
Never	3 (1.4)	2 (0-6)	0.011*†
Seldom (once/ week)	16 (7.3)	2 (0-14)	
Sometimes (> once/week)	40 (18.3)	4,5 (0-20)	
Everyday (< 3 times/day)	81 (37.2)	4 (0-20)	
Everyday (≥ 3 times/day)	78 (35.8)	5 (0-20)	

Table 6. The association between breast milk complementary food and substitute feeding pattern with primary dentition caries.
* Significant $p < 0.05$
† Kruskal-Wallis

Discussion

The CAST index in an epidemiological survey tool provided a similar prevalence of dental caries according to WHO criteria. The advantage of this tool is providing less cost and time spent on examining children.[22] To the best of our knowledge, the present study is one of the first reports on the prevalence of dental caries in primary teeth using the CAST index. Our study

reported a slightly high prevalence of dental caries in primary dentition, which is in line with the survey conducted in Jakarta.[17] The highest mean value for individual CAST categories was caries-free dentition, and this result is in agreement with other studies.[13,23] The score of enamel lesions reported by this study was higher than the previous result, suggested that professional prophylaxis with pit fissure sealant or fluoride varnish should be implemented for preventive strategy.[23] Moreover, our findings present the dentinal caries was the highest prevalence among samples. Similar results were also reported from the Polish and Iran children population.[13,23] The annual incidence of caries rate was 0.16 within two years of follow-up, and more than half of the children developed at least one new dental caries (enamel or dentine).[12]

We found no associations between dental caries in primary teeth and all the sociodemographic factors of both children and parents, indicating that the factors did not directly affect dental caries. The previous study has shown that low birth weight and social deprivation factors may lead to high-risk dental caries.[4] Age group of children was found to have no statistically significant association with dental caries in the primary dentition; however, another study has reported in contrast.[25] These differences are likely due to dental caries is a process that involving multifactorial and cumulative effects in the lifetime of particular dentition. Maternal education and family's economic level have no association with dental caries in primary teeth, which agrees with the previous result.[26] Whereas, another study reported a significant correlation of ECC severity and mothers with low education levels who might rarely be exposed to health information.[27]

Finding reveals a statistically significant association between children's tooth brushing and dental caries in the primary dentition. Preschool children do not understand and have the manual dexterity to maintain their oral hygiene, so they need to be supervised and directed by their parents.[28] Toothbrushing after drinking milk or eating food, and before going to bed was statistically significantly associated with dental caries in primary teeth. This is related to the need for regular tooth brushing at least two times a day after breakfast and before bed, as recommended by WHO.[1] Plaque index was also associated with ECC development and similarly was documented by other studies.[19] This may be explained by the unsupervised tooth brushing of the children or lack of awareness of the mother regarding the oral hygiene practice.

This study demonstrated the duration of exclusive breastfeeding had no association with dental caries in the primary dentition. Since the period gap between the child's current age and the history of breastfeeding was distant, a recall bias might be happening. In agreement with another study, the frequency, period, and duration also did not have associations with dental caries.[29] Whether breast milk is a protective or causative factor is still unclear. Another study reported that there was no association between prolonged breastfeeding and dental caries among young children.[30] The etiology of ECC is multifactorial, and several behavioral risk factors, such as oral hygiene practice and feeding pattern, influenced the development of dental caries. It was also found that there was no association between dental caries and the method of breastfeeding or breastfeeding until the child fell asleep. It could be explained that breastfeeding up to 12 months could act as a protective factor. However, beyond 12 months, several factors could increase the risk of dental caries, such as nocturnal feeding during sleep, a cariogenic diet, and improper oral hygienepractice.[31]

The present study demonstrated the feeding pattern using breast milk substitutes and complementary food had no association with dental caries in primary teeth in all age groups. However, when the type of complementary food and dental caries in the age group of 36–42 months old was analyzed, an association was revealed. Moreover, our findings present the frequency of cariogenic snack feeding was found statistically significant with ECC, which was in line with the other study.[32] The observed result can beconfounded by other risk factors related to the development of dental caries, such as sugar consumption, oral hygiene practice, and sociodemographic.[25,27] The questionnaire used in this study did not lead to cariogenic questions and only addressed breast milk substitutes and complementary foods for children's nutritional status. The frequency of cariogenic snack consumption is one of the ECC predictors. Those who had snacks more or equal to three times had a higher risk of dental caries. Higher daily consumption of sugary food was an essential factor in developing dental caries in twelve-

month-old children.[29,32]

The limitation of this study is the difficulty in determining the cause and effect of dental caries in primary dentition due to the one-point data collection of the risk factors and consequences. Moreover, the number of samples obtained for the data analysis did not reach the minimum sum of samples. Such a cross-sectional study requires a large number of samples, especially if there are many variables in the study. A small sample size (≤ 250 subjects) can maximize the statistical power value and increase type I error or false-positive rate.[33] A recall bias might be introduced by the questionnaire used for interviewing the mothers, not only because of the beyond recall period but also because of the variations in responses, which made a valid conclusion challenging to obtain. The social desirability effect might also occur due to sensitive questions, such as age, education level, and family income.[34] Here, only demographic data, breastfeeding and complementary feeding patterns, and the maintenance of oral hygiene behavior were studied. Other factors, such as salivary flow rate, salivary buffer capacity, and daily use of fluoride, can also affect dental caries in primary teeth.

Conclusions

The carious lesion patterns of the 24- to 42-month-old children mainly were distinct cavitation on dentin lesions, followed by enamel lesions. In addition, the dental plaque index, tooth brushing supervision, tooth brushing habits after drinking milk or having a meal and before going to bed, and the cariogenic snack consumption frequency were found to be associated with dental caries in the primary dentition. These findings suggest that dental caries prevention could be accomplished by limiting the frequency of cariogenic snacks and emphasizing oral hygiene awareness among parents to address oral health in early childhood.

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Declaration of Interest

The authors report no conflict of interest.

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