

Original

## Factors Influencing Dental Caries in 3-year-old Children: Effect of Prenatal Oral Health Examination on Behavioral Change

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**Abstract:** The aim of this study was to analyze factors influencing dental caries in 3-year-old children. In addition, we investigated the effect of prenatal oral health examination on oral health behavior related to dental caries by a retrospective cohort study.

The subjects enrolled in this study were 647 children and their mothers who received oral health examinations from 2015 to 2020 at both the 18-month and 3-year-old health check-ups, which were conducted by Naruto City, Tokushima Prefecture, Japan. The relationship between dental caries in 3-year-old children and items related to oral health behavior were analyzed by binomial logistic regression analysis using the results of the questionnaire for the 18-month-old or 3-year-old child health check-ups. Furthermore, 480 subjects who had not received a dental check-up during pregnancy were divided into two groups: a prenatal examination group, who received prenatal oral health examination conducted by the municipality, and a non-examination group. Then, differences in oral health behavior after childbirth were analyzed between the two groups.

The prevalence rate of dental caries in 3-year-old children was 14.5%. It showed that dental caries was significantly correlated with the frequency or regularity of eating between meals, regular dental check-ups, mothers' knowledge of periodontal disease, and smoking habits of mothers or family members. In addition, the rate of mothers/children who acquired the behavior of regular dental check-ups after childbirth significantly increased, and the rate of regular dental check-ups of the mother at the 18-month-old child checkup was higher in the prenatal examination group when compared with the non-examination group.

These results indicate that factors related to dental caries in 3-year-old children were eating between meals, regular dental check-ups, knowledge of periodontal disease, and smoking habits. Furthermore, prenatal oral health examinations may promote mothers' acquisition of good health behavior for themselves or their child, such as understanding the necessity of having regular dental check-ups after childbirth.

**Key words:** Dental caries, Factor analysis, Behavioral change, Prenatal oral health examination

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### Introduction

In recent years, the prevalence of dental caries in infants has decreased in Japan, whereas the prevalence of dental caries from 18-month-olds to 3-year-olds has clearly increased<sup>\*1</sup>. It was reported that various factors

such as the frequency of eating between meals, tooth brushing habits, and presence or absence of regular dental check-ups, affect dental caries in early childhood<sup>1,2)</sup>. It was also reported that knowledge and awareness of oral health of guardians was closely related to oral health conditions in infancy because children will

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<sup>\*1</sup> National Institute of Public Health: The results of dental health examination in Japanese infants. Available online, <https://www.niph.go.jp/soshiki/koku/oralhealth/infantcaries.html> (7/3/2022 access)

acquire lifestyle habits under the protection of their caregivers<sup>3,4</sup>). In addition, there are significant effects of the social context on dental caries of infants in municipalities<sup>5</sup>).

Japan enacted a law on dental and oral health in 2011, and several local governments have been implementing various efforts to improve and maintain the oral health of residents<sup>6</sup>. However, there are differences in the content among municipalities, and this may markedly influence the awareness and knowledge of oral health and health behavior of residents.

The oral condition tends to deteriorate during pregnancy due to morning sickness and changes in hormonal balance, increasing the incidence and development of dental caries and periodontal disease<sup>7,8</sup>). It has been reported that pregnant women with a poor periodontal condition have higher risks of adverse pregnancy outcomes such as premature births and low-birth-weight infants<sup>9,10</sup>). Therefore, maintaining a good oral condition during pregnancy by preventing periodontal disease is important for managing the health of mothers and children. Oral health examination for pregnant women is expected to contribute to the subsequent health of mothers and children by raising awareness of good oral health behavior leading to the start of oral health management at family dental clinics.

Under the Maternal and Child Health Law in Japan, oral health examinations at health check-ups for 18-month-old and 3-year-old children are compulsory by municipalities<sup>6</sup>), and the child consultation rate is 90% or higher\*2. On the other hand, oral health examination for pregnant women is not obligatory and the average rate of receiving oral examinations was reported to be around 30%<sup>11</sup>), being extremely low compared with the above-mentioned infant examinations. It is an issue of community health that there are many residents who do not receive oral health examinations or oral health guidance during pregnancy.

The aim of this study was to analyze health behavioral factors related to the prevalence of caries in 3-year-old children, and to verify the effect of prenatal oral health examination conducted by a municipality by a retrospective cohort study.

## Methods

### 1. Study design and subjects

#### 1) Oral health examination of children

The subjects enrolled in this study were 647 children and their mothers who gave consent, and we obtained the results of both oral health examination and the questionnaire survey during the 18-month-old and 3-year-old health check-ups of the child (Fig. 1), conducted in Naruto City, Tokushima Prefecture, Japan from April 2015 to March 2020. The average age of the mothers was 32.8±5.1 years at the health check-up for their 18-month-old children.

#### 2) Prenatal oral health examination

The prenatal oral health examination was conducted for free by Naruto City from April 2013 to March 2016. Prenatal oral health examination forms including a questionnaire about oral health behavior were distributed to all pregnant women who lived in Naruto City. Pregnant women received oral health examination and an explanation of the results at the dental clinic, and then related oral health guidance was performed. The oral health examination forms were collected at the central office of Naruto City.

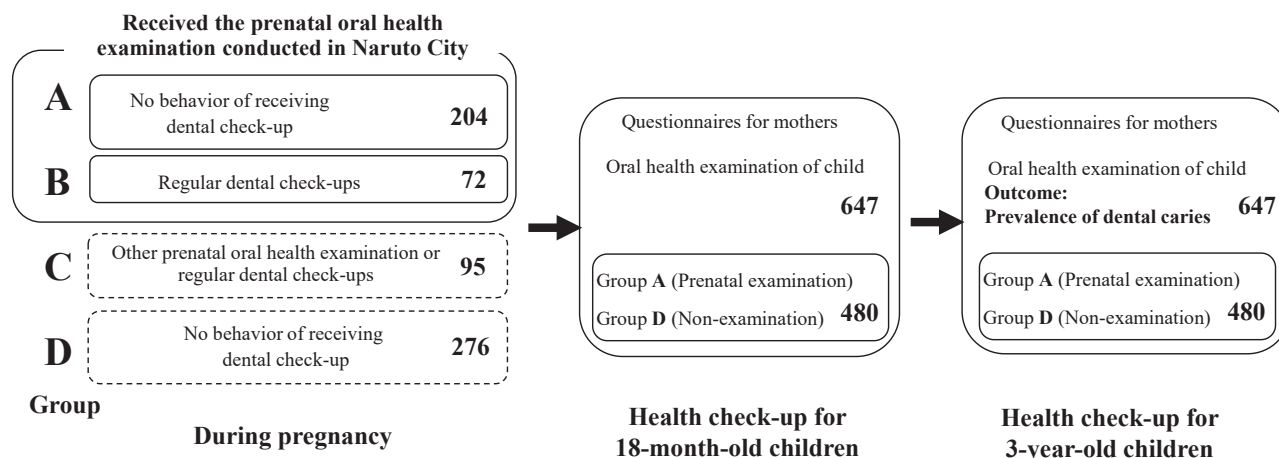
#### 3) Verification of the effect of prenatal oral health examination

Among mothers who received prenatal oral health examination, oral health behavior regarding regular dental check-ups during pregnancy was investigated. Two hundred and four subjects who did not receive regular dental health check-ups were defined as a prenatal examination group (Fig. 1, Group A). On the other hand, for subjects who did not receive a prenatal oral health examination, we investigated their health behavior regarding regular dental check-ups during pregnancy using the questionnaire survey at the 18-month-old health check-up of their child. Two hundred and seventy-six subjects who did not receive regular dental check-ups during pregnancy were defined as a non-examination group (Fig. 1, Group D).

### 2. Contents of the oral health examination of children

Oral hygiene and dental caries were investigated

\*2 Ministry of Health, Labor and Welfare: Overview of Community Health/ Health Promotion Business Report for the 2019, <https://www.mhlw.go.jp/toukei/saikin/hw/c-hoken/19/dl/R01gaikyo.pdf> (7/3/2022 access)



**Figure 1** Flow chart of the cross-sectional and retrospective cohort study regarding the prenatal oral health examination. Pregnant women were divided into four Groups (A, B, C, and D). Subjects in Groups A and B received the prenatal oral health examination and questionnaires conducted in Naruto City, whereas subjects in Group C and D had not. Subjects in Group C had the behavior of regular dental check-ups or received the other prenatal oral health examinations. Subjects in Groups A and D had no behavior of regular dental check-ups during pregnancy. The value means the number of subjects.

regarding the oral health examination at the 18-month and 3-year-old health check-ups. Both oral health examinations were performed by 26 dentists from the regional dental clinic commissioned by Naruto City. Dental caries was evaluated according to Implementation Guidelines for Maternal and Child Dental Health Examinations and Health Guidance from the Ministry of Health, Labour, and Welfare. The oral hygiene condition of the child was evaluated as: poor, fair, or good, depending on the accumulation of dental plaque on the labial side of the upper teeth according to the Maternal and Child Health Manual of Tokushima Prefecture\*<sup>3</sup>.

### 3. Questionnaire survey

A questionnaire including items on oral health behavior and an explanatory document describing the purpose of this study were mailed to each mother at the 18-month and 3-year-old health check-ups. The questionnaire was collected on the day of the oral examination at the health center in Naruto City. Subjects who did not give their consent to participate in this study were excluded from the analysis. The questionnaire items were categorized into three periods: three items at pregnancy, seven items at the 18-month-old health check-up, and nine items at the 3-year-old health check-up, as shown in Table 1. If there was a questionnaire

with an unfilled item in each answer column, those were excluded, and only the filled items were calculated.

### 4. Statistical analysis

#### 1) Analysis of factors related to dental caries in 3-year-old children

The outcome of the analysis was the prevalence of dental caries in 3-year-old children, obtained from the results of the oral health examination shown in Fig. 1. Chi-square tests were performed on the relationship between the prevalence of dental caries in 3-year-olds and oral health behaviors in the three life stages. Furthermore, binomial logistic regression analysis was performed. The presence or absence of dental caries was used as a dependent variable, and items related to oral health from the questionnaire were used as independent variables. Then, the odds ratio (OR) and 95% confidence interval (CI) were calculated. To deal with multicollinearity, the absolute value of the correlation coefficient or phi coefficient between the items used in the logistic analysis was set at 0.25 or lower.

#### 2) Verification of the effect of prenatal oral health examination

The subjects in Groups A and D, who did not receive regular dental check-ups during pregnancy, were enrolled in the retrospective cohort study. The differ-

\*<sup>3</sup>Tokushima Prefecture: <https://www.pref.tokushima.lg.jp/ippannokata/kenko/kosodateshien/2014071700293/dental.pdf> (9/30/2022 access)

**Table 1** Comparison of characteristics and oral health behavior related to the prevalence of dental caries in three investigation periods

Investigation Periods		Dental caries in 3-year-old children		p-value <sup>#</sup>
Items	Category	Prevalence (%)	Subtotal	
Total		94 (14.5)	647	
<b>During pregnancy</b>				
Age				
	≤24	10 (27.8)	36	0.075
	25-34	50 (14.1)	355	
	35≤	30 (13.7)	219	
Order of birth				
	first	39 (13.4)	290	0.067
	second	32 (12.9)	249	
	third or latter	23 (21.9)	105	
Prenatal oral health examination				
	yes (conducted in Naruto City)	27 (9.8)	276	0.003
	yes (others) or regular dental check-ups	22 (23.2)	95	
	no	45 (16.3)	276	
<b>Health check-up for 18-month-old children</b>				
Oral hygiene condition of child				
	good	21 (9.8)	215	0.050
	fair	69 (17.0)	407	
	poor	4 (17.4)	23	
Frequency of eating between meals of child				
	2 times or fewer	71 (12.5)	569	0.000
	3 times or more	22 (28.9)	76	
Brushing by guardians				
	yes	81 (14.1)	574	0.272
	no	8 (20.5)	39	
Knowledge of fluoride				
	yes	83 (14.7)	564	0.287
	no	10 (20.4)	49	
Knowledge of periodontal disease				
	yes	68 (13.1)	521	0.010
	no	26 (22.4)	116	
Regular dental check-ups of mother				
	yes	28 (12.1)	232	0.187
	no	65 (15.9)	409	
Smoking habit of mother				
	no	79 (13.4)	588	0.002
	yes	15 (29.4)	51	
<b>Health check-up for 3-year-old children</b>				
Oral hygiene condition of child				
	good	2 (1.9)	104	0.000
	fair	74 (15.0)	493	
	poor	17 (35.4)	48	
Regularity of eating between meals of child				
	regularly	65 (12.8)	509	0.003
	random	28 (23.3)	120	
Frequency of eating between meals of child				
	2 times or fewer	78 (14.0)	557	0.424
	3 times or more	15 (17.2)	87	
Brushing by guardians				
	yes	87 (14.4)	604	0.532
	no	4 (15.4)	26	
Use of fluoride toothpaste				
	yes	76 (14.8)	515	0.626
	no	17 (13.1)	130	
Knowledge of periodontal disease				
	yes	68 (13.0)	525	0.038
	no	24 (20.3)	118	
Regular dental check-ups of child				
	yes	76 (14.8)	513	0.615
	no	17 (13.1)	130	
Regular dental check-ups of mother				
	yes	58 (17.1)	340	0.057
	no	36 (11.8)	306	
Smoking habit of a family member				
	no	38 (11.0)	344	0.009
	yes	55 (18.3)	300	

<sup>#</sup>Chi-square test

The value means the number of subjects and the value in parentheses means its percentage.

ences in oral health behavior after childbirth were analyzed using the chi-square test between two groups to evaluate the effect of prenatal oral health examination on oral health behavior. McNemar's test was also used to examine the health behavioral changes in mothers regarding regular oral health check-ups in both Groups (A and D).

Each statistical analysis was conducted with IBM SPSS Statistics 26 software (IBM SPSS, Tokyo, Japan), and the level of significance was set at  $p < 0.05$ .

### 3) Sample size calculation

The sample size for the study design to verify the effect of the prenatal dental examination was determined from the results of our preliminary study of subjects whose infants underwent an 18-month-old health check-up in the 2015 fiscal year. Sixteen mothers had the behavior of regular dental check-ups among the 50 subjects in Group A, and 18 mothers had the behavior of regular dental check-ups among the 115 subjects in Group D. The sample size was obtained as follows: the variable of the rate of mothers showing behavioral change was 0.320 and 0.157, respectively, with a phi coefficient=0.186. The sample size based on the chi-square test was calculated with a significant difference level of 0.05, a power level of 0.80, and an anticipated effect size=0.186, to obtain an equal number of participants in each group. The required sample size was 114 or more in each group.

### 5. Ethics

The Ethics Committee of Tokushima University Hospital approved this study (protocol approval number: 3042-3).

## Results

### 1. Analysis of factors influencing dental caries in 3-year-old children

The prevalence rate of dental caries in 18-month-old children was 0.8%, and that in 3-year-old children was 14.5%. Table 1 shows the relationship between dental caries in 3-year-old children and the survey items. Among the survey items at the 18-month-old health check-up, the prevalence rate of dental caries was significantly higher in cases of poor oral hygiene, in those eating 3 times or more between meals, and with the smoking habit of the mother. The prevalence rate of

dental caries was significantly lower in the case of possessing knowledge about periodontal disease. Among the survey items at the 3-year-old health check-up, the prevalence rate of dental caries was significantly higher in cases of poor oral hygiene, in those randomly eating between meals, and with the smoking habit of a family member, while it was significantly lower in the case of possessing knowledge of periodontal disease. Concerning the item of oral health examination during pregnancy, the prevalence rate of dental caries was significantly lower in those receiving prenatal oral health examination conducted by Naruto City.

Table 2 shows the results of binomial logistic regression analysis with the presence or absence of caries at the 3-year-old health check-up as the dependent variable and the survey items at the 18-month-old health check-up as independent variables. Seven items related to oral health from the questionnaire were used as independent variables. The items related to dental caries were as follows: frequency of eating between meals: 3 times or more (OR=2.65,  $p < 0.001$ ), knowledge of periodontal disease: none (OR=1.88,  $p < 0.05$ ), and smoking habit of mother: yes (OR=2.23,  $p < 0.05$ ). On the other hand, the results using the 8 survey items at the 3-year-old health check-up as independent variables are shown in Table 3. The items related to dental caries at the 3-year-old checkup are as follows: regularity of eating between meals: random (OR=1.79,  $p < 0.05$ ), knowledge of periodontal disease: no (OR=1.76,  $p < 0.05$ ), regular dental check-up of mother: no (OR=1.75,  $p < 0.05$ ), and smoking habits of a family member: yes (OR=1.93,  $p < 0.01$ ).

### 2. Effect of prenatal oral health examination

Table 4 shows the subsequent changes in oral health behavior after prenatal oral examination in the prenatal examination Group (A) and non-examination Group (D). As a result of analysis by the McNemar's test, significant improvement in health behavior culminating in regular dental check-ups was observed from pregnancy to the child's 18-month-old health check-up and from 18-month-old to 3-year-old health check-ups in both groups ( $p < 0.01$ ).

As a result of analyzing the difference between the two groups at the 18-month-old check-up by the chi-square test, the rate of regular dental check-ups of the mother was 29.9% in Group A and 20.5% in Group D

**Table 2** The factors of 18-month-old child or guardian related to the prevalence of dental caries in 3-year-old children

Variables	Category	Odds ratio (95% CI)	<i>p</i> -value <sup>#</sup>
Frequency of eating between meals of child			
	2 times or fewer	1.00 (ref)	
	3 times or more	2.65 (1.47–4.79)	0.001
Knowledge of periodontal disease			
	yes	1.00 (ref)	
	no	1.88 (1.09–3.24)	0.023
Smoking habit of mother			
	no	1.00 (ref)	
	yes	2.23 (1.12–4.45)	0.023

<sup>#</sup>Binomial logistic regression analysis

Items for analysis: Order of birth, Frequency of eating between meals of child, Brushing by guardians, Knowledge of fluoride, Knowledge of periodontal disease, Regular dental check-ups of mother, Smoking habit of mother

showing a significant difference. The rate of regular dental check-ups of the mother at the 3-year-old health check-up was 50.0% in Group A and 42.5% in Group D showing no significant difference. On the other hand, the rate of regular dental check-ups of children was 82.6% in Group A, being significantly higher than that in Group D. It was also revealed that the items which showed significant differences between the two groups at the 3-year-old health check-up were dental caries, oral hygiene condition of the child, and frequency of eating between meals.

### Discussion

It has been reported from several studies that there are various factors related to dental caries in early childhood, such as the frequency of toothbrushing, frequency of eating between meals, brushing by a guardian, and child-rearing environment<sup>3,12</sup>. Although there have been many cross-sectional studies using the results of questionnaires and oral examination, there have been few longitudinal studies on oral conditions and oral health behaviors from pregnancy to postpartum until the child's 3-year-old health check-up. In this study, the relationship between the prevalence of dental caries in 3-year-old children and items related to

**Table 3** The factors of 3-year-old child or guardian related to the prevalence of dental caries

Variables	Category	Odds ratio (95% CI)	<i>p</i> -value <sup>#</sup>
Regularity of eating between meals of child			
	regularly	1.00 (ref)	
	random	1.79 (1.05–3.05)	0.034
Knowledge of periodontal disease			
	yes	1.00 (ref)	
	no	1.76 (1.01–3.06)	0.044
Regular dental check-ups of mother			
	yes	1.00 (ref)	
	no	1.75 (1.08–2.85)	0.024
Smoking habit of a family member			
	no	1.00 (ref)	
	yes	1.93 (1.20–3.11)	0.007

<sup>#</sup>Binomial logistic regression analysis

Items for analysis: Order of birth, Regularity of eating between meals of child, Brushing by guardians, Use of fluoride toothpaste, Knowledge of periodontal disease, Regular dental check-ups of child, Regular dental check-ups of mother, Smoking habit of a family member

oral health behavior during pregnancy, at 18 months old, and at 3 years old were investigated. From the results by binomial logistic analysis regarding eating between meals, there was a significantly higher risk of dental caries in infants who eat 3 times or more in addition to infants who eat at random. It was reported that the development of dental caries was the result of the simultaneous action of oral bacteria, fermentable carbohydrates, hosts and teeth, and time as a factor related to dental caries<sup>9</sup>. Although the content of eating between meals was not investigated in this study, it has been reported that a frequency of eating between meals of 3 times or more is associated with a sweet snack-eating habit<sup>13</sup>. The results of our study may support the involvement of fermentable carbohydrates and time as factors in the development of dental caries in infants.

Fejerskov proposed that social factors cause dental caries<sup>14</sup>. Then, it was reported that health behavioral factors have an influence on the causes of dental caries in infants as well as social factors such as the socio-economic status<sup>15–17</sup>. Dental caries in early childhood was



**Table 4** Effect of prenatal oral health examination on behavioral change

Investigation Periods		Prenatal oral health examination held in Naruto City		<i>p</i> -value <sup>#</sup>
Items	Category	Yes: Group A (%)	No: Group D (%)	
<b>Pregnancy</b>				
Regular dental check-ups				
	yes	0 (0.0)	0 (0.0)	
	no	204 (100.0)	276 (100.0)	
<b>18-month-old child</b>				
Regular dental check-ups of mother				
	yes	60 (29.9)	56 (20.5)	0.019
	no	141 (70.1)	217 (79.5)	
<b>3-year-old child</b>				
Regular dental check-ups of mother				
	yes	102 (50.0)	117 (42.5)	0.105
	no	102 (50.0)	158 (57.5)	
Regular dental check-ups of child				
	yes	166 (82.6)	203 (73.8)	0.024
	no	35 (17.4)	72 (26.2)	
Dental caries				
	none	184 (90.2)	231 (83.7)	0.040
	prevalence	20 (9.8)	45 (16.3)	
Oral hygiene condition of child				
	good	36 (17.6)	37 (13.5)	
	fair	159 (77.9)	208 (75.9)	0.030
	poor	9 (4.4)	29 (10.6)	
Frequency of eating between meals of child				
	2 times or fewer	184 (90.2)	226 (81.9)	0.011
	3 times or more	20 (9.8)	50 (18.1)	

<sup>#</sup>Chi-square test

The value means the number of subjects and the value in parentheses means its percentage.

affected by the background of the caregiver and social background, such as health awareness and behavior<sup>3)</sup>. This study showed that the prevalence rate of dental caries in infants of mothers without knowledge of periodontal disease was significantly higher. It also showed that there was a significant difference regarding the prevalence of dental caries in children between mothers who undergo regular dental check-ups and those who do not. This might show that an interest in oral health leads to the subsequent prevention of dental caries. *Streptococcus mutans* and *Streptococcus sobrinus*, which are the main bacteria causing dental caries, are not detected in edentulous infants but are detected in dentulous infants, and are considered to be transmitted from the saliva of caregivers (mainly mothers)<sup>18)</sup>. Therefore, it is important for mothers to be aware that oral

health promotes healthy behavior to maintain a good oral status, lead to a reduction of Mutans streptococci.

It is well-known that tobacco affects various systemic diseases such as cancer, chronic lung disease, ischemic heart disease, and premature birth<sup>19)</sup>. In recent years, the relationship between smoking and dental caries has been clarified, and the relationship between the smoking status of family members and dental caries has also been reported<sup>20,21)</sup>. The results of this study also showed that the prevalence rate of dental caries in infants whose mother was a current smoker at 18 months old was significantly higher, as shown in Tables 1 and 2. Furthermore, there was a significant difference between the dental caries prevalence rate of infants and presence or absence of family smokers, as shown in Tables 1 and 3. It is important to disseminate knowl-

edge about the effects of smoking not only on one's own health but also on children. Furthermore, it is important for family members to receive education about the risk of passive smoking for children.

Dental caries of deciduous teeth in Japan has been on the decline in recent years, but individual and regional disparities are still a problem<sup>22)</sup>. Although the results of data regarding the number of dental caries were not shown, the average number of dental caries at the 18-month-old and 3-year-old health check-ups were 0.02 and 0.56, respectively. However, there were some children with the many dental caries: for example, 4 carious teeth at the 18-month-old health check-up and 13 carious teeth at the 3-year-old health check-up. The American Society of Pediatric Dentistry defined this as early childhood caries (ECC) and explained the importance of maintaining a good oral condition in infants<sup>23)</sup>. Early childhood is an important time for the completion of dentition. Early tooth loss due to dental caries of deciduous teeth can cause malocclusion. Furthermore, ECC is considered to adversely affect the development of healthy dentition and a normal oral function. Therefore, it is important to perform preventive measures for dental caries in early childhood, and it is also necessary to adopt a high-risk approach for young children who are likely to have ECC.

The World Health Organization (WHO) states that identifying health inequalities and their drivers is essential for achieving health equity, and recommends the application of fluoride as an oral health measure. The use of fluoride toothpaste is also recommended for the prevention of dental caries as an approach in young children. By the application of fluoride, some molecules of hydroxyapatite in tooth crystals replace fluorapatite and improve acid resistance<sup>24-26)</sup>. In the questionnaire at the 18-month-old health check-up, the rate of knowing the effectiveness of fluoride against dental caries was 92.0%. However, only 79.8% of subjects answered that they used fluoride toothpaste in the questionnaire at the 3-year-old health check-up. It is necessary to support oral health with the use of fluoride toothpaste at home.

There are few reports on the preventive effectiveness of oral health examination during pregnancy. It was reported that one of major factors determining

whether to receive prenatal oral health examination was public subsidy by municipality<sup>27)</sup>. Although the reasons for receiving prenatal oral health examination were not investigated in this study, the participation rate for prenatal oral health examination was 42.7% (276/647), which was relatively high when compared with others<sup>11,28)</sup>. The publicly-funded oral health examination was considered to have contributed to the increase of pregnant women who received the examination.

As mentioned previously, no behavior on receiving regular dental check-ups was related to the prevalence of dental caries in children. The prenatal examination group who received a prenatal dental health examination conducted by Naruto City showed a significant behavioral change on receiving regular dental check-ups when compared with the non-examination group. The fact that prenatal oral health examinations are useful for the health management of pregnant women may be a new finding. Sasahara et al. showed that "the factor of interest in dental health" influenced the behavior of regular dental check-up<sup>29)</sup>. As the reason why the regular dental checkup rate in Group A was significantly higher than that in Group D at the health check-up for 18-month-old children, it was conceivable that their awareness of oral health increased after receiving dental health guidance at the prenatal oral health examination. On the other hand, no significant difference between Groups A and D was observed at the health check-up for 3-year-old children. It was considered that mothers' interest in dental health in Group D was increased by children's health check-ups including the dental health check-up for 18-month-old children, and the subsequent regular dental check-up rate was increased, as well as that in Group A.

In addition, a significant effect of the regular dental check-up for 3-year-old children was also found. It was reported that subjects who undergo regular dental check-ups have a higher level of knowledge about dentistry and a good oral condition<sup>30)</sup>. It might be considered in this study that the prenatal oral health examination made pregnant women more aware of the importance of their own and child's oral health, which led to desirable health behavior.

There were also significant differences in the oral hygiene condition and prevalence of dental caries



between the prenatal examination group and non-examination group in addition to the item of the frequency of eating between meals. It considered that prenatal oral health examination leads to changes in the oral health behavior of mothers and the prevention of caries in children. It was reported to be important to understand the knowledge and practice of oral hygiene among pregnant women, given that the maintenance of hygiene during pregnancy improved general health<sup>31)</sup>. The examination that was conducted by a municipality in this study might be effective as a preventive measure. It has been reported that the implementation of publicly-funded prenatal oral health examination contributes to an increase in the rate of examinations<sup>11)</sup>. Therefore, it is necessary to increase publicly-funded prenatal oral health examinations and implement a population approach that encourages behavioral change in many pregnant women.

The limitations of this research were as follows. The difference at the baseline could not be verified in comparison with subjects in the prenatal examination Group (A) and those in the non-examination Group (D), because there were no data on the oral condition during pregnancy in Group D. The existence of bias cannot be denied. It has also been reported that parents' final educational background and household income affected infant health inequalities including caries<sup>5,32,33)</sup>, whereas these data could not be obtained in this study as well. Further verification will be required regarding related factors derived from logistic regression analysis. It is necessary to reconstruct the contents including the questionnaire on the socio-economic status and perform a more comprehensive survey in the future.

## Conclusions

This study revealed that factors related to dental caries in 3-year-old children included oral health knowledge and behavior of the mother and/or family, in addition to the frequency and regularity of eating between meals of the child. Furthermore, it suggests that prenatal oral health examinations conducted by municipalities may influence the acquisition of good health behavior of the mother or child, such as having regular dental check-ups.

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## 3歳児う蝕に影響を与える要因： 行動変容に対する妊婦歯科健康診査の有効性

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**概要：**本研究の目的は、3歳児う蝕に影響を与える要因分析、および後ろ向きコホート研究によりう蝕関連の口腔保健行動に対する妊婦歯科健康診査の有効性を検証することである。

研究対象者は、2015年から2020年までに徳島県鳴門市が実施した1歳6か月児健康診査と3歳児健康診査の両方で歯科健康診査を受けた647人の子どもとその母親である。二項ロジスティック回帰分析により、3歳児う蝕と1歳6か月児または3歳児健康診査時のアンケート結果からの口腔保健行動の項目との関連を分析した。さらに、妊娠中に定期的な歯科健診を受けていなかった対象者480名を、鳴門市が実施した妊婦歯科健康診査を受けた妊婦健診群と非健診群の2群に分け、出産後の口腔保健行動の相違を2群間で分析した。

3歳児のう蝕有病率は14.5%であり、間食回数または規則性、母親の定期的な歯科健診、歯周病に関する知識、母親または家族の喫煙習慣と有意に関連していた。また、出産後に定期的な歯科健診を受ける母子の割合は増加し、1歳6か月時の母親の定期歯科健診受診率は、妊婦健診群では非健診群に比べて有意に高かった。

これらの結果から3歳児う蝕に関連する要因として、間食、定期歯科健診、歯周病に関する知識、喫煙習慣が示された。さらに、妊婦歯科健康診査は、出産後の定期的な歯科健診受診など、母親が自分自身や子どものための良好な保健行動獲得に影響を与える可能性がある。

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