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Toothbrushing And Dietary Behavior of Children Aged 3–6 Years with Early Childhood Caries in Impoverished Community of Semampir District, Surabaya

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Abstract

Objective: This research aimed to observe tooth brushing and dietary behavior of children aged 3–6 years with early childhood caries (ECC) in impoverished communities, Semampir District, Surabaya City. **Materials and Methods:** This was descriptive observational with cross-sectional design study in 50 samples of mother whom their children diagnosed with ECC. Research instrument using questionnaires based on caries risk assessment (CRA) which modified. **Results:** Most samples showed good tooth brushing behavior, which includes brushing frequency and duration, routines using toothpaste, had tooth brushing initiative and independently brushing teeth. The majority of samples had poor dietary behavior which includes snacking habit frequency, time management, fruit and milk consumption. **Conclusion:** Most children aged 3–6 years in impoverished communities, Semampir District of Surabaya already had good brushing teeth behavior, but they had poor diet which explain high prevalence of caries.

Keywords: toothbrushing, diet, caries, impoverished community

Introduction

Caries is a biofilm (plaque)-induced acid demineralization of enamel or dentin, mediated by saliva. The disease of early childhood caries (ECC) is the presence of 1 or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger¹. In Indonesia, 90% of children aged 3–5 years have caries with a def-t value of more than six². The American Academy of Pediatric Dentistry recommends that caries risk assessment (CRA) shall be carried out as part of a child's first dental examination to facilitate an individual prevention plan. CRA currently generally assesses risk factors for early childhood caries in biological, protective, and clinical settings. Risk factors for early childhood caries include vulnerable hosts, excessive carbohydrate diets, the presence of dental plaque, a large number of cariogenic microorganisms such as *Streptococcus mutans* and *Lactobacillus*, and the most important factor is time. Habitual diet, fluoride

exposure, sociodemographic status, maternal behavior, oral hygiene habits, and drug intake are also triggering factors for this condition^{3,4}.

In children, oral hygiene and dietary behavior is predominantly by parents which factors influenced include socio-demographic factors⁵. Children who come from families with low socioeconomic status have a higher risk of caries. Socioeconomic status factors include income, employment, and education. Socioeconomic status is inversely proportional to general health status. The lower socioeconomic status denotes a higher rate of occurrence of illness⁶. Socioeconomic status affects caries through behavior, especially habits of maintaining oral hygiene, diet, as well as smoking⁷. Low-income family tends not to pay attention to dental and oral health. Bad dietary choices due to limited food selection and not regularly having dentist checks increase caries prevalence⁸.

In 2017, the city of Surabaya had a poverty line figure of Rp474,365 per capita per month, with a number of impoverished people as much 154,710⁹. According to the East Java Central Statistics Agency in 2012, there were 3 impoverished subdistricts in Surabaya, including Semampir District¹⁰. This research aimed to observe brushing teeth and dietary behavior of children aged 3–6 years old with early childhood caries (ECC) in impoverished communities, Semampir District, Surabaya. From preliminary study obtained caries prevalence for children aged 3–6 years in Semampir poor communities was 8.4, which was classified as very high¹¹.

39

Material and Methods

Study design and sample

This descriptive observational research with cross-sectional design, involving unemployed mothers who independently raise their 3–6 years old children diagnosed with early childhood caries (ECC). The sampling technique to be used was simple random sampling technique.

Data Collection

The study was conducted in July - August 2018 at Balai RW 3 Sidotopo, Semampir district, Surabaya. This study used questionnaires as research instrument based on modified caries risk assessment (CRA) of The American Academy of Pediatric Dentistry [12]. A reliability test was performed to questionnaires resulted in relatively the same output upon several tests. The reliability was measured statistically using Cronbach's Alpha in 0.778 reliability coefficient. The result score was above 0.60; therefore, it means that the instrument was reliable [13]. Validity test was then performed to examine the accuracy of the actual data and collected data per item. The score of the item was then correlated with the total items. The results of the validity test of this study indicate overall validity.

1

Data Analysis

Microsoft Excel (version 2013) and Statistical Package for the Social Sciences (SPSS) statistical software (version 23) were used for data entry, and the data were performed with cross-tabulation and then were analyzed using Chi-Square to determine the relation of

42

toothbrushing and dietary behavior with early childhood caries.

Ethical Aspects

4

This study was approved by the Ethics Committee of Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia. Before starting the study, all mothers were informed about the aim, nature, potential distresses and benefits of the study. Then, informed consent were obtained from all of them. Samples who were unable to give consent form were excluded from the study.

Results

Total samples were 50 mothers from impoverished community whom met the inclusion criteria were interviewed of their children toothbrushing and dietary behavior using questionnaire of AAPD caries risk assessment which being modified. Toothbrushing behavior includes brushing frequency and duration, toothpaste usage, tooth brushing initiative and independency in brushing teeth. Table 1 illustrates cross-tabulation of samples' brushing teeth frequency in a day and toothbrushing duration with caries score. From the result for brushing teeth behavior, both samples categories who brushed their teeth once a day and twice or more per day showed lower percentage (20%) of caries score def-t 14-20. Samples who brushed their teeth once a day with caries score def-t of 7-13, and 0-6, both showed same percentage of 40%. While for samples who brushed their teeth twice or more a day, showed 35% and 40% of def-t score 7-13, and 0-6, respectively. The chi-Square test showed no significant relationship between the frequency of tooth brushing and the level of caries in samples ($P = 0.933$).

About toothbrushing duration results also shown in table1. Samples who brushed their teeth with duration less than 1 minute, 40% of them had a caries score def-t of 14-20, 20% had caries score def-t 7-13, and 40% had caries score def-t 0-6. Samples who brushed their teeth for 1 minute, as much as 20% had caries score def-t 14-20, 40% had caries score 7-13, and 40% had caries score def-t 0-6. While samples who brushed their teeth for 2 minutes or more, as much as 23.3% had caries score def-t 14-20, 36.7% had caries score 7-13, and 40% had caries score def-t 0-6. Chi-Square test showed no significant

relationship between the duration of toothbrushing and the level of caries (P = 0.9).

Table 1. Cross-tabulation between toothbrushing frequency and duration with caries score.

Caries score	Toothbrushing Frequency			Toothbrushing Duration			
	Fair (1x/day)	Good (≥2x/day)	Significance	Poor (<1 min)	Fair (1 min)	Good (>2 min)	Significance
def-t: 14-20	20%	25%	Correlation Coefficient = 0.418 P-Value = 0.933	40%	20%	23.3%	Correlation Coefficient = 0.555 P-Value = 0.900
def-t: 7-13	40%	35%		20%	40%	36.7%	
def-t: 0-6	40%	40%		40%	40%	40%	

Table 2 illustrates cross-tabulation of toothpaste use for brushing teeth with caries score. Samples who brushed their teeth without toothpaste were 100% have a caries score def-t 14-20. Samples who did not routinely use toothpaste, 40% showed caries score def-t of 14-20, 40% had caries score def-t 7-13, and 20% with caries score def-t 0-6. Whereas samples who routinely brushed using toothpaste were 20.5% had caries score def-t 14-20, 36.4% with caries score def-t 7-13, and 43.2% showed caries score def-t 0-6. Chi-Square test results showed no significant relationship between routine use of toothpaste and caries rate in children (P = 0.335).

Table 2. Cross-tabulation between toothpaste use and caries score.

Caries score	Toothpaste use			Significance
	Poor (no toothpaste)	Fair (not routine)	Good (routine)	
def-t: 14-20	100%	40%	20.5%	Correlation Coefficient = 0.688 P-Value = 0.335
def-t: 7-13	0%	40%	36.4%	
def-t: 0-6	0%	20%	43.2%	

Samples' initiative and independency in brushing teeth is presented in Table 3. Samples who lack initiative (poor) and being reminded to brush their teeth by parents were 36.4% with caries score def-t 14-20, 45.5% with def-t 7-13, and 18.2% with def-t 0-6. Samples who sometimes had own initiative but sometimes also being reminded by parents were 12.5% had caries score def-t 14-20, 25% with def-t 7-13, and 62.5% had caries

score def-t 0-6. Whereas samples who always had own initiative to brush their teeth were 22.6% showed caries score 14-20, 35.5% with a caries score def-t 7-13, and 41.9% had caries score def-t 0-6. Chi-Square test results showed no significant relationship between samples' initiative in brushing their teeth against caries (P = 0.398).

Table 3 also shows samples' independence in brushing teeth cross-tabulation with caries score. The table shows that 22.2%, 44.4%, and 33.3% samples with poor independence had caries score def-t 14-20, 7-13, and 0-6, respectively. From the table also shows that 21.4%, 35.7%, and 42.9% of samples with fair independence which sometimes assisted by their parents, had caries

score def-t 14-20, 7-13, and 0-6, respectively. And for samples who brushed their teeth independently 25.9%, 33.3%, and 40.7% had a caries score def-t 14-20, 7-13, and 0-6, respectively. The Chi-Square test showed no significant relationship between samples' independence in brushing their teeth against caries ($P = 0.978$).

Table 3. Cross-tabulation between toothbrushing initiative and independence with caries score.

Caries score	Toothbrushing Initiative				Toothbrushing Independence			
	Poor (lack initiative)	Fair	Good (self initiative)	Significance	Poor (being brushed)	Fair	Good (by him/herself)	Significance
def-t: 14-20	36.4%	12.5%	22.6%	Correlation Coefficient = 0.518 P-Value = 0.398	22.2%	21.4%	25.9%	Correlation Coefficient = 0.490 P-Value = 0.978
def-t: 7-13	45.5%	25%	35.5%		44.4%	35.7%	33.3%	
def-t: 0-6	18.2%	62.5%	41.9%		33.3%	42.9%	40.7%	

The results of caries risk assessment for dietary behavior includes snacking habit frequency, snacking time management, and fruit and milk consumption. Table 4 illustrates that 13%, 34.8%, and 52.2% of samples who had snacks more than 3 times a day had caries score 14-20, 7-13, and 0-6, respectively. For samples who had snacks 3 times a day were 33.3% and 66.7% had caries score def-t 7-13 and 0-6, respectively. And for samples who had snacks less than 3 times a day, had caries score def-t 14-20, 7-13, and 0-6, as much as 33.3% each. Chi-Square test showed no significant relationship between the frequency of snacking with the level of caries in samples ($P = 0.212$).

Table 4 also shows that 10.3%, 34.5%, and 55.2% of samples had poor snacking time management with caries score def-t 14-20, 7-13, and 0-6, respectively. For samples with fair snacking time management showed 20%, 20%, and 60% had caries score def-t 14-20, 7-13, and 0-6, respectively. And samples with good snacking time management were 31.25%, 37.5%, and 31.25% had caries score def-t 14-20, 7-13, and 0-6, respectively. The Chi-Square test showed no significant relationship between the timing of snacking and the level of caries in children ($P = 0.372$).

Table 4. Cross-tabulation between snacking frequency and time management with caries score.

Caries score	Snacking Frequency				Snacking Time Management			
	Poor (>3x/day)	Fair (3x/day)	Good (<3x/day)	Significance	Poor (No time setting)	Fair (Rarely with a time setting)	Good (With time setting)	Significance
def-t: 14-20	13%	0%	33.3%	Correlation Coefficient = 0,662 P-Value = 0,212	10.3%	20%	31.25%	Correlation Coefficient = 0,776 P-Value = 0,372
def-t: 7-13	34.8%	33.3%	33.3%		34.5%	20%	37.5%	
def-t: 0-6	52.2%	66.7%	33.3%		55.2%	60%	31.25%	

Table 5 presents cross-tabulation between fruit and milk consumption with caries score. It shows that 26.6%, 26.6%, and 46.7% of samples with poor fruit consumption had caries score def-t 14-20, 7-13, and 0-6, respectively. For samples with fair fruit consumption 18.75%, 25%, and 56.25% had caries score def-t 14-20, 7-13, and 0-6, respectively. And for samples with good fruit consumption, 10.5%, 47.4%, and 42.1% had a caries score def-t 14-20, 7-13, and 0-6, respectively. Chi-Square test showed no significant relationship between snack types and caries rates in children (P = 0.524).

Result for cross-tabulation between samples' milk consumption with caries score, shows that 16.7%, 35.7%, and 47.6% of samples with poor milk consumption had caries score def-t 14-20, 7-13, and 0-6, respectively. It also shows 100% of samples with fair milk consumption had caries score 0-6, respectively. And for samples with good milk consumption, 28.5%, 28.5%, and 21% had caries index of 14-20, 7-13, and 0-6, respectively. The Chi-Square test showed no significant relationship between the type of milk consumed and the level of caries in samples (P = 0.791).

Table 5. Cross-tabulation between fruit and milk consumption, with caries score.

Caries score	Fruit Consumption				Milk Consumption			
	Poor (Not accustomed)	Fair (Rarely)	Good (Accustomed)	Significance	Poor (Formula Milk)	Fair (Pure Milk)	Good (Breasts Milk)	Significance
def-t: 14-20	26.6%	18.75%	10.5%	Correlation Coefficient = 0,399 P-Value = 0,524	16.7%	0%	28.5%	Correlation Coefficient = 0,330 P-Value = 0,791
def-t: 7-13	26.6%	25%	47.4%		35.7%	0%	28.5%	
def-t: 0-6	46.7%	56.25%	42.1%		47.6%	100%	21%	

Discussion

14 Early childhood caries (ECC) term was recommended in a workshop by the Center for Disease Control and Prevention, focusing on many contributing factors not just tooth brushing habits as the main cause. Prevalence and severity of caries can't be determined just by one factor, all factors must be holistically considered to promote exact caries prevention strategy and treatments¹⁴. Socioeconomic status is inversely proportional to general and oral health and also associated with dental disease has been demonstrated from previous studies, with education and income as the most common and relevant indicators used in epidemiology for socioeconomic status measurement. Poorer self-rated oral health and higher untreated caries reported in lower income and education groups. Children born to low socioeconomic families have twice the risk of caries than children born to high-income families^{15,16}. From preliminary study showed that children aged 3–6 years in impoverished communities of Semampir District had very high prevalence of early childhood caries (ECC) which was 8.4¹¹. Caries Risk Assessment (CRA) from American Academy of Pediatric Dentistry had been modified to focus on determining children toothbrushing and dietary behavior which results can be use as data for local government to make more specific strategy for impoverished community able to achieve Indonesia caries free in 2030 as goal set by Ministry of Health Republic Indonesia.

Statistic results for tooth brushing frequency to caries rate on poor community in this study showed no significant relation ($P = 0.933$). This result was in accordance with Kumarihamy *et al.*, that stated there were no statistically significance difference in def-t average (including non cavity lesion) between children who only brush once or less in a day and twice a day ($P = 0.18$)¹⁷. It is widely believed that effective removal of biofilm by tooth brushing could decrease development on new carious lesion, but the evidence was so weak especially if it related to tooth brushing frequency¹⁸. According to the general consensus among the professionals, everyone has to brush their teeth with effective technique at least twice a day and spend at least two minutes. A study conducted by Gallagher *et al.* showed that brushing teeth for two minutes could remove plaque 26% more than brushing for 45 seconds¹⁹. Stronger remineralisation response

requires longer tooth brushing duration as it alleviates fluoride concentration in saliva, which lubricates enamel for at least two hours after brushing²⁰. In the contrary, Klukowska *et al.* showed that brushing for more than a minute did not improve plaque removal²¹. These result is consistent with this study that there was no significant relation between children tooth brushing duration and caries level ($P = 0.9$). Tooth brushing is connected with many factors other than brushing duration such as the property and design of the brush, brushing method, and the type of toothpaste used²².

Folayan *et al.* suggested to brush our teeth twice a day and use the toothpaste regularly²². Tooth brushing without fluoridated toothpaste has failed to decrease caries prevalence²³. But, Kumarihamy *et al.* said that brushing teeth with fluoridated toothpaste versus unfluoridated toothpaste had no significance difference ($P = 0.22$)¹⁷. This finding was corresponding with this study that there was no significant relation between daily use toothpaste with def-t score ($P = 0.335$). The use of different kinds of toothpaste failed to demonstrate the significant effect, whereas tooth brushing frequency is related to the prevalence of carious lesions¹⁸. From Zero *et al.* showed that brushing teeth with fluoride toothpaste but in short duration will limit fluoride contacts and dose in the oral cavity²⁰.

Based on this study, 62% of children brush their teeth on their own will and 54% brush their teeth by them self with parental guidance³. Some researchers reported that children should be able to brush their teeth since the age of two, and it was the parents' responsibility to teach how to clean their teeth and hold the brush correctly since early age; and parents help should be continued until around age 7 or 8^{24,25}. The lowest def-t was found in children who brush their teeth with parental guidance, but still brush independently and by their own initiative. But this study showed no significant relation between independency of tooth brushing and caries score ($P = 0.978$) and also between tooth brushing on their own will and caries score ($P = 0.398$). Child behavior management skills of parents and the duration of parent-led toothbrushing were associated with better children's oral health. Collete *et al.* suggest that parenting skills are an important target for future behavioral oral health interventions²⁶. AAPD suggest parents to make toothbrushing as a fun time together, for

example by playing favorite song while brushing or tell jokes before and after brush²⁵.

Postnatal diet influences the caries status. Children with poor dietary habits had greater risk of caries compared to children with good dietary habits²⁷. The sequence and frequency of consumption are closely related to the incidence of tooth decay. The prevalence of caries was higher in children who consumed snacks more than 4 times a day compared to children who consumed snacks less than 4 times a day²⁸. The frequency of consuming cariogenic foods, especially between meals, has a strong relationship with the risk of tooth decay because it inhibits the normalize of oral pH and inhibits the “self-cleansing”, which both increasing potential of enamel demineralization. This rinsing period depends on food consistency and solubility; and individual characteristics such as chewing, and salivary flow and quality²⁹. But from this study Chi-Square test results found that there was no significant relationship between level of caries and snacking frequency ($P = 0.212$), and the timing ($P = 0.372$). This study results is in accordance with the research of Zahara *et al.* where there was no relationship between feeding frequency ($P = 0.800$) and the incidence of dental caries³⁰. Cariogenic potential of a food is influenced by several factors like fermentable carbohydrate content, cariostatic properties or a food’s ability to remain in the mouth, dietary habit, also sequence and eating frequency²⁹.

Children with low socioeconomic status experienced more childhood caries³¹. Low socio-economic value relates to mothers’ education. Mothers with low education, equal to or lower than high school, usually do not aware of their children’s diet. Children who come from low-income families tend to have poor-quality diets, less nutritious but high sugar diet which promote caries development³². Based on the available evidence, it is very likely that there is no relationship between the consumption of fresh fruit and dental caries. The WHO on “Diet, Nutrition and Prevention of Chronic Diseases” report also concluded that despite the acidic nature of some fresh fruits, still not enough evidence to link the consumption of whole fruit with a higher risk of tooth erosion. Fruit does not pose a significant risk to dental health, and replacing high sugar foods with fresh fruit will reduce the chance of tooth decay. By contrast, a serving of fruit juice contains more energy,

free sugars and fruit acids than whole fruits and so its consumption may contribute to both undesirable weight gain and dental caries. All dental health professionals should have skills to provide healthier eating advice for their patients, including how to limit free sugars intake. Ideally, all patients, or their parents or caregivers, should receive dietary advice at the time of dental examination based on current food-based dietary guidelines^{32, 33}.

Based on the results of data analysis obtained from this study it can be concluded that there is no significant relationship between milk type and caries level in children ($P = 0.791$). This contrasts with research conducted by Firdaus and Iswati which stated children who consumed formula milk had a greater tendency to develop caries compared to children who consumed breast milk and there was a significant relationship between formula feeding and the level of caries in children^{34, 35}. Formula milk has high carbohydrates and sugar compared to breast milk and whole milk, therefore promoting caries, especially milk consumption in the bottle before bed. In contrast to formula milk, both breast milk and cow’s milk have anti-cariogenic properties and high concentration of calcium and phosphate. In addition, cow’s milk has phosphoprotein, which can be absorbed by enamel to prevent enamel demineralization. Pure milk also contains 3.5% fat, which form a protective membrane on the teeth to facilitate the process of self cleaning and reducing bacterial activity³⁶. On the other hand, Feldens *et al.* showed significant relationship between milk diet and caries risk by his research which conducted in 345 children aged approximately 12 months or 1 year who were still breastfeeding³⁷. One of the caries factors that can underlie this different opinion maybe is time which is the length of time the teeth are exposed to sugar. The acid produced by bacteria can last for 20 to 40 minutes in the oral cavity. If teeth are exposed to an acidic environment for too long, tooth enamel will demineralize due to its susceptibility to acid. Duration of formula milk consumption as a risk factor for dental caries found in kindergarten students ($P = 0.013$). Children who consumed formula milk in more than 15 minutes duration had greater possibility exposed to dental caries³⁵.

Children under 2 years get the majority of nutrients from breast milk, while children over 3 years have received nutrition indifference to most adults. However,

the mother and the environment greatly influence children's diet. Mothers with a high sugar diet are likely to introduce the same diet to their children, promoting high sugar consumption in children³⁸. Children with a high-sugar diet tend to continue the habit in their childhood and adolescence. Maternal habits play an important role in dietary choices and caries status of children^{39,40}.

Conclusion

Children have very complex conditions and caries is a multifactorial disease. Socioeconomic and environmental factors may have effect in behavior shaping. It is mothers as close related person for their children who have significant role in inculcate healthy behavior. Young children tend to imitate their parents habit so it is important to educate mother. Both good brushing and dietary habit needed to reduce ECC rate. High prevalence of children caries in impoverished community need more government attention in setting prevention strategy.

²⁰
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