

Original

Associations between oral health behavior and anxiety about water fluoridation and motivation to establish water fluoridation in Japanese residents

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(Received 8 March and accepted 7 June 2011)

Abstract: Since 1972, community water fluoridation programs have not been practiced in Japan. Risk perception among the population plays an important role in the implementation of water fluoridation programs. The oral health behavior of Japanese children has changed, especially due to recent increases among children in the use of fluoridated products and fluoride applications by dentists. The purpose of this study was to examine the associations between oral health behavior, risk perception, and the desire to implement water fluoridation among Japanese residents. We distributed a questionnaire survey (response rate: 92.8%) to mothers with children aged two or three years ($n = 573$). There was a correlation between anxiety and level of motivation to implement water fluoridation (Spearman coefficient: 0.355, $P < 0.001$). Exposure to various fluoride experiences was higher in the “not anxious” group. The motivation level was significantly higher in subjects who had a better understanding of the effectiveness of fluoride, those who used fluoride tooth paste, and those whose children received fluoride applications from dentists. We conclude that increased knowledge of and experience with fluoride might help decrease the perception of risk and increase motivation for implementing

water fluoridation among the general public. (*J Oral Sci* 53, 313-319, 2011)

Keywords: water fluoridation; risk perception; fluoride application.

Introduction

The first community water fluoridation program in the world began in 1945 (1). Since then, numerous studies have demonstrated that water fluoridation effectively reduces the incidence of dental caries in the community, with minimal side effects (2). More than 350 million people in over 30 countries have benefitted from the addition of fluoride to public water (3). Although water fluoridation is a widely endorsed public health measure, proposals to introduce water fluoridation are often controversial, and public opinion frequently plays a role in the outcome (4).

Japan had three experiences with water fluoridation (5). The first fluoridation program was in Kyoto prefecture (1952–1965), the second was established by US military authorities in Okinawa prefecture (1957–1972), and the last experience was in Mie prefecture (1967–1971). Water fluoridation has not been practiced in Japan since 1972. The decision to implement water fluoridation in Japan now depends on achieving consensus among the residents of each municipality.

A person’s general evaluation of a program or practice is a major predictor of the risk / benefit correlation, (6) and the processes of decision-making are influenced by

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risk perception. Studies have investigated the perception of risks related to water fluoridation (4,7).

In Japan, fluoride toothpaste represented only a relatively small proportion (approximately 50%) of the dentifrice market in the mid-1990s (8). In addition, foreign experts often accuse Japanese dental professionals of failure to both promote the use of fluoride toothpaste and sufficiently educate the public regarding the benefits of fluoride (9). A new government program called "Healthy Japan 21" (10) set a goal of preventing dental caries by increasing the public's use of fluoride toothpaste and topical fluoride applications. The proportion of children who receive topical fluoride applications and use fluoride toothpastes has since increased (11), as has the proportion of those who use fluoride mouth rinse (12).

We conducted this survey to examine, 1) the correlation between anxiety about and motivation for implementing water fluoridation, 2) the relationship between anxiety about water fluoridation and knowledge of oral health and oral health behaviors, and 3) the relationship between motivation to implement water fluoridation and knowledge of oral health and oral health behaviors.

Materials and Methods

Subjects

Tomioka-kanra area is located in southwest Gunma prefecture, about 100 km northwest of Tokyo, Japan. According to the 2005 national census (13), the population of the area was approximately 76,000, and the population of children aged two or three years was approximately 1,200. The health center in each municipality and the Tomioka-kanra dental association are responsible for the oral health of the residents. Water fluoridation promotion activities are very active in this area (14). For instance, the dental association conducted a project called "Promoting Activities about Water Fluoridation", for which it received funding from the 8020 Promotion Foundation (15).

During the period from April through September 2010, we asked public health nurses to distribute a questionnaire survey to the caregivers of children aged one through four years. A total of 1,006 questionnaires were distributed, and the response rate was 92.8% ($n = 934$). For the analysis, we selected 573 mothers who had a child aged two or three years. The present study was approved by the ethics committee of Tsurumi University.

Questionnaire

The questionnaire was composed of 4 parts: opinions about water fluoridation, oral health knowledge, maternal

oral health behavior, and child oral health behavior. The section on opinions about water fluoridation included questions about whether the subjects were anxious about water fluoridation and their level of motivation for implementing water fluoridation in their community. Motivation level was assessed by choosing a number on a scale between two opinions, with 5 indicating the highest support for fluoridation. The section on oral health knowledge assessed recognition of the effectiveness of fluoride and water fluoridation. The section on the maternal oral health behavior included questions on use of fluoride toothpaste, experience with fluoride mouth rinse, and experience with fluoridated water. The sections on child oral health behavior assessed the frequency of snacking (snacking habits), frequency of caregiver brushing of their child's teeth, use of fluoride toothpaste for the child, and experience of fluoride application to the child's primary teeth.

Analysis

The Spearman rank correlation coefficient was used to examine the correlation between anxiety about fluoride and the level of motivation for implementing public water fluoridation. To investigate the relationship between anxiety about water fluoridation and oral health knowledge and behavior, the subjects were classified as "anxious" or "not anxious". The anxious group included the "very anxious", "anxious", "somewhat anxious", and "unknown" subgroups, and the not anxious group included the "minimally anxious" and "never anxious" subgroups. Differences in the anxious and not anxious groups were analyzed by using the binomial test, Pearson chi-square test, or Fisher exact test. To explore the relationship between motivation to implement public water fluoridation and oral health knowledge and behavior, we categorized each item of oral health knowledge and behavior into two groups and compared the average motivation level by using the two-tailed Student *t*-test. The data were analyzed using the SPSS 16.0J software package.

Results

Characteristics of study subjects

The subjects in our survey were mothers who had a child aged two or three years. Regarding maternal age, 152 (26.6%) mothers were aged 21 to 30 years, 367 (64.1%) were 31 to 40, 30 (5.2%) were older than 40, and age data were missing for 24 (4.2%).

With regard to oral health knowledge, 95.3% of mothers recognized the effectiveness of fluoride in preventing dental caries, and 47.3% were aware of water

fluoridation. For oral health behaviors, 76.0% used fluoride toothpaste, 33.2% used fluoride mouth rinse, and 8.4% had tried a cup of fluoridated water. With regard to child oral health behaviors, 74.3% of mothers limited their child to fewer than two snacks per day, 96.1% brushed their child's teeth more than once per day, 70.7% used a fluoride toothpaste to brush their child's teeth, and 96.0% had their child receive a fluoride application for their primary teeth.

Opinions on water fluoridation

The section eliciting opinions regarding water fluoridation included both anxiety about fluoridation and level of motivation to implement public water fluoridation (Table 1). The anxious group comprised 37.3% of the study population. The average level of motivation for

implementing water fluoridation was 4.0 ± 1.0 (average \pm standard deviation), and the number of mothers who had a very high motivation level (5.0) was 239 (42.9%).

Correlation between anxiety and level of motivation for implementing water fluoridation

The Spearman rank correlation coefficient between anxiety and the motivation level for implementing public water fluoridation was 0.355 (Table 2). Anxiety level was significantly inversely correlated with motivation.

Association between anxiety about water fluoridation and oral health knowledge and behavior

We analyzed differences in oral health knowledge and behavior between the anxious and not anxious groups. Recognition of the effectiveness of fluoride for preventing

Table 1 Motivation and opinions of respondents regarding water fluoridation

		(n)	(%)
Level of motivation for water fluoridation	1	19	3.4%
	2	13	2.3%
	3	131	23.5%
	4	155	27.8%
	5	239	42.9%
Level of anxiety about water fluoridation	Very anxious	21	3.7%
	Anxious	100	17.5%
	Somewhat anxious	127	22.2%
	Unknown	110	19.3%
	Minimally anxious	177	31.0%
	Never anxious	36	6.3%

Table 2 Correlation between anxiety and level of motivation regarding implementation of water fluoridation

Motivation level	Level of anxiety about water fluoridation						Total
	Very anxious	Anxious	Somewhat anxious	Unknown	Minimally anxious	Never anxious	
1	(n) 7 (%) 36.8%	3 15.8%	6 31.6%	2 10.5%	1 5.3%	0 0.0%	19 100.0%
2	(n) 2 (%) 15.4%	6 46.2%	2 15.4%	1 7.7%	2 15.4%	0 0.0%	13 100.0%
3	(n) 1 (%) 0.8%	25 19.1%	43 32.8%	43 32.8%	18 13.7%	1 0.8%	131 100.0%
4	(n) 2 (%) 1.3%	28 18.1%	48 31.0%	27 17.4%	49 31.6%	1 0.6%	155 100.0%
5	(n) 7 (%) 2.9%	32 13.4%	28 11.7%	34 14.2%	106 44.4%	32 13.4%	239 100.0%
Total	(n) 19 (%) 3.4%	94 16.9%	127 22.8%	107 19.2%	176 31.6%	34 6.1%	557 100.0%

Spearman correlation: 0.355, $P < 0.000$

dental caries, knowledge of water fluoridation, previous use of fluoridated water, and use of fluoride toothpaste to brush their child’s teeth were all significantly higher in the not anxious group. In addition, they were more likely to have sought fluoride application for the primary teeth of their children (Table 3).

Association between level of motivation for implementing water fluoridation and oral health knowledge and behavior

The level of motivation for implementing water fluoridation was significantly higher in mothers with greater knowledge of the effectiveness of fluoride and those with experience using fluoride, including the use of

Table 3 Association between anxiety and oral health behavior

		Level of anxiety about water fluoridation				P value
		Not Anxious	Anxious	Total		
Oral health knowledge	Recognition of effectiveness of fluoride	Effective	210 98.6%	334 93.3%	544 95.3%	0.00
		Not effective + unknown	3 1.4%	24 6.7%	27 4.7%	
Recognition of water fluoridation	Well known + known	127 59.9%	142 39.8%	269 47.3%	0.00	
	Heard of + unknown	85 40.1%	215 60.2%	300 52.7%		
Maternal oral health behavior	Use of fluoride toothpaste	Using	169 80.1%	262 73.6%	431 76.0%	0.08
		Not using + unknown	42 19.9%	94 26.4%	136 24.0%	
Experience of fluoride mouth rinse	Experience	74 34.7%	115 32.3%	189 33.2%	0.58	
	No experience + unknown	139 65.3%	241 67.7%	380 66.8%		
Sampling of a cup of fluoridated water	Experience	26 12.2%	22 6.1%	48 8.4%	0.02	
	No experience + unknown	187 87.8%	336 93.9%	523 91.6%		
Child oral health behavior	Child's snacking frequency	Fewer than 2 times a day	155 73.5%	268 74.9%	423 74.3%	0.77
		More than 3 times a day	56 26.5%	90 25.1%	146 25.7%	
Frequency of parental brushing of child's teeth	More than once a day	205 96.7%	340 95.8%	545 96.1%	0.66	
	Less than once a day	7 3.3%	15 4.2%	22 3.9%		
Use of fluoride toothpaste for child	Daily	162 76.1%	241 67.5%	403 70.7%	0.04	
	Other	51 23.9%	116 32.5%	167 29.3%		
Fluoride application on child's primary teeth	Yes	209 99.1%	337 94.1%	546 96.0%	0.03	
	No	2 0.9%	21 5.9%	23 4.0%		

Table 4 Association between motivation level and oral health behavior

		Motivation level			
		Average	SD	P value	
Oral health knowledge	Recognition of effectiveness of fluoride	Effective	4.08	1.00	0.004
		Not effective + unknown	3.27	1.03	
Recognition of water fluoridation	Well known + known	4.06	1.12	0.619	
	Heard of + unknown	4.02	0.95		
Maternal oral health behavior	Use of fluoride toothpaste	Using	4.09	1.01	0.036
		Not using + unknown	3.88	1.10	
Experience of fluoride mouth rinse	Experience	4.18	1.26	0.027	
	No experience + unknown	3.98	1.03		
Sampling of a cup of fluoridated water	No experience + unknown	4.03	1.02	0.183	
	Experience	4.24	1.12		
Child oral health behavior	Child's snacking frequency	Fewer than 2 times a day	4.01	1.04	0.166
		More than 3 times a day	4.15	1.00	
Frequency of parental brushing of child's teeth	More than once a day	4.04	1.02	0.146	
	Less than once a day	4.06	1.05		
Use of fluoride toothpaste for child	Daily	4.12	0.96	0.014	
	Other	3.87	0.96		
Fluoride application on child's primary teeth	Yes	4.07	1.02	0.006	
	No	3.45	1.14		

fluoride toothpaste, fluoride mouth rinse, use of fluoride toothpaste for their child, and experience with fluoride application for the primary teeth of their children (Table 4).

Discussion

The response rate for our survey was very high (92.8%), and the number of subjects included in our analysis was 573. Our study subjects therefore comprised approximately half the population of mothers of children aged two or three years. Our study revealed their current knowledge and opinions about water fluoridation in Tomioka-kanra.

Most subjects had a good knowledge of oral health and behavior for both their child and themselves. Healthy Japan 21 (10) set a goal of ensuring fluoride application on the primary teeth of 50% of children under age 3 years. According to the Survey of Dental Disease (2005), the proportion of topical fluoride use was approximately 42.2% by age 2 years and 48.9% by age 3 years (11), indicating that this goal is close to being achieved. Fluoride application for young children was very high in the study area. However, use of fluoride toothpaste among mothers was not very high, although most recognized the effectiveness of fluoride for preventing dental caries.

Dentists, dental hygienists, and public health nurses provide information on water fluoridation to residents of Tomioka-kanra at various events, eg, at dental health check-ups at the health center, during Oral Health Week in June, and at health events in the municipalities. They also post educational posters, distribute leaflets, give lectures, and encourage individuals to try a cup of fluoridated water. In addition, they conducted active oral health promotions to prevent dental caries with the effective use of fluoride. All children aged one year six months to three years six months are eligible to receive a free fluoride application at all health centers in Tomioka-kanra. In addition, the effective use of fluoride toothpaste was described to caregivers at these various events.

In 2006, the prevalence rate of dental caries in three-year-old children was 17.2% in Tomioka-kanra, and the number of dmft was 0.6 (14) in this region. The number of dmft and prevalence of dental caries were low as compared with Japanese nationwide dental examination data for 3-year-old children (16), for whom the prevalence of dental caries was 31.3% and the number of dft was 1.32 in 2006. There has not been a large analysis of public understanding and motivation regarding water fluoridation among Japanese residents; ours is the largest to date. In this study, 43.6% of subjects were aware of water fluoridation, while 24.2% were not. The propor-

tion of respondents with the highest motivation level for implementing public water fluoridation was 42.9%. However, despite this considerable desire for water fluoridation, 62.3% of residents had some anxiety about water fluoridation. In a past study in Japan, 21.4% of subjects agreed or strongly agreed that adding fluoride to water could reduce tooth decay (5). In a study in the Australian state of Queensland, where water fluoridation was started in 2008 (17), 70.5% percent of respondents supported water fluoridation (4). In the present study, 70.7% of the study population supported water fluoridation (defined by a motivation level of 4 or 5). The continuous promotion of water fluoridation activities in the area improved public recognition and motivation regarding water fluoridation. However, there remains a need to use more-effective promotional materials to overcome anxiety about water fluoridation, as indicated by the inverse correlation we observed between anxiety and level of motivation for implementing water fluoridation. Studies in the United States (18) and Australia (4) also found associations between promotion of water fluoridation and perception of risk.

Using factor analysis, Slovic (19) observed two factors of risk perception. Factor 1 was labeled "dread risk", and factor 2 was labeled "unknown risk". Similar results have been reported in other studies (7,20,21). A recent study (7) of Japanese mothers showed that their perception of the risk of fluoride consisted of two factors: factor 1 was "a sense of fear", and factor 2 was the "amount of information". There was little difference in "sense of fear" regarding various fluoride therapies; however, the perceived "amount of information" for fluoridation and fluoride mouth rinse was significantly less than that for fluoride application and fluoride toothpaste.

Our study shows that recognition of water fluoridation and the effectiveness of fluoride for preventing caries as well as the likelihood of trying a cup of fluoridated water and topical fluoride application at health centers were significantly higher in the not anxious mothers. Providing direct information about water fluoridation and sampling a cup of fluoridated water may therefore have important roles in decreasing the perception of dread risk and unknown risk in residents. Topical fluoride use among children might also help to decrease the perception of risk.

In Tomioka-kanra, residents have numerous chances to receive information on water fluoridation and to sample fluoride. Such an environment not only decreases the perception of dread risk, it reduces the perception of unknown risk as well. Moreover, by allowing parents to try fluoride, both types of perceived risk of water fluoridation

dation can be simultaneously addressed.

The motivation for implementing water fluoridation was significantly higher in subjects who recognized the effectiveness of fluoride use, but there was no significant difference with respect to recognition of water fluoridation. We believe that this may have been due to the way subjects were categorized. Subjects were classified as “recognizing” water fluoridation when information on water fluoridation was “well known” or “known” to them; residents who had merely “heard of” water fluoridation were classified as not recognizing water fluoridation. It is possible that residents who had only heard of the process might still have a high motivation level for implementing water fluoridation, due to their knowledge of the effectiveness of fluoride and/or their regular use of topical fluoride.

Our analysis was limited by the fact that it was conducted in a community that strongly promoted fluoride use and had a goal of promoting public water fluoridation.

Recently, the number of schools participating in a school-based fluoride mouth rinse program has been increasing (12), and many municipalities have begun to establish dental health regulations, including promotion of fluoride use, at the local government level (22). In 2005, the percentage of persons with experience of topical fluoride application was five times that in 1975. However, promoting only topical fluoride use, in the absence of information on water fluoridation, will likely not improve the motivation of residents to implement public water fluoridation.

Improving public awareness of fluoridation is important. However, the general public expects experts to make the final decision on whether to implement water fluoridation programs (23). In Japan, limited awareness among dental professionals of the effectiveness of water fluoridation (5) and differences in dental education regarding fluoride therapy are believed to be obstacles to promoting water fluoridation.

Our study shows that increasing knowledge and experience of fluoride can change risk perception of water fluoridation and might thus improve the motivation of residents to support public water fluoridation. To encourage adoption of water fluoridation in Japan, continued promotion of the daily use of fluoride toothpaste, regular topical fluoride applications for children, and school-based fluoride mouth rinse programs will help improve awareness and motivation regarding the implementation of water fluoridation. In addition, to better promote the topical use of fluoride in communities, more dental professionals should be trained to deliver

accurate information on water fluoridation.

Acknowledgments

We wish to thank the public health nurses in Tomioka-kanra and the staff of the Tomioka-kanra Dental Association. This work was partially supported by Grants-In-Aid from the Ministry of Health, Labour and Welfare of Japan (H21-Circulation-Dental-General 001).

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