Dental Caries in 3-Year-Old Children is Associated More with Child-Rearing Behaviors than Mother-Related Health Behaviors

Yumiko Kawashita, DDS, PhD; Hideki Fukuda, DDS, PhD; Koji Kawasaki, DDS, PhD; Masayasu Kitamura, DDS, PhD; Hideaki Hayashida, DDS, PhD; Reiko Furugen, DDS; Emiko Fukumoto, DDS, PhD; Youichi Iijima, DDS, PhD; Toshiyuki Saito, DDS, PhD

Abstract

Objective: *We assessed whether child- or mother-related health behaviors were associated more strongly with dental caries in 3-year-old children.* ***Methods:*** *Multiple logistic regression analyses were performed on dental caries' presence as the dependent variable with independent variables from the results of examination and a self-administered questionnaire of 396 mother–child pairs.* ***Result:*** *Dental caries of 3-year-old children was more strongly associated with child-related health behavior than mother-related health behavior. Of the child-related variables, "a habit of feeding in bed" [OR (odds ratio) 10.14; 95 percent class interval (CI) 1.80-56.97], "eating between meals three times a day or more" (OR 3.33; 95 percent CI 1.56-7.10), "consuming a sports drink three times a week or more" (OR 4.47; 95 percent CI 1.60-12.49), "having both home and professional preventive dental care" (OR 3.02; 95 percent CI 1.44-6.32), and "having professional preventive dental care" (OR 3.79; 95 percent CI 1.75-8.21) were significantly associated with dental caries in children. Of the mother-related variables, "brushing teeth once a day or less" (OR 2.72; 95 percent CI 1.19-6.20) and "drinking alcohol three times a week or more" (OR 0.38; 95 percent CI 0.16-0.93) had significant effects.* ***Conclusion:*** *Dental caries of 3-year-old children was more strongly associated with child-related health behavior than mother-related health behavior. The results of this study suggest that encouraging good child-rearing behavior among mothers could result in better dental health among their children regardless of the mother's dental health status.*

Key Words: preschool children, dental caries, behavior

Introduction

Prevention of early childhood dental caries is important for healthy permanent dentition. Previous studies have indicated that a child's oral health status is influenced by family oral health status, especially the mother's. Sasahara *et al*. reported that mothers' gingival condition was associated with the severity of dental caries in their children (1). Several studies have reported a stronger association between dental caries in mothers and children than between dental caries in fathers and children (2,3). Bedos *et al*. found an association between edentulousness in mothers and dental caries in their children (4).

The association between oral health in mothers and children is probably caused by several factors. Mothers are usually responsible for regulating children's dietary habits, not only by preparing meals but also by shaping eating behavior (5). Children usually learn individual dietary patterns and feeding preferences from their mothers during early childhood (6,7). For example, children's consumption of sweets appears to be dependent on their mothers' attitudes toward eating sweets. In addition, early infection of mutans streptococci is transmitted from mothers to infants through nurturing habits such as a mother cleaning a pacifier by putting it in her mouth before giving it to her child, kissing her child's mouth, and pretasting food before giving it to her child (8).

Other mother-related risk factors for dental caries in preschool children include dental health behavior (9), socioeconomic status (1, 10-15), educational level (3,16), and smoking habit (17). Child-rearing related risk factors include prolonged breast feeding (18,19), feeding in bed (20), and daily frequency of sugar intake (21).

The studies discussed earlier revealed that mothers play an important role in preventing dental caries in their children, but few studies have examined dental caries in children while simultaneously examining and comparing mother- and child-related factors. Mother health- and child rearing-related factors, especially those related to lifestyle and dietary habit, probably confound each other. In this study, we simultaneously examined mother-related health behaviors and child-rearing

Send correspondence and reprint requests to Dr. Yumiko Kawashita, Department of Oral Health, Nagasaki University Graduate School of Biomedical Sciences, 1-7-1 Sakamoto, Nagasaki 8528588, Japan. Tel.: 81-95-819-7663; Fax: 81-95-819-7665; e-mail: yumiko-t@nagasaki-u.ac.jp. Yumiko Kawashita, Hideki Fukuda, Masayasu Kitamura, Emiko Fukumoto, Youichi Iijima, and Toshiyuki Saito are with the Department of Oral Health, Nagasaki University Graduate School of Biomedical Sciences. Koji Kawasaki is with the Community Medical Network Center, Nagasaki University Hospital of Medicine and Dentistry. Hideaki Hayashida and Reiko Furugen are with Preventive Dentistry, Nagasaki University Hospital of Medicine and Dentistry. This study was previously presented as a poster presentation at the 55th Nihon Koku Eisei Gakkai, 2006/10/8, Osaka, Japan. Manuscript received: 2/20/2008; accepted for publication: 9/11/2008.

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behaviors to identify risk factors for dental caries in 3-year-old children.

Subjects and Methods

In Japan free health checkups (including dental examinations) are administered by all municipal governments as prescribed by law at the age of 1.5 and 3 years and are available for all children in a health center in the district where they live. At the examinations, the children and their guardians also receive dental health education. The national average of attendance rate for the health checkups of 1.5- and 3-year-olds was 92 percent and 87.5 percent in 2005, respectively (data source from the Dental Health Division of Health Policy Bureau, Ministry of Health, Labor and Welfare).

This study was designed with the help of Nagasaki University and the 8020 Promotion Foundation and was carried out from December 2005 to March 2006 as part of the Study on the Dental Health of Nagasaki Preschool Children and their Mothers. Participants were mother–child pairs who attended the dental checkup for 3-year-olds at 1 of 10 community health centers in Nagasaki, Japan.

Each municipal government used a list of residents to identify all mothers of 3-year-old children, and the mothers were sent a package describing the objective of this study. It included a questionnaire and an invitation for the mothers to receive a free dental examination. Written informed consent was obtained from each mother. The study design and procedures for obtaining informed consent were approved by the ethics committee of the Nagasaki University Graduate School of Biomedical Sciences.

Dentists or dental hygienists from Nagasaki University Hospital interviewed mothers to confirm their questionnaire responses before dental examinations were conducted. The questionnaire was derived from the national health and nutrition survey, health and welfare survey, and dental disease survey, and included sociodemographic variables such as residential area (urban, a town ≥100,000 population; rural, a town <100,000 population), age, smoking status, and drinking habits. Health insurance was a variable also. The public health insurance system of Japan has a policy of universal care with the type of health insurance depending on parent's employment. Heath insurance includes dental treatment. Child's health insurance is based on a parent's coverage. Also, we included mother and child variables related to the dental health behaviors such as eating between meals, and the dental health behaviors of a mother for her child such as home care (with fluoride mouthrinses or toothpastes) and professional care (topical application of fluoride or sealant). Moreover, we asked about knowledge using a total of 20 dental terminologies such as dental plaque, fluoride toothpaste, and xylitol to evaluate the level of dental literacy.

Eight dentists from Nagasaki University Hospital examined each mother's teeth for dental caries using the World Health Organization's caries diagnostic criteria for decayed, missing, and filled teeth (DMFT) (22). Before the beginning of this study, the eight dentists attended lectures in order to familiarize themselves with diagnostic criteria of dental caries. All dentists examined the same subjects and calibrated their responses before the study began to ensure standardization. During the study, each subject was seated on a portable dental chair, and examinations were conducted using a dental explorer and a dental mirror under an artificial light. DMFT indexes of mothers were divided into tertile according to the total of the indexes as follows; 0-11, 12-16, and 17-28. The number of mothers with DMFT = 0 was only one.

Information about the dental checkup was sent through the post to parents of all 696 3-year-olds living in the jurisdiction. Of these, 541 mother–child pairs (77.7 percent) attended the dental checkup. Four hundred twenty mothers (60.3 percent) returned their questionnaire and agreed to a dental examination. Of these, 24 questionnaires were incomplete and therefore eliminated. Thus, the study sample included a total of 396 mother–child pairs (56.9 percent).

Statistical Analysis

Children were divided into two groups: those with and those without dental caries. Mantel-Haenszel chi-squared tests were conducted to compare the prevalence of 140 children with decay to 256 children without dental caries according to mother- and child-related variables; a probability value of less than 0.05 was considered significant. Also, another chi-squared test was conducted between snacking frequencies of mothers and children to investigate interaction between mother and child behaviors. We conducted three multiple logistic regression analyses for dental caries in children (caries-present/caries-free). First, we selected only mother-related variables whose Mantel-Haenszel chi-squared test had a $P < 0.20$ for independent variables. Second, we selected only child-related variables whose Mantel-Haenszel chi-squared test had a $P < 0.20$ for independent variables. Third, we selected both mother- and child-related variables whose Mantel-Haenszel chi-squared test had a $P < 0.20$ for independent variables. Odds ratios (ORs) with 95 percent confident intervals (CIs) were calculated for these comparisons. Collected data were analyzed using SPSS Version 12.0 for Windows (SPSS Japan Inc., Tokyo, Japan).

Results

Dental caries' prevalence in the subjects was 35.4 percent, and mean score for dmft was 1.6. Table 1 shows numbers and percentages of children with dental caries and without dental caries in bivariate analysis. Children were significantly less likely to have caries if their mothers had cooperative or fraternal insurance, drank more alcohol, knew more dental terminology, brushed their teeth more, ate less between meals, and exhibited less DMFT.

Table 1
Characteristics of Subjects by Dental Caries

	Dental caries in children				
	Caries-free		Caries present		
	n	(%)	*n*	(%)	*P* value*
Mother-related variables					
Residential area					0.070
Urban	175	(68)	83	(32)	
Rural	81	(59)	57	(41)	
Health insurance					0.014
Cooperative or fraternal insurance	128	(71)	52	(29)	
Others	128	(59)	88	(41)	
Age of the mother					0.772
≤30	79	(62)	48	(38)	
31-34	101	(67)	49	(33)	
≥35	76	(64)	43	(36)	
Drinking alcohol					0.036
No	152	(61)	97	(39)	
Twice a week or less	73	(69)	33	(31)	
Three times a week or more	31	(76)	10	(24)	
Smoking habit					0.137
Never	179	(67)	90	(33)	
Past smoker	49	(64)	27	(36)	
Current smoker	28	(55)	23	(45)	
Knowledge of dental terminology					0.041
0-11	72	(57)	54	(43)	
12-14	89	(67)	44	(33)	
15-20	95	(69)	42	(31)	
Frequency of toothbrushing a day					0.030
Once or less	24	(52)	22	(48)	
Twice	146	(64)	82	(36)	
Three times or more	86	(70)	36	(30)	
Frequency of eating between meals a day					0.005
Once or less	132	(73)	50	(27)	
Twice	92	(59)	65	(41)	
Three times or more	32	(56)	25	(44)	
DMFT					0.006
0-11	88	(73)	33	(27)	
12-16	94	(66)	49	(34)	
17-28	74	(56)	58	(44)	
Child-related variables					
Sex					0.010
Male	108	(58)	78	(42)	
Female	148	(70)	62	(30)	
Birth order					0.040
First	150	(69)	67	(31)	
Second or latter	106	(59)	73	(41)	
Habit of feeding in bed					0.018
No	254	(65)	134	(35)	
Yes	2	(25)	6	(75)	
Frequency of eating between meals a day					<0.001
Once or less	82	(78)	23	(22)	
Twice	129	(65)	68	(35)	
Three times or more	45	(48)	49	(52)	
Frequency of consuming sports drinks					<0.001
No	50	(75)	17	(25)	
Once a month or less	155	(68)	73	(32)	
Twice a week or less	38	(56)	30	(44)	
Three times a week or more	13	(39)	20	(61)	
Preventive dental care					<0.001
Home care (fluoride mouthrinses or toothpastes)	57	(78)	16	(22)	
No	62	(70)	26	(30)	
Both home and professional care	88	(62)	54	(38)	
Professional care (topical application of fluoride or sealant)	49	(53)	44	(47)	

* *P* value for the linear component was calculated by the Mantel-Haenszel chi-square test.
DMFT, decayed, missing, and filled teeth.

Children were significantly less likely to have dental caries if they were female and firstborn children, did not feed in bed, ate less between meals, drank sports drinks less frequently, and practiced preventive dental care at home. Moreover, a significant association appeared between snacking frequencies of mothers and children ($P < 0.001$).

A multiple logistic regression analysis was performed in Table 2 on independent mother-related variables. Dental caries of children was only significantly associated with "eating between meals twice a day" (OR 1.69; 95 percent CI 1.04-2.73). Children of mothers who drank less alcohol and exhibited more DMFT were more likely to have dental caries, but this association was not statistically significant.

A multiple logistic regression analysis was performed on independent child-related variables (Table 3). "A habit of feeding in bed" (OR 7.38; 95 percent CI 1.39-39.20), "three times or more eating between meals" (OR 3.35; 95 percent CI 1.75-6.42), "twice a week or less consuming sports drinks" (OR 2.39; 95 percent CI 1.09-5.25), "three times a week or more consuming sports drinks" (OR 5.00; 95 percent CI 1.90-13.13), "having both home and professional preventive dental care" (OR 2.39; 95 percent CI 1.19-4.82), and "having professional preventive dental care" (OR 3.26; 95 percent CI 1.56-6.82) were all significantly associated with dental caries in children.

The final multiple logistic regression analysis simultaneously analyzed both mother- and child-related variables (Table 4). The child-related variables of "a habit of feeding in bed" (OR 10.14; 95 percent CI 1.80-56.97), "eating between meals three times a day or more" (OR 3.33; 95 percent CI 1.56-7.10), "consuming sports drinks three times a week or more" (OR 4.47; 95 percent CI 1.60-12.49), "having both home and professional preventive dental care" (OR 3.02; 95 percent CI 1.44-6.32), and "having professional preventive dental care" (OR 3.79; 95 percent CI 1.75-8.21) were significantly associated with dental caries in children. The mother-related variables of "brushing teeth once a day or less" (OR 2.72; 95 percent CI 1.19-6.20) and "drinking alcohol three times a week or more" (OR 0.38; 95 percent CI 0.16-0.93) were significantly associated with dental caries in children.

Table 2
Multiple Logistic Regression Analysis of Mother-Related Variables of Dental Caries in Children

Mother-related variables	Adjusted OR	(95% CI)	*P* value
Residential area			
Urban	1		
Rural	1.31	(0.83-2.06)	0.248
Health insurance			
Cooperative or fraternal insurance	1		
Others	1.42	(0.90-2.23)	0.129
Drinking alcohol			
No	1		
Twice a week or less	0.71	(0.43-1.19)	0.196
Three times a week or more	0.49	(0.22-1.08)	0.078
Smoking habit			
Never	1		
Past smoker	1.09	(0.62-1.91)	0.767
Current smoker	1.58	(0.82-3.08)	0.175
Knowledge of dental terminology			
15-20	1		
12-14	0.99	(0.58-1.71)	0.979
0-11	1.39	(0.81-2.40)	0.229
Frequency of toothbrushing a day			
Three times or more	1		
Twice	1.07	(0.65-1.77)	0.780
Once or less	1.90	(0.90-3.98)	0.091
Frequency of eating between meals a day			
Once or less	1		
Twice	1.69	(1.04-2.73)	0.033
Three times or more	1.49	(0.77-2.89)	0.239
DMFT			
0-11	1		
12-16	1.40	(0.81-2.43)	0.227
17-28	1.71	(0.98-2.99)	0.061

DMFT, decayed, missing, and filled teeth; OR, odds ratio; CI, confidence interval.

Discussion

In this study dental caries' prevalence and mean score for dmft were higher than those of nationwide 3-year-old children (dental caries' prevalence: 28.0 percent, mean score for dmft: 1.1; data source from the Dental Health Division of Health Policy Bureau, Ministry of Health, Labor and Welfare, 2005). To the best of our knowledge, this is the first study to determine dental caries in 3-year-old children that is more strongly associated with child-rearing behaviors than mother-related health behaviors. Significant child-rearing behaviors associated with dental caries in 3-year-old children included "a habit of feeding in bed," "frequency of eating between meals a day," "frequency of consuming sports drinks," and "preventive dental care," whereas sex and birth order appeared to have no statistically significant effect. These results support Kubota *et al.*'s study (23), a study with participants from a demographic similar to those in this study.

Although the analysis of mother-related variables revealed that the frequency of snacking among mothers was associated with dental caries in their children (Table 2) and a significant association appeared between the snacking frequencies of

Table 3
Multiple Logistic Regression Analysis of Child-Related Variables of Dental Caries in Children

Child-related variables	Adjusted OR	(95% CI)	*P* value
Sex			
Male	1		
Female	0.70	(0.44-1.10)	0.117
Birth order			
First	1		
Second or latter	1.57	(1.00-2.46)	0.051
Habit of feeding in bed			
No	1		
Yes	7.38	(1.39-39.20)	0.019
Frequency of eating between meals a day			
Once or less	1		
Twice	1.65	(0.93-2.94)	0.090
Three times or more	3.35	(1.75-6.42)	<0.001
Frequency of consuming sports drinks			
No	1		
Once a month or less	1.40	(0.72-2.72)	0.324
Twice a week or less	2.39	(1.09-5.25)	0.030
Three times a week or more	5.00	(1.90-13.13)	0.001
Preventive dental care			
Home care (fluoride mouthrinses or toothpastes)	1		
No	1.30	(0.60-2.82)	0.513
Both home and professional care	2.39	(1.19-4.82)	0.014
Professional care (topical application of fluoride or sealant)	3.26	(1.56-6.82)	0.002

OR, odds ratio; CI, confidence interval.

mothers and children (data not shown), the final multiple logistic regression analysis did not reveal an association between this factor and dental caries (Table 4). This suggests that controlling between meals of children can reduce dental caries in children, even though their mothers themselves snack frequently. Moreover, mothers who brushed their teeth less frequently were also more likely to have children with dental caries, supporting the results from a previous study (9). Mothers who brush their own teeth once or less per day might not brush their children's teeth frequently.

The results of this study have interventional implications; identifying the relative strength of certain behaviors in the dental health of children can be used to improve dental educational intervention. In other words, these data suggested that dental educational programs for mothers must emphasize child-rearing behaviors rather than health behaviors of mothers themselves. While changing one's demographic status is difficult and changing mother-related factors is difficult, we can improve child-rearing behavior among mothers.

As many pediatricians advise parents to give their children sports drinks when their children suffer from mild dehydration, diarrhea, or fever, many parents give sports drinks to their children. However, sports drinks are acidic (pH < 5.5) and contain, on average, a total amount of sugars (fructose + glucose + sucrose) of 4.4 percent. Therefore, sports drinks have about the same cariogenicity as usual sweetened drinks such as fruit juices and carbonated beverages (24).

The Cochrane Database of Systematic Reviews (25) reported that preventive behaviors such as topical fluoride application (toothpastes, mouthrinses, gels, or varnishes) reduce tooth decay in children. The results of our study indicate that home care was associated with the lowest risk of dental caries in children (Table 4). Frequent use of low-concentration topical fluoride at home (toothpastes and mouthrinses) may effectively prevent dental caries in children. Although professional preventive dental care was associated with dental caries in children in this study, it is likely that those children with dental caries might have professional preventive dental care after treatment, and caries-free small children did not usually visit dental clinic.

A significant association appeared between mothers who drank alcohol and caries-free children. Although the frequency of alcohol consumption was related to smoking (data not shown), smoking was not associated with dental caries in children, a result inconsistent with previous cross-sectional studies (17). Colditz *et al.* (26) found that consumption of candy and sugar was inversely related to alcohol intake, and so the consumption of alcohol may have been related to food selection. Mothers who frequently drink alcohol might be more likely to select salty foods for their children's snack instead of sweets.

In some countries, socioeconomic factors such as residential area (9), family income (4), educational level (4), and employment (10) are significant indicators of dental caries in children. This study did not reveal any significant association between residential area or type of health insurance and dental caries in children. No information was collected about other direct socioeconomic factors such as mothers' educational level and family income; questions about personal educational level and family income are considered sensitive issues in Japan, and including this type of question would have reduced the questionnaire return rate. Moreover, the fact that this study observed no significant relationships between socioeconomic factors and dental caries in children might be attributable to the minimal socioeconomic variation in Japan relative to other countries.

Table 4
Multiple Logistic Regression Analysis of Mother- and Child-Related Variables of Dental Caries in Children

Independent variables	Adjusted OR	95% CI	*P* value
Mother-related variables			
Residential area			
Urban	1		
Rural	1.42	(0.85-2.38)	0.174
Health insurance			
Cooperative or fraternal insurance	1		
Others	1.41	(0.86-2.32)	0.174
Drinking alcohol			
No	1		
Twice a week or less	0.82	(0.47-1.44)	0.496
Three times a week or more	0.38	(0.16-0.93)	0.033
Smoking habit			
Never	1		
Past smoker	1.12	(0.60-2.08)	0.717
Current smoker	1.65	(0.80-3.41)	0.175
Knowledge of dental terminology			
15-20	1		
12-14	1.12	(0.62-2.00)	0.714
0-11	1.43	(0.77-2.63)	0.255
Frequency of toothbrushing a day			
Three times or more	1		
Twice	1.25	(0.72-2.15)	0.428
Once or less	2.72	(1.19-6.20)	0.017
Frequency of eating between meals a day			
Once or less	1		
Twice	1.00	(0.57-1.77)	0.991
Three times or more	0.84	(0.38-1.83)	0.654
DMFT			
0-11	1		
12-16	1.27	(0.69-2.32)	0.447
17-28	1.64	(0.88-3.05)	0.117
Child-related variables			
Sex			
Male	1		
Female	0.74	(0.46-1.18)	0.207
Birth order			
First	1		
Second or latter	1.49	(0.91-2.42)	0.112
Habit of feeding in bed			
No	1		
Yes	10.14	(1.80-56.97)	0.009
Frequency of eating between meals a day			
Once or less	1		
Twice	1.71	(0.90-3.27)	0.103
Three times or more	3.33	(1.56-7.10)	0.002
Frequency of consuming sports drinks			
No	1		
Once a month or less	1.39	(0.69-2.80)	0.355
Twice a week or less	1.79	(0.78-4.14)	0.172
Three times a week or more	4.47	(1.60-12.49)	0.004
Preventive dental care			
Home care (fluoride mouthrinses or toothpastes)	1		
No	1.16	(0.52-2.58)	0.724
Both home and professional care	3.02	(1.44-6.32)	0.003
Professional care (topical application of fluoride or sealant)	3.79	(1.75-8.21)	0.001

DMFT, decayed, missing, and filled teeth; OR, odds ratio; CI, confidence interval.

This study had other limitations in addition to the lack of socioeconomic data. We collected no data about fathers' dental status (although Ringelberg *et al.* (2) found a weaker association between dental caries among father–child pairs than mother–child pairs). In addition, no information was collected about children's toothbrushing habits by themselves and by their mothers, only whether home care involved toothpaste with fluoride. A study demonstrated that 89.8 percent of mothers brushed their children's teeth more than once per day among Japanese preschool children (27). This means that toothbrushing behavior is widespread and well accepted among mothers. Finally, as this study was cross-sectional, prospective studies will be necessary to demonstrate the risk factors.

In conclusion, dental caries in 3-year-old children is associated more strongly with child-rearing behaviors than with mother-related health behaviors. These findings suggest that encouraging good child-rearing behavior among mothers could result in better dental health among children regardless of their mother's oral health status.

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