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Effect of School-Based Fluoride Mouth Rinsing Program in a Socially Deprived Community

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Purpose: The objective of this study was to evaluate the caries prevention effect of school-based fluoride mouth rinsing (FMR) program implemented in the Hanuul district of Mongolia, which has a very low socioeconomic status and extremely poor infrastructure for oral health.

Materials and Methods: One hundred and seventy children aged from 6 to 8 years of the FMR school and 187 children aged from 6 to 8 years of the control school completed the baseline survey. Children from the FMR school rinsed with 0.05% sodium fluoride everyday under supervision, while those from the control school did not. Adjusted caries preventive fraction (CPF) for 2 years were calculated to evaluate the effect of the FMR program.

Result: After 2 years, 288 schoolchildren remained in the study. Decayed, missing or filled permanent teeth (DMFT) and index of the FMR and the control schools at baseline were 0.11 and 0.12, respectively, and the average DMFT increment of the FMR and the control schools after 2 years were 0.35 and 0.65, respectively. The adjusted CPF of DMFT was 48.5%.

Conclusion: These findings show that a school-based FMR is an effective caries preventive program in a socially deprived community with poor infrastructure for oral health.

Key Words: Caries preventive fraction; Dental caries; Deprived community; School-based fluoride mouth rinsing program; Sodium fluoride

Introduction

Fluoride mouth rinsing (FMR) is one of the most widely used methods to prevent caries. Since the 1970s, the use of fluoride rinse has been especially widespread in organized school-based programs in countries experiencing a high prevalence of caries[1,2]. The effect of school-based FMR on the incidence of caries in children has been investigated during the past four decades in a large number of clinical trials. A caries decline of 20%~50% due to FMR has been reported[3-7]. A Cochrane review also concluded that

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the use of FMR by children is associated with a clear reduction in the caries increment. The review found that the FMR program resulted on average in 26% fewer decayed, missing or filled permanent tooth surfaces[8].

Caries, which might be associated with general health and nutrition status, is the main dental problem in children[9], particularly those in socially deprived communities[10,11]. A school-based FMR program targeted to children in a deprived community may be an effective method to reduce the prevalence in caries and inequalities in dental health[6]. Furthermore, considering that children of low socioeconomic status have a disproportionately high share of dental caries, a school-based FMR program could be more effective to children in a deprived community[6,12].

Mongolia has a gross national product (GNP) of 1,486 USD, which is the 121st in the world. The Hanuul district, which is the region where this study carried out, is an urban slum located on the outskirts of Ulaanbaatar, the capital of Mongolia. There are no private oral health care personnel to mafnage the oral health of 54,000 residents of the district. The only oral health workforce to care for residents are four dentists working at the public health centers; as such, there is an extremely poor infrastructure for the oral health of children. While the mean decayed or filled primary teeth (dft) index of a 6-year-old child was 4.1 according to the Korean national oral health survey in 2006[13], the dft index in the Hanuul district in 2008 was found to be 8.7 in the baseline survey of this study. The children in Hanuul showed much poorer oral health than those in Korea. Therefore, this study was carried out to evaluate the caries prevention effect of a school-based FMR program implemented in the Hanuul district of Mongolia, which has a very low socioeconomic status and extremely poor infrastructure for oral health.

Materials and Methods

1. Procedure

Through a baseline survey of the Hanuul district in May 2008, one school at which to implement the FMR program was chosen as the experimental school (FMR school), and another school in the vicinity with an economic level and size similar to the experimental school was chosen as the control school. The experimental and control schools located in non-fluoridated areas with no public water supply (fluoride concentration of well water <0.005) selected conveniently, because the cooperation of school members is prerequisite for follow-up study. A seminar was held on the program for the teachers and students in the FMR school. A baseline survey composed of oral examination and a questionnaire survey was carried out at the two schools in October 2008. Oral health education and the FMR program were implemented immediately following the seminar, and only oral health education was implemented in the control school. The contents of oral health education were tooth brushing by rolling method with toothpaste containing fluoride and diet control for prevention of caries. The toothpaste containing fluoride was not dispensed, and the use of toothpaste containing fluoride for caries prevention was simply discussed during oral health education.

2. Participants

In the first year of the FRM program, a survey of 170 children with an age range of 6~8 years in the FMR school and 187 children with an age range of 6~8 years at the control school was completed. Two years after the program, 32 students (18.8%) at the FMR school and 37 students (19.8%) at the control school dropped out due to reasons such as transfer to another school or absence. Therefore, the total number of subjects that were subjected to follow-up survey in this study was 288, composed of 138 students (70 boys, 50.7%; 68 girls, 49.3%) at

the FMR school and 150 students (73 boys, 48.7%; 77 girls, 51.3%) at the control school. In the FMR school, oral health education was executed once a year and instructed the students to rinse the mouth with 0.05% sodium fluoride solution once a day on school days, and only oral health education was executed once a year at the control school.

The study was conducted in compliance with the principles of the Helsinki Declaration. Ethical clearance of the study was approved by the institutional review board (IRB) of School of Dentistry, Seoul National University (IRB No. S-D20080011).

3. Instruments

The survey team was composed of one dentist and one dental hygienist, and the state of dental caries was examined using a dental mirror under fluorescent light in the classroom by a dentist according to the standard proposed by the World Health Organization[14]. And, gauze was used for drying tooth as the portable drier was not operational at the survey sites. The oral hygiene status was examined by a dental hygienist according to the oral hygiene index[15]. In addition, information on the oral health knowledge, behavior, and socio-demographic variables was obtained using a questionnaire survey by group interview, with one interviewer for each group composed of 5~7 students.

4. Data Analysis

Results of oral examinations and the questionnaire survey were analyzed using PASW Statistics version 18.0 (IBM Co., Armonk, NY, USA). The level of significance was determined to be α=0.05 in all tests. The difference between the FMR and control schools for each variable, including the decayed, missing, or filled permanent tooth (DMFT) and DMFT surface (DMFS) increment, was analyzed by chi-square test for non-continuous variables and independent samples t-test for the continuous variables. The difference in the DMFT and DMFS increment between the two schools after adjusting for oral health behaviors and socio-demographic factors was analyzed by a general linear model. The caries preventive fraction (CPF) was computed according to the following formula by the DMFT increment of the FMR group (DMFT increment$_{FMR}$) and DMFT increment of the control group (DMFT increment$_{control}$):

$$\text{CPF (\%)} = \frac{(\text{DMFT increment}_{control} - \text{DMFT increment}_{FMR})}{\text{DMFT increment}_{control}} \times 100$$

The adjusted CPF was also computed with the following formula using the adjusted DMFT increment of the FMR group (DMFT increment$_{FMR}$) and adjusted DMFT increment of the control group (DMFT increment$_{control}$). The CPF and adjusted CPF of DMFS were calculated using the above formula substituting DMFS for DMFT.

Result

Oral health knowledge and behavior were not different in terms of the awareness of healthy teeth, understanding of snacks that induce caries, frequency of consumption of sweet food, and frequency of tooth brushing between the FMR and control schools (Table 1). However, there were differences between the schools in terms of knowledge on prevention of dental caries by toothpaste containing fluoride and whether the caregiver of the student is the student's parent or not. There were no differences in the average dft index, decayed or filled surface on primary teeth (dfs) index, oral hygiene index, and the number of erupted permanent teeth at baseline and over 2 years between the FMR and control schools (Table 2).

The DMFT index of the FMR and control schools at the beginning of the survey were 0.11 and 0.12, respectively, and the average DMFT increment of the FMR and the control school over 2 years were

Table 1. Oral health knowledge and behaviors between FMR and control schools

Variable	FMR (n=138)	Control (n=150)	P-value[a]
Perception about good teeth			
Inherited	59 (43.4)	79 (53.0)	0.104
Acquired	77 (56.6)	70 (47.0)	
Sugar containing snacks as a caries cause			
Know	116 (84.7)	136 (90.7)	0.121
Don't know	21 (15.3)	14 (9.3)	
Fluoride containing dentifrice prevents caries			
Know	125 (91.2)	148 (98.7)	0.004
Don't know	12 (8.8)	2 (1.3)	
Frequency of eating sweet food			
More than 2 times a day	113 (81.9)	133 (89.3)	0.074
One time a day	25 (18.1)	16 (10.7)	
Frequency of teeth brushing			
More than 2 times a day	81 (58.7)	97 (66.9)	0.153
One time a day	57 (41.3)	48 (33.1)	
Care-giver			
Parents	114 (83.8)	144 (96.0)	0.002
Others	22 (16.2)	6 (4.0)	

FMR: fluoride mouth rinsing.

Values are presented as number (%).

[a]By chi-square test.

Table 2. Subjects' OHI, the number of dft index and dfs index, and nPT_b and nPT between FMR and control schools

	School	Value	P-value[a]
OHI	FMR	1.29±0.46	0.779
	Control	1.31±0.42	
dft index	FMR	6.74±4.29	0.298
	Control	7.25±4.00	
dfs index	FMR	14.9±11.8	0.846
	Control	15.2±12.1	
nPT_b	FMR	2.87±1.09	0.663
	Control	2.65±1.02	
nPT	FMR	11.89±2.62	0.359
	Control	11.60±2.88	

OHI: oral hygiene index, dft: decayed or filled primary teeth, dfs: decayed or filled surface on primary teeth, nPT_b: the number of permanent teeth at baseline, nPT: the number of permanent teeth after 2 years, FMR: fluoride mouth rinsing.

Values are presented as mean±standard deviation.

[a]By independent samples t-test.

0.35 and 0.65, respectively. The CPF according to the crude DMFT increment was 46.2%, and the CPF according to the adjusted DMFT increment was 48.5%. The crude and adjusted CPFs of DMFS were 40.0% and 40.2%, respectively (Table 3).

Discussion

The Hanuul district, in which this study was conducted, is an urban slum district in Mongolia. Based on the results of the study by Kwon et al.[16], this district has a very high possibility of damage to oral health due to dental caries; thus, the need to implement an FMR program is increased. Due to the actual implementation of the program, the CPF for permanent teeth, computed by dividing the difference in the average DMFT increment between the FMR and control schools by the average DMFT increment of the control school, 2 years after the FMR program was found to be

Table 3. Mean and adjusted mean DMFT and DMFS increment and CPF between FMR and control schools

	FMR (a)	Control (b)	CPF (%)	P-value
Baseline DMFT	0.11	0.12	-	-
DMFT after 2 yr	0.46	0.77	-	-
DMFT increment	0.35	0.65	46.2	0.003[a]
Adjusted DMFT increment	0.35	0.68	48.5	0.018[b]
Baseline DMFS	0.12	0.15	-	-
DMFS after 2 yr	0.69	1.10	-	-
DMFS increment	0.57	0.95	40.0	0.035[a]
Adjusted DMFS increment	0.58	0.97	40.2	0.052[b]

DMFT: the decayed, missing, or filled permanent tooth, DMFS: the decayed, missing, or filled permanent tooth surface, FMR: fluoride mouth rinsing, CPF: caries preventive fraction.

CPF (%)={(b−a)/a}×100.

[a]By independent samples t-test.

[b]By general linear model adjusting for oral hygiene index, decayed or filled primary teeth index (decayed or filled surface on primary teeth index in the DMFS model), the number of permanent teeth after 2 years, perception about good teeth, knowing sugar containing snacks as a caries cause, knowing fluoride containing dentifrice prevents caries, frequency of eating sweet food, the frequency of teeth brushing, care-giver. Additionally, the adjusted increments were also calculated by that analysis.

46.2%, and the adjusted CPF, which adjusted for several factors that can affect the caries preventive fraction of the permanent teeth was a little higher, at 48.5%. Furthermore, the adjusted CPF of DMFS was 40.2%. Although the effectiveness of a school-based FMR reported in a recent review of previous studies showed 26%~29% effectiveness[8,17,18], the caries preventive fraction for permanent teeth was found to be 46.2% in this study, because the preventive approach for dental caries in the Hanuul district, which has a low socioeconomic status and extremely poor oral health infrastructure, is highly limited. Twetman et al.[18] reported that school-based FMR has a high anti-caries effect when exposure to other fluoride treatment is limited, and that usage of toothpaste containing fluoride everyday weakens the effectiveness of FMR. The potable water supplied to this Hannul district is not fluoridated, and toothpaste containing fluoride is rarely used. Accordingly, this district showed a substantially higher preventive effect in comparison to the prevention effect reported in the previous studies, because the dilution effect of the usage of toothpaste containing fluoride was eliminated. Furthermore, topical fluorides such as this program are more effective on newly erupted teeth than on teeth that have been in the mouth for several years[19]. This study could show the relatively higher effect than previous studies partly because 6-year-old students start to have newly erupted permanent teeth.

The direct cost of plastic cup and sodium fluoride powder for the FMR program was 360 USD during 2 year for 2,000 students. A FMR program is a project with higher benefits than cost from an economic perspective[20,21]. In addition, this program can be referred to as the most effective project that can be executed to prevent dental caries in regions without adjustment of concentration of fluoride in piped water, because the cost of the program is low and can be administered by non-professionals who receive some training. Scheetz et al.[22] asserted that members of the teaching staff have a favorable opinion of the FMR program at school and do not think it adversely affects the studies of the students and that the parents also support the program. Therefore, it seems that a FMR program is a project that can be considered with priority along with the project for water fluoridation in order to prevent dental caries of children in socially deprived communities. In addition, the

comprehensive approach including not only FMR program but also pit and fissure sealant, oral health education, and oral health screening program needs to be performed considering the resources of the community.

There was a shortcoming about quality control of interview and ethical issue. This study might not have good reliability of group interview, because it seems to be common that one student was influenced by other student's response. Furthermore, there might be an ethical issue at the control school as oral health education was implemented with dispensing not a dentifrice containing fluoride but a toothbrush due to customs clearance.

Conclusion

The caries prevention effect of the FMR program conducted over 2 years in the Hanuul district of Mongolia, which has a low socioeconomic status and extremely poor oral health conditions, was found to be higher than those of the previous studies[8,17,18]. Further studies for direct comparison of the effectiveness of this program between regions with low and high socioeconomic status are needed in order to more definitively evaluate the idea that a school-based FMR program is more effective in socially deprived communities.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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