The Relationship between Oral Health Habits in Children and Early Childhood Caries in Jakarta, Indonesia

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Abstract

Objective: Early childhood caries (ECC) is a health challenge in Indonesia. It causes problems with mastication and digestion, and causes growth and speech disorders, as well as low self-esteem. The prevalence and severity of ECC is increasing. Thus, the study objectives were to analyze the relationship between dental caries activity in mothers and that in their children; the relationship between the oral health habits of children and ECC; the relationship between cariogenic carbohydrate snacking consumption and ECC; and the relationship between dental plaque pH and ECC. Methods: A cross-sectional study was conducted on 424 children aged 6–24 months, using two-stage cluster random sampling. A self-administered questionnaire was completed by the mothers to determine the oral habits of their children. An intraoral examination was performed on the children to obtain deft index data and to determine the pH of the dental plaque, using the GC™ Plaque Indicator Kit (GC India Dental, Telangana, India). The dental caries-related activity of mothers and their children was measured using the Cariostat® test. Results: A significant relationship was found between the dental caries activity of mothers and their children ($p \leq 0.000$); between ECC and teeth-cleaning behavior ($p \leq 0.050$); as well as between cariogenic carbohydrate snacking consumption ($p \leq 0.050$) and the pH of dental plaque ($p \leq 0.050$). Conclusions: A lower rate of EEC was observed in children whose teeth were cleaned daily than in those who brushed more irregularly (odds ratio [OR]=2.00). Higher ECC was also noted in children who consumed snacks ≥3 times daily (OR=3.43). Children with a dental plaque pH of 5.00–5.54 experienced the most ECC (OR=24.42). Untreated dental caries in the mothers resulted in an increase in cariogenic bacteria which was later transferred to their children.Decreasing dental caries activity in mothers and controlling the oral health habits of children are important factors in the prevention of ECC in children aged 6–24 months.

Clinical article (J Int Dent Med Res 2017; 10(Special Issue): pp. 540-545)

Keywords: ECC, oral health habits, children, plaque, caries activity

Received date: 14 August 2017 **Accept date:** 16 September 2017

Introduction

Early childhood caries (ECC) is a condition that affects children aged ≤71 months and is characterized by the presence of one or more decayed (non cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in a primary tooth.[1] The management of ECC, as a significant health issue, needs to be prioritized because it causes mastication, digestion, and growth and speech disorders. It can also lead to low self-esteem.[2] ECC occurs early in life, affecting groups at high risk of dental caries and those who are do not receive treatment for it.[3] ECC negatively affects the overall quality of life of children over the short or long term, and is associated with negative social and economic familial consequences.[4]

It is a serious community health challenge in developing and industrial countries and has been identified as a significant health issue, where it is increasing in both prevalence and severity.[5] In 1988, the prevalence of ECC in pre-school children in Jakarta and surrounding areas

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was 85%, with a reported severity level of 6.03 affected teeth per child. In 1992, the rate of ECC in children aged 1–4 years in Depok, West Java, ranged from 10–94%.[7] In 2007, based on research conducted in five areas in Jakarta, 52% of children aged ≤3years were affected by ECC.

An average score of 2.85 was reported for these children. Elsewhere in North Jakarta, in 2010, 63% of children aged 6–24 months were affected by ECC, with a reported severity level of 3.3 affected teeth perchild.[6-9] Thus, effectively managing the oral health habits of children, including teeth-cleaning behavior, and ensuring a reduction in cariogenic carbohydrate snacking is essential lif an increase in ECC occurrence is to be prevented. Children aged ≤ 3 years old are particularly vulnerable to ECC.[1,2,6–9]

Dental caries, a chronic infectious disease, is common in childhood, and is caused by bacterial interaction, and is caused by *S.mutans,* in particular, which is a cariogenic microorganism and attaches to tooth enamel. *S.mutans* can spread and be transferred from mother to infant, even in pre-dental children. It breaks down sugar for energy, causing an acidic environment in the oral cavity that results in demineralization of the tooth enamel, ultimately leading to dental caries.[10]

The latter is a transmissible infectious disease caused by the interaction between the host (tooth), agent (*S.mutans*), and the environment (cariogenic carbohydrate substrate). Infection by *S.mutans* mostly occurs due to its vertical transmission from the mother to the child. The children of mothers with heavy infection by *S.mutans* are at high risk of being infected at a very early age.[11,12] Thus, the study objectives were to analyze the relationship between dental caries activity in mothers and that in their children; the oral health habits of children, i.e., teeth cleaning behavior, and ECC; cariogenic carbohydrate snacking consumption and ECC; dental plaque pH and ECC.

Methods

The study research design was cross-sectional. The study population was children aged 6–24 months and their mothers, selected from subdistricts in Jakarta. Two-stage cluster random sampling was employed. The final sample size was 424 (comprising of 424 mothers, and 424 children). Various data collection methods were used. Interviews were conducted with the mothers using a validated questionnaire to obtain information on their socio-demographic characteristics, oral health care behaviour, and cariogenic snacking consumption.

A clinical examination was also performed. The dental caries of patients was visually examined using a standard lamp and instruments, and evaluated according to the deft index. Dental plaque pH was measured using the GC™ Plaque Indicator Kit (GC India Dental, Telangana, India). Dental caries activity was measured in 61 mothers and children using Cariostat®, a caries prediction test, based on *S.mutans* acid-producing activity. Dental caries was more likely to occur with a frequently occurring decrease in plaque pH, as determined by Cariostat®. Caries activity was categorized as: Inactive, a score of 0: Blue=pH of 6.1±0.3. Lightly active, a score of 1: Green=pH of 5.4±0.3. Moderately active, a score of 2: Green-yellow=pH of 4.7±0.3. Severely active, a score of 3: Yellow = pH of 4.0 ± 0.3.

The sensitivity, specificity, and positive predictive value in relation to the prediction of dental caries, based on S.*mutans* acid-producing activity, were 90%, 66% and 99%, respectively, using Cariostat®. The colour media changed as the pH increased. A low pH, determined using Carostat®, was associated a greater likelihood of dental caries.

Results

Most of the children (*n*=30, 49%) experienced moderate caries activity, 18 (30%) had mild caries activity, and 12 (20%) had severe caries activity. Of the 12 cases of severe caries activity, 8 (67%) had ECC; of those with moderate caries activity, 17 children (57%) had ECC;and of those with mild caries activity, ECC was identified in 4 (22%).

Most mothers (n=29, 48%) experienced moderate caries activity, 23 (38%) had mild caries activity, and 8 (13%) had severe caries activity. A significant relationship was established between dental caries activity in mothers and that in their children (r=0.509, p≤0.000). Thus, the status of caries activity in the children was influenced by that in the mothers.

Only 122 (29%) of the research subject always cleaned their children's teeth, and of the children in this category, only 32 (26%) had ECC (Table 1). Three hundred and two children (71%)

never cleaned their teeth, and 124 children (41%) of these had ECC. A significant relationship was found between children who cleaned their teeth regularly and ECC ($p \leq 0.000$). Those who never cleaned their teeth were at two times greater risk of having ECC than those who did so daily.

Three hundred and seventy-four children (88%) consumed cariogenic-containing snacks, and 91 (22%) did so ≥3 times a day (Table 2). The highest rate of reported ECC was 46%. A significant relationship was found between the consumption of snacks and ECC. The risk of acquiring ECC was 3.43 times higher for children who consumed cariogenic snack ≥3 times daily, compared to that in those who never consumed such snacks of the 181 children with a dental plaque pH of ≥6.5, only 22% had ECC. Similarly, of the 128 children with a dental plaque pH of ≤5.9, 59% (76 children) had ECC (Table 3). A significant relationship was found between the dental plaque pH of the children and ECC. A low pH was associated with a greater likelihood of dental caries.

Discussion

A significant relationship was determined between dental caries activity in mothers and that in their children in the current study. Dental caries in an infectious disease capable of transmission. The mother is the main source of *S.mutans* in a child.[13-14] *S.mutans* is an important microorganism that plays a role during the initiation of dental caries and in its pathogenesis.

Table1:The relationship of teeth-cleaning behavior and early childhood caries

Teeth-cleaning behavior	ECC +		ECC -		Total		*p*-value	OR	95% CI
	n	%	*n*	%	*n*	%			
Always (everyday)	32	26.2	90	73.8	122	28.8	0.005		
Never	124	41.1	178	58.9	302	71.2		2.00	1.23–3.12
Total	156	36.8	268	63.2	424	100			

CI: confidence interval, ECC: early childhood caries, OR: odds ratio

Table 2: The relationship between the consumption of snacks and early dental caries.

Snacking consumption	ECC +		ECC -		Total		*p*-value	OR	95% CI
	n	%	*n*	%	*n*	%			
None	10	20.0	40	80.0	50	11.8	0.014		
Seldom or 1 time/ week	14	29.8	33	70.2	47	11.1		1.70	0.67–4.32
Sometimes or >1 time/week	40	33.9	78	66.1	118	27.8		2.05	0.93–4.52
Everyday or <3 times/day	50	42.4	68	57.6	118	27.8		2.94	1.34–6.44
Everyday or ≥3 times/day	42	46.2	49	53.8	91	21.6		3.43	1.53–7.68
Total	156	36.8	268	63.2	424	100			

CI: confidence interval, ECC: early childhood caries, OR: odds ratio.

Table 3: The relationship between dental plaque pH and early dental caries in the children.

Dental plaque pH	ECC +		ECC -		Total		*p*-value	OR	95% CI
	n	%	*n*	%	*n*	%			
≥ 7.0	1	5.9	16	94.1	17	4.0	0.000		
6.5–6.9	27	16.4	138	83.6	165	38.9		3.13	0.40–24.61
6.0–6.4	52	45.6	62	54.4	114	26.8		13.42	1.72–104.62
5.5–5.9	47	58.8	33	41.3	80	19.0		22.79	2.88–180.36
5.0–5.4	29	60.4	19	39.6	48	11.3		24.42	2.99–199.72
Total	156	36.8	268	63.2	422	100			

CI: confidence interval, ECC: early childhood caries, OR: odds ratio.

It has been demonstrated that bacteria can even colonize on the teeth of infants that have not yet erupted. Bacteria is transferred through vertical and horizontal transmission.[15] Vertical transmission, i.e., from mother to child, refers to the spread of infection or disease from a person who is caring for an infant to him or her. The earliest evidence in support of this concept derives from bacterioc in typing studies in which *S.mutans* was isolated from the mother and the child, and an identical bacterioc in inhibition pattern was demonstrated in both.[16]The vertical transmission of *S.mutans* from the caregiver to children has been reported elsewhere.[17] Children acquire *S.mutans* during the "window period",i.e., aged two years, when they are most susceptible.[17]

The ability of *S.mutans* to successfully colonize and be transmitted from mother to child is determined by several factors, including the amount of inoculum administered to the infant, the frequency of inoculations, too small a dose being administered, and the lack of efficacy of the dose given. Mothers with high salivary viscosity are at high risk of infecting their children at a very early age.[18] Thus, poor oral hygiene in the mothers and a high frequency of snacking and exposure to sugar on a daily basis increases the likelihood of infection being transmitted from mother to child.[19] The time span between colonization with *S.mutans* and the development of dental caries lesions is approximately 13–16 months. The duration may be shorter in children with a higher risk of dental caries, i.e., premature infants, those with a low birth weight, or with hypomineralized teeth. There is considerable evidence that malnutrition, and malnutrition during pregnancy and in the perinatal period causes hypoplasia. An association between enamel hypoplasia and ECC has also been reported.[20]

Therefore, a history of infectious disease should be the focus when seeking to prevent dental caries disease.[14] Poor dental health status in a mother was a reflection of her oral healthcare behavior, and that this further influenced the dental health status of the child. A high prevalence of untreated dental caries in a mother increases the amount of cariogenic bacteria that can be transferred to her child at a later stage.[21] Cariogenic is something that causes or enhances the formation of tooth cavities.[19] Thus, cariogenic food causes or increases the risk of tooth cavities developing. Other factors that influence an increase in dental caries are the frequency of consumption of a certain food, the type of consumption, and retention and consumption time.[20] Individual characteristics, such as salivary pH, genetic factors, a history of dental caries, medication taken, the presence of autoimmune disease and adherence or non-adherence to oral hygiene also impact on the role of food as a risk factor for dental caries.[21]

The characteristics of highly cariogenic food are the presence of easily fermented carbohydrates, such as sugar and flour; food that has a sticky consistency; results in a decrease in the pH to ≤5.5; and that has been highly processed; for instance, crackers, cereal, bread, cakes, dried fruit or sweets, cookies, and potato chips.[20] Nevertheless, children require carbohydrates for growth and as an energy resource. The optimum amount of carbohydrate intake, expressed as a percentage of total energy, ranges from 40–60%. Ideally, carbohydrate consumption should include polysacchardides (comprising many units of sugar and resembling a long chain), for instance, rice, wheat, potatoes, and vegetables. Sugar contentin jam, sweet drinks, cakes, sweets, and chocolate should comprise ≤10% of total energy. Foods and drinks with a high sugar content are not recommended for children because they are likely tocause dental caries.[22]

Foods with low cariogenic characteristics contain relatively high protein, moderate fat, minimum carbohydrates, and high mineral content, i.e., calcium and phosphate;have a pH ≥6, and stimulate salivary flow. Examples of these foods are cheese, peanuts, meat, milk, eggs, and vegetables.[20] Acid that is produced as a result of carbohydrate consumption is not dependent on the amount of sugar or flour that is consumed, but rather on the frequency with which these types of food are consumed.[20,21] The transmission of cariogenic bacteria occurs when there is a frequent supply of substrate for dental plaque action, usually in the form of sweetened drinks, such as fruit juice; and cariogenic solid foods, such as sweets, chocolate, cakes, and biscuits. ECC is likely to occur in such circumstances. If the substrate is supplied at night, on uncleaned teeth, dental caries will rapidly result.[23]

The relationship between cariogenic carbohydrate snacking consumption and early dental caries

A significant relationship was established between the consumption of cariogenic foods

and ECC ($p \leq 0.050$) in the current study. If the pH of the dental plaque frequently falls below a critical level, demineralization is likely to occur, thereby affecting the dental enamel. Sugary snack consumption was shown to be related to *S.mutans* colonization in toddlers in a previous study.[19] Twenty-eight per cent of the research subjects consumed cariogenic snacks <3 times daily. ECC prevalence of 43% was reported in this group and the average number of teeth affected by ECC per child was 1.7. A further 28% of the study participants consumed cariogenic snacks more than once a week, with 34% of this group being affected by ECC and the average number of teeth per child affected by ECC of 1.64. Twenty-two per cent of the research subjects consumed cariogenic snacks ≥3 times a day, with comparative figures of 46% for ECC prevalence and the average number of teeth affected by ECC being 1.90 per child. Only 11% of the children consumed cariogenic snacks once a week (ECC prevalence of 30%;the average number of teeth affected by ECC=1.13 per child), and 12% never consumed cariogenic snacks (ECC prevalence of 20% and the average number of teeth affected by ECC=0.54 per child).The risk of ECC in the group who consumed cariogenic snacks <3 times a day was 2.94 times greater than that for the group who did not consume any, and 3.43 times greater for the group who consumed cariogenic snacks ≥3 times a day compared with those who did not consume snacks. The consumption of sugar-containing snacks was associated with the early colonization of *S.mutans* in children.[19] Caries risk is greatest if sugar is frequently consumed and exists in a form that is retained in the mouth for a long period.[24]

The relationship between the oral health habits of children and early dental caries

A significant relationship was established between oral health care and ECC ($p \leq 0.050$) in the current study. The risk of acquiring ECC was twice as high for children who never cleaned their teeth compared to that for those who always did so. Dental plaque pH was also significantly associated with ECC. Thus, adecrease in dental plaque pH equated to an increased risk of ECC. Seventy-one per cent of the research subjects had never cleaned their teeth. The rate of ECC in this group was 41% and the average number of teeth affected by ECC was 1.80 per child. Twenty-nine per cent of the research subjects always cleaned their teeth (ECC prevalence of 26% and the average number of teeth affected by ECC of 0.83 per child). A significant relationship between the habit of cleaning the children's teeth and the incidence of ECC was found ($p \leq 0.050$). The risk of ECC occurence was two times greater in children who had never cleaned their teeth than that for children who always cleaned their teeth after eating or drinking.

The relationship between dental plaque pH and early dental caries

The dental plaque pH for 39% of the research subjects ranged from 6.5–6.9. Those with a dental plaque pH of 4.9–5.4 had the highest proportion of ECC (60%) with the average number of teeth being affected by ECC of 3.04 per child, whereas in the group with a plaque pH of 6.5–6.9, the proportion ofsubjects affected by ECC was 16% with the average number of teeth being affected by ECC of 0.49 per child. The group with a dental plaque pH of ≥7 was associated with a 6% rate of ECC and the average number of teeth that were affected by ECC was 0.12 per child.The risk of ECC occurence in the group of children with a plaque pH of 6.5–6.9 was 3.13 times greater than that for the group of children with a plaque pH of ≥7. The group of children with a plaque pH of 6.0–6.4 was at considerably greater risk of acquiring ECC than the group with a dental plaque pH of ≥7, i.e. 13.42 times greater. Similarly, the risk of acquiring ECC in the group of children with a plaque pH of 5.5–5.9 was 22.79 times greater than that for the group of children with a plaque pH of ≥7. The risk of ECC occurence was 24.42 times greater in the group of children with a very low plaque pH of 4.9–5.4, compared to that for the group of children with a dental plaque pH of ≥7. Thus, the lower the dental plaque pH, the greater the risk of acquiring ECC.

Conclusion

A significant relationship was established between the dental caries activity of mothers and their children in this study. The role of the mother was demonstrated to be very important in ensuring optimum oral health habits in her children. In addition, the mother was the main source of *S.mutans* in the children. *S.mutans* is an important microorganism that plays a key role

during the initiation of dental caries and in its pathogenesis. A high incidence of untreated dental caries in the mother can increase the growth of cariogenic bacteria, which can then be transferred to her children at a later stage. Thus, the prevention of ECC in children is best achieved by ensuring a decrease in the dental caries activity in the mother, as evidenced by the findings of previous research and those of the current study. The more frequently the dental plaque pH drops below a critical point, the more frequently demineralization occurs. A significant relationship was also established between cariogenic carbohydrate snacking consumption and the incidence of ECC. Thus, the oral health habits of children are an important factor in the occurrence of dental caries. An important relationship was also observed between dental plaque pH and ECC. Thus, to prevent ECC, greater attention should be paid to the oral health habits of infants at an early stage in their lives, i.e., when they are aged 6–24 months. The mothers of children in this age category should be counselled on the importance of cleaning their children's teeth and must be equipped with greater knowledge about the effect of the consumption of carcinogenic snacks on the occurrence of dental caries.

Acknowledgement

The publication of this manuscript is supported by Universitas Indonesia.

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