

Analysis of the Factors That Affect Dental Health Behaviour and Attendance at Scheduled Dental Check-ups Using the PRECEDE-PROCEED Model

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A questionnaire survey was administered to 317 parents who attended infant health check-ups in City B, Okayama Prefecture between October, 2008 and March, 2009. The questionnaire survey studied 7 factors based on the PRECEDE-PROCEED Model. We analysed factors that affected oral health behaviour and attendance at scheduled dental health check-ups. The survey containing 22 items concerning matters such as 'QOL' and 'health problems' was posted to parents and guardians in advance, and then collected on the day of the medical check-up. The collected data was analysed using the *t*-test and Pearson's correlation coefficient, following which we conducted a covariance structure analysis. The results showed that dental health behaviour was directly affected by reinforcing factors, and indirectly associated with enabling and predisposing factors influenced by reinforcing factors. It was also shown that predisposing factors and oral health behaviour were associated with attendance at scheduled oral health check-ups. The results indicated that strengthening oral health education by sharing knowledge that acts as predisposing factors and introducing adaptations of oral health behaviour that fit individual lives will lead to improved attendance at scheduled dental health check-ups.

Key words: PRECEDE-PROCEED model, dental check-ups, dental health behaviour

The Community Health Law [1], passed in 1994, states that public services imperative to residents, such as maternal and child healthcare services, shall be provided by local governments in order to achieve services of higher quality. The 'Enforcement Procedures Concerning Maternal and Child Dental Check-Ups and Healthcare Guidance' [2] established in 2000 provide effective healthcare guidance and sug-

gest that survey questions be devised to address various local situations and needs. Local governments are required to plan, enforce and evaluate a program based on its adherence to the ideals of health promotion, responsiveness to the needs of the community and provision of scientific, evidence-based services.

Although the incidence of primary teeth caries, one of the main health problems in community dental healthcare, has been declining in Japan since late 1970s, its incidence differs among regions [3]. Some of the regional differences may be attributed to variations in social factors, such as employment structure

and income, and dental health behaviour, such as nutrition, lifestyle, brushing habits and attendance at scheduled dental check-ups [4, 5]. Since the causes of caries vary between the regions, it is difficult to promote good lifelong dental and oral health without understanding the situations and characteristics specific to each region. Municipal dental healthcare support requires implementation of a continuous program that extends from maternal and infant healthcare to child healthcare in order to successfully promote good lifelong oral health. Dental health promotion should emphasize scheduled dental check-ups and continuing care for primary prevention rather than early detection and treatment of caries for secondary prevention [6, 7]. In particular, infant dental healthcare programs should be linked to scheduled dental check-ups to provide the guidance necessary for parental care and self-care. Following that program, a system to supplement self-care with professional care in dental facilities should be established.

For the establishment of a consistently effective dental healthcare program, analysis of the factors affecting dental health behaviour is required. Currently, the PRECEDE-PROCEED model proposed by Green and colleagues in 1991 [8] is considered useful as a theoretical model for evaluating socio-psychological health behaviour. Analysis of the factors affecting dental health behaviour, clarification of preventive dental health behaviour and evaluation of healthcare policies using this model have been reported [9, 10].

In this study, we considered the low attendance of infants at scheduled dental check-ups (30%) as a potential problem in preventive dental health behaviour. Incorporating the 7 factors in the PRECEDE-PROCEED model, we analyzed the correlation between the parents' awareness and their participation

in a conventional dental healthcare program [11].

Further, using the results of an investigation of the changes among 7 factors with respect to individual check-ups, we analysed the relationship of those factors and their effect on regular dental check-ups. Subsequently, we investigated assistive methods for the systematization of 'regular dental check-ups & continuing care' by means of the participation of parents in mother-and-child oral health activities and the promotion of awareness of infant oral health.

Materials and Methods

Pre-survey.

Investigation of Questionnaire Items

Before conducting a full-scale survey, a 4-point scale questionnaire containing 26 questions was administered to a population of 43 subjects. The subjects were parents who were accompanying children, aged 1–3 years, to scheduled dental check-ups. The appointments took place in August, 2008 in City A in Okayama Prefecture, Japan. Those who gave consent filled out the survey and returned it to the collection box onsite (collection rate of 81.4%).

The questionnaire consisted of questions regarding the 7 factors in the PRECEDE-PROCEED model [8, 11]: Factor 1 is quality of life (QOL); Factor 2, health problems; Factor 3, health behaviour; Factor 4, environmental factors; Factor 5, predisposing factors; Factor 6, reinforcing factors; and Factor 7, enabling factors. The relationships between the 7 factors of the PRECEDE-PROCEED Model, which include QOL, health problems *etc.*, are shown in Table 1. Of the responses collected, the question items were divided into those with imprecise written notation and those showing the possibility for content comprehension. Internal consistency reliability was

Table 1 7 Factors of PRECEDE-PROCEED model

	Term	Definition
Factor(1)	QOL	The patient's ability to enjoy normal life activities
Factor(2)	Health Problems	Problems having a direct negative effect on QOL
Factor(3)	Health Behaviors	Lifestyle habits that are adopted in response to health problems
Factor(4)	Environmental Factors	Factors directly affecting health behaviour, health problems and QOL
Factor(5)	Predisposing Factors	The knowledge, attitude and values that are present prior to adopting the health behaviour
Factor(6)	Reinforcing Factors	Benefits from continuing the health behaviour
Factor(7)	Enabling Factors	Support systems and skills that help to realize the health behaviour

investigated using Cronbach's alpha coefficient (0.7 or above). Adjustments were made to question items based on the imprecision of written notation and reorganisation of item content, while question items with a Cronbach's alpha coefficient of 0.7 or less were eliminated. Finally, a questionnaire form including 22 question items addressing the 7 factors of the PRECEDE-PROCEED Model was prepared.

Main-survey. Based on these small-scale, pre-survey results, the questionnaire was rewritten to contain 22 questions. A full-scale survey using the new questionnaire was then conducted between October, 2008 and March, 2009 in City B in Okayama Prefecture. This questionnaire targeted 391 parents of infants attending scheduled dental check-ups. The infants were classified into groups based on age: up to 18 months (18m), 18 months to 2 years and 6 months (2y6m), and 2 years and 6 months to 3 years (3y). The 4-point scale questionnaire (0, don't know; 1, almost never; 2, sometimes and 3, yes) used in City A was developed in reference to the PRECEDE-PROCEED model, and higher points were considered to represent more favourable conditions. The questionnaires and an interview letter were sent out prior to the scheduled visits along with the notice of the scheduled check-ups. The questionnaires and interview letter were collected on the day of the check-ups (collection rate of 81.1%).

Analysis methods. After the normality of item scores for the 7 factors of the PRECEDE-PROCEED Model was confirmed, we analysed the relevance of each factor. Cross tabulation was performed for each check-up to investigate the effect of the age and employment status of the parent and guardian on attendance at scheduled oral health check-ups. We used the *t*-test to ascertain what changes occurred in the items of the 7 factors from the PRECEDE-PROCEED Model at each check-up, and Pearson's correlation coefficient was used to analyse the items in which the *t*-test found a significant difference. Following this, we carried out covariance structure analysis and investigated the factors that affected attendance at scheduled oral health check-ups. The model fit indices of GFI (0.9 or above), IFI (0.9 or above) and RAMSEA (0.08 or below) were used for the analysis of covariance structure. Error variables e1 to e10 and disturbance variables d1 to d4 sequentially.

These were analysed using Pearson's correlation coefficient, and followed by co-variance structural analysis in order to investigate the factors affecting the behaviour for attendance at scheduled dental check-ups. For the analysis, SPSS 16.0J, Amos7.0 (SPSS, Tokyo) was used [12].

Ethical considerations. This study was conducted after obtaining the approval of the Domestic Ethics Committee of the Graduate School of Health Sciences, Okayama University. The letter accompanying all questionnaires explained the purpose of the survey, confidentiality agreements and the option to not respond without disadvantages. Only those who agreed to the survey submitted the questionnaires at the check-ups sites. Documentation that was sent by post described the research objectives, maintenance of confidentiality, survey participation by one's own free will, and non-cooperation not resulting in the loss of benefits and anonymity of the survey. The survey form was then carried to the place of check-up for those people from whom consent was obtained, and the form was retrieved.

Results

Table 2 shows the ratio of the infants taken to dental check-ups, the ratio of infants having caries and the mean number of decayed teeth per infant in each target age group for the 317 participating infants (160 males and 157 females). As seen in the table, the 2005 dental disease survey results [13] show a lower ratio of infants having caries in Okayama Prefecture compared to the national ratio, excluding the group of 3y infants.

Table 3 shows the correlations between the age and employment status of the mothers and attendance at scheduled dental check-ups. The overall ratio of infants who attended the scheduled dental check-ups was 26.3%, and the ratio increased as age increased. Although the rate of infants who attended the check-ups was lowest for the group of mothers in their twenties (21.4%), no other significant differences were found that were dependent on the age of the mothers. The ratio of infants who attended the check-ups was highest in the group of housewives (33.3%) and lowest in the part-time and full-time working mothers (20.7%).

Variations in the 7 factors of the PRECEDE-

Table 2 Facts about dental health check-ups

The target ages for check-ups	Number of target infants	Number of infants attending the check-ups	Ratio of infants attending the check-ups (%)	Mean number of teeth per infant	SD	Ratio of Infants having Caries (%)	Mean number of decayed teeth per Infant	SD	Dental disease survey 2005	
									Ratio of Caries (%)	Decayed teeth per infant (number)
18m	125	117	93.6	14.7	2.9	1.7	0.2	1.2	3.1 (1y)	0 (1y)
2y6m	118	105	89.0	18.6	1.7	13.3	0.4	0.8	17.8 (2y)	0.4 (2y)
3y	148	136	91.9	20.0	0.6	25.0	0.9	1.6	24.4 (3y)	0.9 (3y)

Table 3 Study group profile and scheduled dental check-ups attendance

Terms	Scheduled dental check-ups			
	Once and more N	(%)	Not attending N	(%)
check-ups				
Overall check-ups	83	26.3	233	73.7
18m	14	13.5	90	86.5
2y6m	24	25.5	70	74.5
3y	45	38.1	73	61.9
Parent age				
20th	22	21.4	81	78.6
30th	55	28.6	137	71.4
40th	5	26.3	14	73.7
Parent employment				
Employed	37	20.7	142	79.3
On leave	4	23.5	13	76.5
Housewife	39	33.3	78	66.7

PROCEED model for infants at 18m, 2y6m and 3y were evaluated (Table 4-1, 4-2). For 18m and 2y6m infants, the results showed significant differences in health problems ($t[196] = 2.42, p < 0.05$), and in 2 dental health behaviours: Parents brush the infant's teeth a second time after letting the infant brush his/her own teeth ($t[197] = -2.83, p < 0.01$) and parents apply fluoride varnish at least once a year for caries prevention ($t[196] = -4.66, p < 0.001$). For 2y6m and 3y infants, significant differences were found in dental health behaviour (parents apply fluoride varnish at least once a year for caries prevention ($t[210] = -4.61, p < 0.001$)), reinforcing factors (having been praised for the infant's good brushing practice by the dentist or public health nurse ($t[210] = -2.23, p < 0.05$)) and enabling factors (there are opportunities to

learn how to brush the infant's teeth at a public health centre ($t[210] = -5.55, p < 0.001$)). For 18m and 3y infants, significant differences were found in 9 items: health problems ($t[220] = 3.96, p < 0.001$), dental health behaviour (parents apply fluoride varnish at least once a year for caries prevention ($t[220] = -10.42, p < 0.01$)), environmental factors (hours a day of interaction with the infant ($t[220] = -2.89, p < 0.001$)), 3 predisposing factors (parents give up brushing if the infant strongly dislikes it ($t[220] = -2.64, p < 0.01$)), parental knowledge that many caries in primary teeth negatively impact systemic growth and development of the infant ($t[220] = -2.06, p < 0.05$), and parents let the infant have the sweets when he/she wants ($t[220] = -2.06, p < 0.05$)), reinforcing factors (having been praised for your infant's good brushing practice by the dentist or public health nurse ($t[220] = -3.53, p < 0.01$)), and 2 enabling factors (there are opportunities to learn how to brush the infant's teeth at the dentist's ($t[220] = -3.14, p < 0.01$) and there are opportunities to learn how to brush the infant's teeth at a public health centre ($t[220] = -7.30, p < 0.001$)).

We analysed the correlation coefficient of items where the results of the *t*-test found a significant difference in the 7 factors of the PRECEDE-PROCEED Model and each oral health check-up (Table 5). A positive correlation was found between health problems at the scheduled dental health check-ups and attendance. In addition, a moderate correlation was found between fluoride coating and attendance at dental check-ups, and a weak correlation was found between receiving praise and 22 enabling factors.

Next, in order to investigate the causal factors involved in attendance at scheduled dental health check-ups, the model in Fig. 1 was constructed the

Table 4-1 Survey Findings in Check-ups Concerning the 7 Factors: (QOL, Health Problems, Health Behaviours, Environmental Factors)

	Terms	Age	Difference of the Mean	Difference of SD	t value	Probability
Factor(1)	QOL					
	1. There are some concerns about the infant's growth or development ⁺	18m-2y6m	0.03	0.08	0.36	0.72
		18m-3y	0	0.08	-0.06	0.95
		2y6m-3y	-0.03	0.08	-0.44	0.66
Factor(2)	Health Problems					
	7. Less than thirty % of parents take their infants to the dentist at least once a year for caries prevention ⁺	18m-2y6m	0.28	0.11	2.42	0.02*
		18m-3y	0.43	0.11	3.96	0.00***
		2y6m-3y	0.15	0.13	1.13	0.26
Factor(3)	Dental Health Behaviours					
	2. Parents clean the infant's teeth using dental floss	18m-2y6m	-0.16	0.09	-1.71	0.09
		18m-3y	-0.29	0.09	-3.24	0.00***
		2y6m-3y	-0.13	0.11	-1.20	0.23
	3. Parents brush the infant's teeth while holding him/her on his/her lap	18m-2y6m	-0.22	0.13	-1.74	0.08
		18m-3y	-0.05	0.12	0.42	0.67
		2y6m-3y	0.17	0.09	-0.14	0.17
	4. Parents brush the infant's teeth a second time after letting the infant brush his/her own teeth	18m-2y6m	-0.25	0.09	-2.83	0.00**
		18m-3y	-0.16	0.09	-1.80	0.07
		2y6m-3y	0.09	0.07	1.25	0.21
	5. Parents apply fluoride varnish at least once a year for caries prevention	18m-2y6m	-0.75	0.16	-4.66	0.00***
		18m-3y	-1.42	0.14	-10.42	0.00***
		2y6m-3y	-0.67	0.15	-4.61	0.00***
Factor(4)	Environmental Factors					
	6. Number of children in the family ⁺	18m-2y6m	-0.09	0.12	-0.74	0.46
		18m-3y	-0.16	0.10	-1.62	0.11
		2y6m-3y	-0.07	0.11	-0.70	0.49
	8. Number of family members ⁺	18m-2y6m	-0.03	0.25	-0.11	0.92
		18m-3y	-0.05	0.23	-0.21	0.84
		2y6m-3y	-0.02	0.23	-0.10	0.93
	9. Years or months of living in the current residence	18m-2y6m	-1.14	1.01	-1.13	0.26
		18m-3y	-1.61	0.99	-1.63	0.11
		2y6m-3y	-0.47	1.09	-0.42	0.67
	10. Hours a day of interaction with the infant	18m-2y6m	1.96	1.24	1.58	0.12
		18m-3y	3.28	1.13	2.89	0.00**
		2y6m-3y	1.32	1.17	1.13	0.26

*p < 0.05, **p < 0.01, ***p < 0.001

+: Responses for inversion questions

from inter-factor change at each oral health check-up and inter-factor correlations, and a covariance structure analysis was carried out. The fitness level indices of GFI = 0.91, IFI = 0.94 and RAMSEA = 0.04 suggested the model fit was acceptable. The covariance

structure analysis results showed that enabling factors and predisposing factors influenced by direct and indirect reinforcing factors were associated with dental health behaviour. The covariance structure analysis results also showed that predisposing factors

Table 4-2 Survey Findings in Check-ups Concerning the 7 Factors: (Predisposing Factors, Reinforcing Factors, Enabling Factors)

	Terms	Age	Difference of the Mean	Difference of SD	t value	Probability
Factor(5)	Predisposing Factors					
	11. Parents give up brushing if the infant strongly dislikes it ⁺	18m-2y6m	-0.09	0.15	-0.61	0.55
		18m-3y	-0.35	0.14	-2.64	0.00**
		2y6m-3y	-0.26	0.14	-1.94	0.05
	12. Parent feel uncomfortable without brushing the infant's teeth every day	18m-2y6m	-0.19	0.12	-1.59	0.12
		18m-3y	-0.13	0.11	-1.73	0.24
		2y6m-3y	0.06	0.11	0.55	0.48
	13. A few caries in primary teeth are negligible because primary teeth will be replaced with permanent teeth. ⁺	18m-2y6m	-0.10	0.09	-1.09	0.28
		18m-3y	-0.02	0.08	-0.26	0.80
		2y6m-3y	0.08	0.08	0.89	0.37
	14. Many caries in primary teeth will negatively impact systemic growth and development of the infant	18m-2y6m	-0.12	0.13	-0.89	0.38
		18m-3y	-0.23	0.11	-2.06	0.04*
		2y6m-3y	-0.11	0.11	-0.98	0.33
	15. Parents should be actively involved in caries prevention in infants	18m-2y6m	-0.07	0.05	-1.47	0.14
		18m-3y	-0.06	0.05	-1.19	0.24
		2y6m-3y	0.01	0.04	0.39	0.70
	16. Parents should take the infants to the dentists only when caries are found in their teeth ⁺	18m-2y6m	0	0.17	0.01	0.99
		18m-3y	-0.09	0.16	-0.58	0.57
2y6m-3y		-0.09	0.16	-0.59	0.56	
17. Parents let the infant have sweets whenever he/she wants ⁺	18m-2y6m	-0.05	0.12	-0.44	0.67	
	18m-3y	-0.23	0.11	-2.06	0.04*	
	2y6m-3y	-0.18	0.12	-1.54	0.13	
18. Parents enjoy being with the kids	18m-2y6m	0	0.09	-0.01	0.99	
	18m-3y	0.08	0.09	0.78	0.43	
	2y6m-3y	-0.08	0.09	-0.81	0.42	
Factor(6)	Reinforcing Factors					
	19. Having been praised for your infant's Dental Health Behaviours good brushing practice by the dentist or public health nurse	18m-2y6m	-0.15	0.11	-1.43	0.16
		18m-3y	-0.43	0.12	-3.53	0.00**
2y6m-3y		-0.28	0.13	-2.23	0.03*	
Factor(7)	Enabling Factors					
	20. There are children's dentists in the neighborhood	18m-2y6m	-0.11	0.17	-0.61	0.55
		18m-3y	-0.24	0.17	-1.38	0.17
		2y6m-3y	-0.13	0.18	-0.74	0.46
	21. There are opportunities to learn how to brush the infant's teeth at a dentist	18m-2y6m	-0.18	0.14	-1.23	0.22
		18m-3y	-0.47	0.15	-3.14	0.00**
		2y6m-3y	-0.29	0.16	-1.79	0.07
	22. There are opportunities to learn how to brush the infant's teeth at a public health center	18m-2y6m	-0.25	0.14	-1.78	0.09
		18m-3y	-1.01	0.14	-7.30	0.00***
2y6m-3y		-0.76	0.14	-5.55	0.00***	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

+: Responses for inversion questions

Table 5 The correlation of 7 factors in the PRECEDE-PROCEED model

Terms	Factor(2)	Factor(3)		Factor(4)		Factor(5)		Factor(6)	Factor(7)	
	Health Problems	Dental Health Behaviours		Environmental Factors		Predisposing Factors		Reinforcing Factors	Enabling Factors	
	7	2	4	5	10	11	14	17	19	21
Factor(3) Dental Health Behaviours										
2	.286**	-	-	-	-	-	-	-	-	-
4	.107	.070	-	-	-	-	-	-	-	-
5	.474***	.288	.145	-	-	-	-	-	-	-
Factor(4) Environmental Factors										
10	.116*	.037	.078	.022	-	-	-	-	-	-
Factor(5) Predisposing Factors										
11	.023	.053	.193**	.145*	.024	-	-	-	-	-
14	.088	.130*	.123*	.149**	-.081	.124*	-	-	-	-
17	.094	.005	.058	.057	-.025	.106	.102	-	-	-
Factor(6) Reinforcing Factors										
19	.254**	.096	.200**	.325**	-.012	.144*	.166**	.250**	-	-
Factor(7) Enabling Factors										
21	.584**	.300**	.079	.402**	.142*	-.026	.126*	.070	.299**	-
22	.276**	.126*	.127*	.501**	-.114*	.075	.178**	.207**	.396**	.390**

Pearson * $p < 0.05$, ** $p < 0.01$

and dental health behaviour were associated with attendance at scheduled dental health check-ups.

Discussion

Regarding the health check-ups undertaken in City B, a regional oral health program was developed comprising a primary prevention strategy focused on self-care, including guidance on between-meal snacking and teeth-brushing education, and secondary prevention by early detection and treatment of disease [13, 14]. Since then, the number of caries per person in City B has fallen each year, and the status of oral hygiene in City B in 2008 for infant check-ups at 18m, 2y6m, and 3y is almost identical to figures in the 2005 dental disease census survey. We believe that future caries reduction will require treatment using specific methods of protection, such as the use of professional fluoride compounds and antibacterial coating materials. Regarding individuals, we also

believe it would be effective to develop each person's consciousness to improve health maintenance in areas where self-care is insufficient, through periodic attendance at a local health care institution. However, City B is located in a mountainous area in the northern part of Okayama Prefecture where there is a shortage of physicians [15-17]. There are just 106.9 physicians per 100,000 people, an availability of less than half the average across the whole of Okayama Prefecture [18]. Hence, we believe it important that the objectives and role of health and welfare services be organised for the purpose of regional health maintenance, and the question of how health services can exist with stronger regional partnerships be investigated.

We studied the effects of changes with increasing age on the 7 factors of the PRECEDE-PROCEED model in infants from the point of view of improving oral self-care and continuous oral health management from an early age, and with the objective of increasing

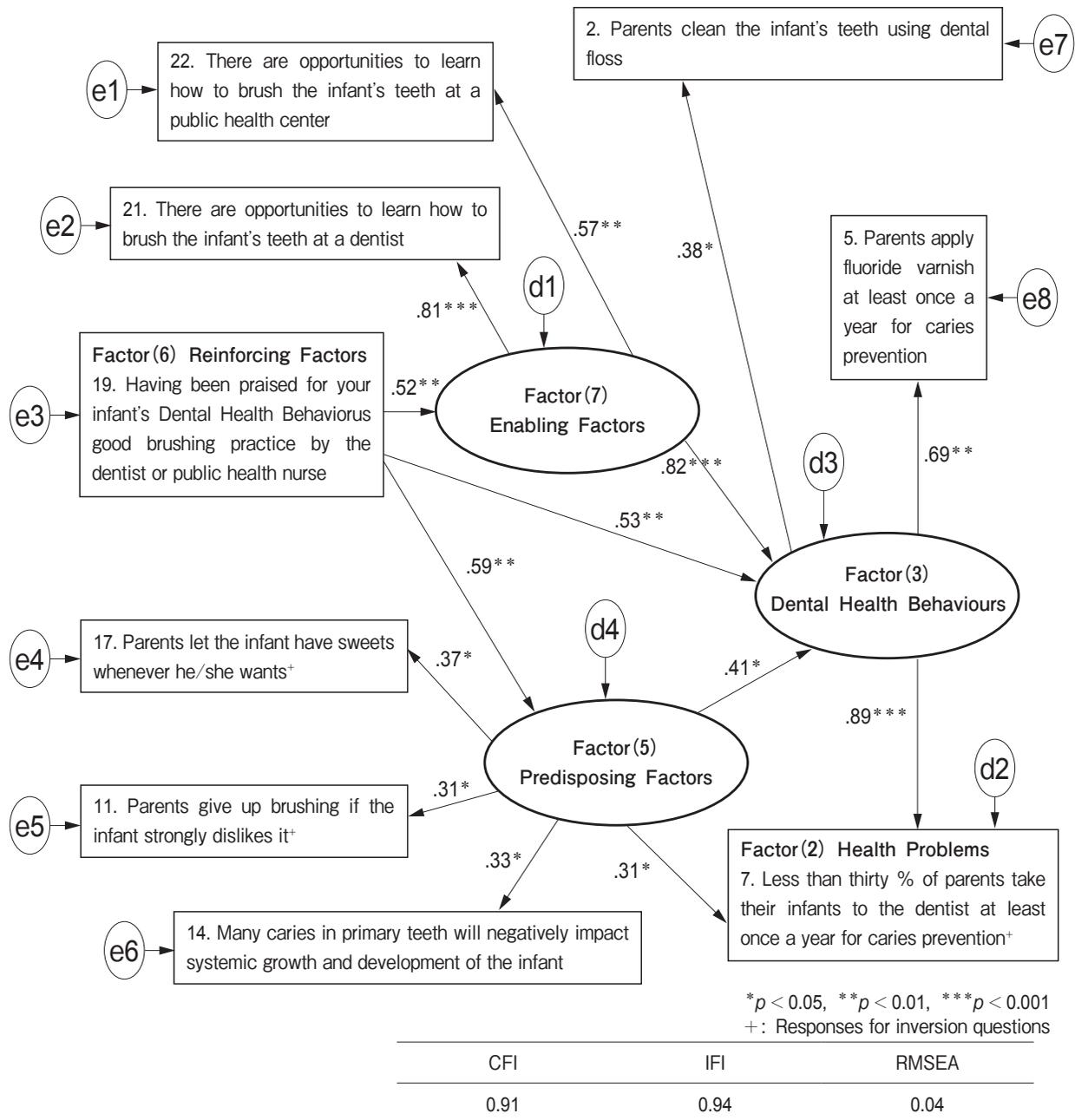


Fig. 1 Cause and Effect Model concerning whether to attend the scheduled dental check-ups for 18 months–3 year old infants.

attendance rates for scheduled dental health check-ups. Significant differences among 11 items were seen between dental health check-ups at 18m and at 3y. These 11 items corresponded to the following factors: health problems (1 item), dental health behaviour (3 items), environmental factors (1 item), predisposing factors (3 items), reinforcing factors (1

item) and enabling factors (2 items) (Table 4-1, 4-2). Among these 11 items, 2 items showed a reduced involvement of the parent with an increase in the infant's age (4, 10). With respect to item 4, the reasons for the increase in the number of parents not performing the item are considered likely to be an improvement in the child's brushing skills as the child's

fingers develop, and a rounding out of the child's sense of independence causing the child's dislike for parental intervention. With respect to item 10, the causes of parents' reduced involvement are thought to be the child's development of language faculties, an increasing number of situations in which the child is capable of performing alone, and improved social skills, resulting in less need for parents to stay next to the child for the purpose of safety, and more time available for parents to spend on activities other than childcare.

Next, we investigated the correlation between items in which a significant difference was found in the *t*-test results, as shown in Table 4-1 and 4-2. The results of this investigation showed that scheduled oral health check-ups of factor 2 was particularly related to receiving guidance at a dental clinic about the brushing of teeth. However, there was no remarkable difference found in attendance at scheduled oral health check-ups according to oral health check-up type, or on the age or employment status of the parent and guardian. Therefore, it seems likely that involvement with a health care institution, an enabling factor, has a great effect on attendance at scheduled dental health check-ups. In addition, it was also shown that receiving praise from a health care professional on the brushing of a child's teeth and receiving guidance on brushing teeth at a dental clinic are related to the motivation to undertake fluoride coating. We consider that it would be effective in the future for scheduled dental health check-ups to be encouraged in association with health maintenance as their objective. This will require health care practitioners to understand the importance of an involvement that is regardful of encouragement, technical guidance and the provision of knowledge about prevention [19, 20].

Using the model adopted by this research, we showed that oral health behaviour was associated with enabling factors and predisposing factors influenced by direct and indirect reinforcing factors. In addition, it was found that attendance at scheduled dental health check-ups was associated with both predisposing factors and dental health behaviour, and the pass coefficient showed that dental health behaviour had a greater impact. As such, to support dental health behaviour on the basis of personal oral self-care capacity such as personal teeth-brushing skills, the most important factors are education on the health

maintenance service side and organisation of health care provision services to take up the responsibility of helping to bring about dental health behaviours. In addition, it will be necessary to be conscious of reinforcing factors as a means of assistance with respect to the medical health side, because reinforcing factors lead to both motivation for participation and continuous behaviour, with the consumer impression that 'health guidance is extremely useful, I want to receive it again, and I want to continue to use what I have learned'.

By such measures, the involvement of multiple professions in health maintenance will help in the dissemination of knowledge regarding personal dental health behaviour, and the adoption of personal coping methods will work to lessen the unidirectional risk for a diverse array of health issues. The involvement of medical treatment aligned with health care will result in the strengthening of dental health behaviour and predisposing factors, support the definite positioning of scheduled dental health check-ups as a means of health maintenance, and lead to individual improvements in QOL.

Conclusions. We administered a questionnaire composed of 22 4-choice items covering the 7 factors from the PRECEDE-PROCEED model to 317 parents who attended infant health check-ups in City B in Okayama Prefecture. As a result, it was shown that enabling factors and predisposing factors influenced by direct and indirect reinforcing factors were associated with oral health behaviour and were indirectly associated with oral health care. In addition, it was shown that predisposing factors and oral health care behaviour were associated with attendance at scheduled dental health check-ups. As such, the results indicated that the strengthening of oral health behaviour and predisposing factors will lead to improvements in attendance at scheduled dental health check-ups. The results of this study indicate the importance of the organization and coordination of the contents of medical check-ups conducted by medical institutions, and for these institutions to assume responsibility in helping to bring about health education and behaviour for health care maintenance.

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References

1. Kadowaki T, Shimizu K and Moriyama H: Nursing laws and ordinances Guidance; in Annual Statistical Report of National Health Conditions, Kadowaki T, Shimizu K and Moriyama H eds, 1st Ed, Japanese Nursing Association, Tokyo (2010) pp169–189.
2. Kadowaki T, Shimizu K and Moriyama H: Nursing laws and ordinances Guidance; in Enforcement Procedures Concerning Maternal and Child Dental Check-Ups and Healthcare Guidance, Kadowaki T, Shimizu K and Moriyama H eds, 1st Ed, Japanese Nursing Association, Tokyo (2010) pp 341–347.
3. Kawaguchi Y, Shinada K and Furukawa K: Dental health status in Japan from the aspect of epidemiology data. *J Tokyo Dental Association* (2001) 51: 20–28 (in Japanese).
4. Ishikawa A, Masuda M, Iwata S, Kodama Y and Onoma R: Changes in Caries Prevalence among 1.5- and 3-year-old Children in a City, *J Dental Health* (1999) 49: 222–229 (in Japanese).
5. Mitoh S: Lifestyle Factors Affecting Prevalence of Dental Caries in Infants in Onomichi-city. *J Dental Health* (2006) 56: 688–708 (in Japanese).
6. Takatoku Y, Sakuma S and Kishi H: The Evaluation of a Community-based Preventive Program for Deciduous Caries with Introduction of a Method of Screening High-risk Children. *J Dental Health* (2000) 50: 69–77 (in Japanese).
7. Morishita M and Fujioka M: Effects of Professional Tooth Cleaning under a Regular Check-up System in Private. *J Dental Health* (2004) 54: 50–57 (in Japanese).
8. Green LW and Kreuter MW: Health Promotion Planning An educational and environmental approach. 2nd Ed, Mayfield Publishing Company, California (1991) pp15–32.
9. Kawamura M and Sasahara H: Differences between a model of dental health on the base of the PRECEDE-PROCEED model and the reality in a community: The results by LISRETL analysis. *J Dental Health* (2004) 54: 115–121 (in Japanese).
10. Kawamura M, Sasahara H, Tomita, Takahash H, Fujii H, Sato M, Yoshioka H, Iwasaki Y and Kajawara K: A Trial of Environmental/Behavioral Assessment Based on the Relationships among Seven Oral Health-related Factors at the Community Level. *J Dental Health* (2005) 55: 95–99 (in Japanese).
11. Nakamura J: Let's Start! Preventive Dentistry in Your Community, Ishiyaku Publishers, 1st Ed, Tokyo (2003).
12. Oshio A: Psychological Research Data Analysis by SPSS and Amos, 4th Ed, Tokyo Tosho, Tokyo (2005).
13. Leavell HR: The basic unity of private practice and public health, *J Pub Health* (1953) 43: 1501–1506.
14. Leavell HR and Clark EG: Preventive medicine for the doctor in his community an epidemiological approach, 2nd Ed, Mcgraw- hill, New York (1958).
15. Statistical Analysis Committee: Comprehensive Guide to the Survey of Dental Diseases in 2005, 1st Ed, Oral Health Association of Japan, Tokyo (2005) pp47–91.
16. Aizawa F: Relationship between the mother's Consciousness about Dental Health and Dental Health Behavior –II. Study of Mothers with 3-year-old Children-. *J Dental Health* (2002) 52: 2–11 (in Japanese).
17. WHO: Fluorides and oral health; in Report of a WHO Experts Committee on Oral Health Status and Fluorides Use. WHO Technical Report Series, Geneva (1994).
18. Niimi City Press Committee: Niimi City Report. Planning & Public Policy Unit, General Affairs Department, Niimi (2006) 12: 1–34 (in Japanese).
19. Yoshida Y: Development of Antibacterial Varnish for Preventing Caries and Periodontal Diseases. *JADS* (2009) 28: 39–43 (in Japanese).
20. Morishita M and Fujioka M: Effects of Professional Tooth Cleaning under a Regular Check-up System In a Private Dental Office. *J Dental Health* (2004) 54: 50–57 (in Japanese).