Evaluation of School Oral Health Program in a Region of Central Nepal

Kakuhiro Fukai[1, 2], Hiroko Yano[2], Seishiro Kamachi[2], Shuich Nakamura[2]

[1] Fukai Institute of Health Science, 3-86 Hikonari, Misato-shi, Saitama, 341-003, Japan
[2] Association of Dental cooperation in Nepal

Abstract : **Objectives:** To evaluate the oral health outcomes of a school oral health program and to assess factors related to oral health status and oral health behavior of children.

Design: Cross-sectional and 10-year follow-up study. The data was collected by self-administered questionnaire and dental examination based on the WHO method. Statistical analysis was performed with multiple logistic regression analysis.

Participants: The participants were 436 school children ages 11-16 years in 4 villages in central Nepal.

Results: The percentage of children practicing oral hygiene behavior such as tooth brushing and using toothpaste was more than 80%, and higher in females than males ($p<0.01$). However, 46.5% of females consumed sweets 2-3 times a week or more, compared with 28.7% of males ($p<0.01$). More than 70% of respondents had good oral health knowledge concerning measures to prevent oral disease. Dental caries reduction was observed among 14-16 year-old children who participated in the fluoride mouth-rinsing program for 4 years or more. Factors contributing to lower sweets intake were gender (male), positive dental visit history, high oral health knowledge score, and positive oral health information source score. Factors contributing to reduction of dental caries (DMFT>1) were school oral health workers' registration period (>6 yrs) and duration of fluoride mouth-rinsing program (>4 yrs).

Conclusion: This study shows that the school oral health program contributed to improvement of the oral health status and oral health behavior of children.

Key words : oral health behavior, oral health status, school oral health program, Nepal

【correspondence】
Kakuhiro Fukai
Fukai Institute of Health Science
3-86 Hikonari, Misato-shi, Saitama, 341-003, Japan
Tel : +81-48-957-3315 Fax : +81-48-957-3315
E-mail : fukaik@fihs.org
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Introduction

Oral health disparity worldwide is a key issue for researchers, dental practitioners, and health policy decision makers. Despite reduction in the prevalence of dental caries in many developed countries, children from disadvantaged communities continue to experience higher oral disease levels[1-6]. Increasing levels of dental caries among

children have been observed in some developing countries[7, 8]. It is especially difficult for those countries to establish community-based oral health care due to limited human and financial resources. Schools provide an ideal setting for promoting oral health. In 2003, the World Health Organization published the document, "Oral Health Promotion: An Essential Element of a Health-promoting School" as part of an information series on school healt[9]. A number of developing countries have recently introduced school-based oral health education and preventive programs aimed at improving the oral health behavior and status of the child population[10, 11]. (Petersen PE et al., 2004). However, few outcome evaluations of the programs are available.

The aims of this study are to evaluate the oral health outcomes of a 10-year school oral health program and to assess the factors related to oral health status and oral health behavior of children.

Methods

This study consisted of two parts: cross-sectional and follow-up. The participants were 436 school children ages 11-16 years. The data was collected by written questionnaire and dental examination in four villages in a district of central Nepal in 2004.

Questionnaire items covered socioeconomic factors, oral health behavior, oral health knowledge and attitude, health information sources, and parental attitudes about oral health. The conceptual framework for evaluation of oral health behavior and oral health status is indicated in Figure 1. The schools in these villages have school oral health programs such as teacher training, regular oral health education, oral health screening by teachers, and fluoride mouth rinsing (Table 1). This school oral health program started in 1994. The duration of the program in each village is 10 years (Thecho), 6 years (Dhapakhel), and 3 years (Sunakothi and Chapagaun). The outcomes of the

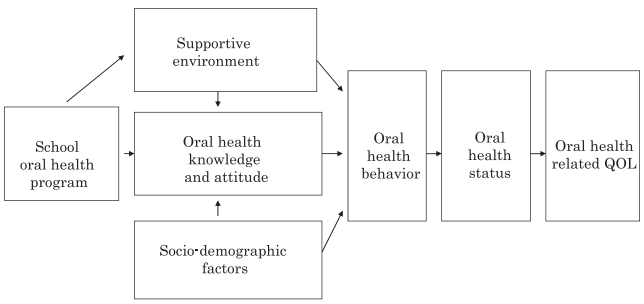

Fig 1　Conceptual framework of oral health behavior and oral health status in this study

Table 1　School oral health program

1	Two or more school oral health workers (who have completed training in all course subjects) are stationed in each school.
2	An annual curriculum for oral health education has been set up.
	2-1. Oral health guidance for students given by teachers (twice a year)
	2-2. Oral health check-up and personal health guidance for each student, administered by teachers (twice a year)
	2-3. Distribution and use of an oral health textbook for each age group
3	A weekly fluoride mouth-rinsing program for students has been implemented.

programs were measured in terms of oral health behavior, oral health status, and oral health related QOL. In assessing the program outcomes, statistical analysis was performed by multiple logistic regression analysis (stepwise procedure) and Chi-square test.

Gender, ethnicity, and regional differences of outcomes were assessed with Chi-square test. In addition, the effectiveness of the fluoride mouth-rinsing program was evaluated. Dependent factors in the multiple logistic regression analysis were local sweet intake behavior and prevalence of dental caries. Independent factors were gender, ethnicity, village of residence, period of registration of school oral health workers (OHW), duration of fluoride mouth-rinsing program, oral hygiene behavior, dental clinic access, score of health information sources, and score of dental health knowledge.

The community-based oral health promotion approach evaluated by this study was initiated in 1989 through cooperation with a Japanese NGO group. Main areas of activity are dental treatment, school-based oral health promotion program, mother and child health program, and oral health workers training.

Results

Table 2 shows the number of schoolteachers who have participated in the oral health workers training program. Duration of participation ranged from 3 years to 10 years. There have been 92 trainees from 31 schools in total.

Table 3 shows the number of participants in the school-based fluoride mouth-rinsing program. The duration of the FMR program was 10 years, 7 years or 2 years, depending on the village. The total number of participants in the FMR program was 5,138 children.

Table 4 illustrates gender differences in oral health behavior and oral health status of children ages 11-13 years. The percentage of children practicing oral hygiene behavior such as tooth brush-

Table 2 Schoolteacher participants in the oral health workers training program

Village	Years of participation	Number of participating schools	Number of teacher trainees
Thecho	10	9	38
Dhapakhel	6	7	27
Sunakothi	3	6	14
Chapagaun	3	10	13

Table 3 Participants in school-based fluoride mouth-rinsing program

Village	Method	Years of participation	Number of schools	Number of students
Thecho	0.2% NaF weekly	10	8	1655
Dhapakhel	0.2% NaF weekly	7	7	1222
Sunakoti	0.2% NaF weekly	2	6	705
Chapagoun	0.2% NaF weekly	2	10	1556

ing and using toothpaste was more than 80%, and higher in females than males ($p<0.01$). However, 46.5% of females consumed sweets 2-3 times a week or more, compared with 28.7% of males ($p<0.01$). More than 70% of respondents had good oral health knowledge concerning measures to prevent oral disease. As for oral health related QOL, tooth pain during the previous year was felt by 48.7% of males and 37.4% of females ($p<0.05$). Caries prevalence was approximately 30%; DMFT was 0.45 in males and 0.64 in females.

Table 5 illustrates community differences in oral health behavior and oral health status of children ages 11-13 yrs. In oral hygiene behavior, sweets intake behavior and dental visit experience, significant differences were found between villages

Table 4　Gender differences in oral health behavior and oral health status of children ages 11-13 yrs.

	gender		
	Male n=150	Female n=197	p
Oral health behavior			
Tooth brushing (more than once a day)	83.3%	94.4%	**
Using toothpaste (more than once a day)	82.0%	93.4%	**
Sweets intake: Biscuits (more than two or three times a week)	53.3%	53.5%	
Sweets intake:Titaura (more than two or three times a week)	28.7%	46.5%	**
No dental visit experience	34.7%	36.9%	
Oral health knowledge			
Tooth brushing prevents tooth decay	87.3%	93.9%	
Tooth brushing prevents bleeding gums	84.7%	80.3%	
Sweets cause tooth decay	96.0%	96.0%	
Fluoride prevents tooth decay	70.0%	76.8%	
Oral health related QOL			
Tooth pain during previous year	48.7%	37.4%	*
Chewing function (poor)	15.3%	14.6%	
Teeth and mouth appearance (poor)	12.7%	11.6%	
Oral health status			
Caries prevalence	29.3%	31.5%	
DMFT (SD)	0.45 (0.79)	0.64 (1.24)	

1) Titaura: Local sweet snack，2）*p<0.05,** p＜0.01

Table 5　Community differences in oral health behavior and oral health status of children ages 11-13 yrs.

	Village					
	Thecho n=133	Dhapakhel n=107	Sunakochi n=41	Chapagaon n=46	Others n=20	p
Oral health behavior						
Tooth brushing (more than once a day)	78.9%	99.1%	87.8%	97.8%	95.2%	**
Using toothpaste (more than once a day)	80.5%	92.5%	90.2%	97.8%	95.2%	**
Sweets intake: Biscuits (more than two or three times a week)	60.9%	46.7%	65.9%	32.6%	61.9%	**
Sweets intake: Titaura (more than two or three times a week)	39.1%	39.3%	58.5%	26.1%	23.8%	*
No dental visit experience	23.3%	60.7%	12.2%	30.4%	47.6%	**
Oral health knowledge						
Tooth brushing prevents tooth decay	88.7%	91.6%	95.1%	89.1%	100.0%	
Tooth brushing prevents bleeding gums	81.2%	80.4%	95.1%	80.4%	76.2%	
Sweets cause tooth decay	94.7%	95.3%	97.6%	100.0%	95.2%	
Fluoride prevents tooth decay	67.7%	82.2%	80.5%	58.7%	90.5%	**
Oral health related QOL						
Tooth pain during previous year	46.6%	34.6%	48.8%	37.0%	52.4%	
Chewing function (poor)	17.3%	18.7%	4.9%	6.5%	19.0%	
Teeth and mouth appearance (poor)	16.5%	15.0%	2.4%	0.0%	14.3%	*
Oral health status						
Caries prevalence	28.0%	26.2%	29.3%	45.7%	38.1%	
DMFT (SD)	0.64(1.3)	0.42(0.9)	0.41(0.7)	0.74(0.98)	0.62(1.0)	

1) Titaura: Local sweet snack，2）*p<0.05,** p＜0.01

($p<0.01$, $p<0.05$). Additionally, oral health knowledge concerning fluoride and perception of teeth and mouth appearance were also clearly linked to community of residence.

Table 6 indicates differences in oral health behavior and oral health status of children aged 11-13 years that are linked to ethnicity.

Table 7 shows the relationship between the duration of fluoride mouth-rinsing program and DMFT index of children aged 11-13 yrs and 14-16 yrs. Dental caries reduction was observed among 14-16 year-old children who participated in this program for 4 years or more.

Multiple logistic regression analyses of factors affecting sweets intake behavior are indicated in Tables 8 and 9. In the 11-13 yrs age group, high oral health knowledge score (OR: 0.17, 95%CI: 0.07-0.44) was found to be a significant factor. For 11-16 year-olds, contributing factors were gender (male), positive dental visit history, high oral health knowledge score, and positive oral health information source score ($p<0.05$). The odds ratio for these factors ranged from 2.07 to 2.24.

The factors affecting dental caries (DMFT>1) are shown in Tables 10 and 11. The registration period of school oral health workers (>6 yrs) was found to be a significant factor in the 11-13 years age group, while duration of the fluoride mouth-rinsing program (>4 yrs) affected DMFT in 11-16 year-olds. The odds ratios (95%CI) were 0.56 (0.33-0.97) and 0.53 (0.34-0.84) respectively.

Table 6 Ethnic differences in oral health behavior and oral health status of children ages 11-13 yrs.

	Ethnic Group					
	Newar n=189	Chetri n=83	Brahman n=24	Lama n=27	Others n=24	p
Oral health behavior						
Tooth brushing (more than once a day)	85.7%	96.4%	95.8%	88.9%	92.0%	
Using toothpaste (more than once a day)	85.2%	94.0%	95.8%	88.9%	88.0%	
Sweets intake: Biscuits (more than two or three times a week)	54.0%	59.0%	37.5%	55.6%	44.0%	
Sweets intake: Titaura (more than two or three times a week)	43.4%	32.5%	29.2%	37.0%	36.0%	
No dental visit experience	28.0%	50.6%	45.8%	37.0%	36.0%	**
Oral health knowledge						
Tooth brushing prevents tooth decay	87.8%	92.8%	95.8%	96.3%	100.0%	
Tooth brushing prevents bleeding gums	81.5%	83.1%	79.2%	88.9%	80.0%	
Sweets cause tooth decay	95.8%	96.4%	100.0%	92.6%	96.0%	
Fluoride prevents tooth decay	69.3%	81.9%	83.3%	70.4%	76.0%	
Oral health related QOL						
Tooth pain during previous year	42.9%	39.8%	50.0%	37.0%	44.0%	
Chewing function (poor)	13.2%	19.3%	20.8%	3.7%	20.0%	
Teeth and mouth appearance (poor)	10.1%	19.3%	4.2%	7.4%	16.0%	
Oral health status						
Caries prevalence	34.9%	19.3%	33.3%	25.9%	37.5%	
DMFT (SD)	0.62(1.04)	0.40(1.01)	0.42(0.71)	0.59(1.62)	0.71(1.12)	

1) Titaura: Local sweet snack, 2) *p<0.05,** p < 0.01

Table 7 The relationship between duration of fluoride mouth rinsing and DMFT index of children (11-13 yrs, 14-16 yrs)

	Fluoride Mouth Rinse Duration (yrs)											
	0 yrs			1-3 yrs			4-6 yrs			>7 yrs		
Age group	DMFT	sd	n	DMFT	sd	n	DMFT	sd	n	DMFT	sd	n
11-13 yrs	0.57	0.76	14	0.61	0.91	69	0.53	1.12	241	0.65	1.12	23
14-16 yrs	1.19	1.78	21	1.28	1.27	18	0.56	0.88	9	0.44	1.02	41

Table 8　Multiple logistic regression analysis of the relationship between sweets intake (more than once a day) and socio-demographic and behavioral factors (11-13 yrs)
(SPSS backward stepwise procedure utilizes the liklehood ratio test)

	B	SE	p	OR	95%CI
Gender (1: male, Chetri, 0: female)	0.53	0.34	0.11	1.70	0.88 - 3.30
School OHW (1: >6 yrs, 0: 0-5 yrs)	-0.40	0.39	0.30	0.67	0.31 - 1.42
Dental visit history (1: yes, 0: no)	0.74	0.40	0.06	2.09	0.96 - 4.56
Oral health knowledge/belief score (1: >5, 0: 0-4)	-1.75	0.47	0.00	0.17	0.07 - 0.44
Oral health information source score (1: >2, 0: 0-1)	0.91	0.36	0.01	2.48	1.23 - 4.99
constant	-1.12	0.66	0.09	0.33	

School OHW: School oral health workers' registration period
Goodness-of-fit of the model
Nagelkerke R^2: 0.133
Hosmer & Lemeshow's goodness of fit test: p=0.684
Omunibus test: p=0,000
Step 1. Variables: Gender, School, OHW, Ethnicity, FMR, Toothbrushing, Toothpaste, Tea with sugar, Sweets, Dental visit, Health knowledge score, Oral health information source score

Table 9　Multiple logistic regression analysis of the relationship between sweets intake (more than once a day) and socio-demographic and behavioral factors (11-16 yrs)
(SPSS backward stepwise procedure utilizes the liklehood ratio test)

	B	SE	p	OR	95%CI
Gender (1: male, Chetri, 0: female)	0.75	0.30	0.01	2.11	1.17 - 3.81
Dental visit history (1: yes, 0: no)	0.73	0.37	0.05	2.07	1.01 - 4.27
Oral health knowledge/belief score (1: >5, 0: 0-4)	-1.35	0.39	0.00	2.24	1.21 - 4.14
Oral health information source score (1: >2, 0: 0-1)	0.81	0.31	0.01	2.24	1.21 - 4.14
constant	-1.90	0.52	0.00	0.15	

Goodness-of-fit of the model
Nagelkerke R^2: 0.122
Hosmer & Lemeshow's goodness of fit test: p=0.706
Omunibus test: p=0,000
Step 1. Variables: Gender, School, OHW, Ethnicity, FMR, Toothbrushing, Toothpaste, Tea with sugar, Sweets, Dental visit, Health knowledge score, Oral health information source score

Table 10　Multiple logistic regression analysis of the relationship between prevalence of dental caries (DMFT>1) and multivariable factors (11-13 yrs)
(SPSS backward stepwise procedure utilizes the liklehood ratio test)

	B	SE	p	OR	95%CI
School OHW (1: >6 yrs, 0: 0-5 yrs)	-0.58	0.28	0.04	0.56	0.33 - 0.97
Ethnicity (1: Braham, Chetri, 0: others)	-0.50	0.28	0.73	0.61	0.35 - 1.05
Oral health information score (1 :> 2, 0: others)	0.37	0.26	0.16	1.45	0.87 - 2.41
constant	-0.37	0.24	0.13	0.69	

School OHW: School oral health workers' registration period
Goodness-of-fit of the model
Nagelkerke R^2: 0.042
Hosmer & Lemeshow's goodness of fit test: p=0.934
Omunibus test: p=0,017
Step 1. Variables: Gender, School, OHW, Ethnicity, FMR, Toothbrushing, Toothpaste, Tea with sugar, Sweets, Dental visit, Health knowledge score, Oral health information source score

Table 11　Multiple logistic regression analysis of the relationship between prevalence of dental caries (DMFT>1) and multivariable factors (11-16 yrs)
(SPSS backward stepwise procedure utilizes the liklehood ratio test)

	B	SE	p	OR	95%CI
Ethnicity (1: Braham, Chetri, 0: others)	-0.38	0.26	0.14	0.69	0.42 - 1.13
FMR Duration (1: >4 yrs, 0: 0-3 yrs)	-0.63	0.23	0.01	0.53	0.34 - 0.84
Tea with sugar (1: > once a day, 0: others)	0.58	0.32	0.07	1.78	0.96 - 3.31
constant	-0.74	0.34	0.03	0.48	

FMR: Fluoride mouth-rinsing
Goodness-of-fit of the model
Nagelkerke R^2: 0.050
Hosmer & Lemeshow's goodness of fit test: p=0.690
Omunibus test: p=0,002
Step 1. Variables: Gender, School, OHW, Ethnicity, FMR, Toothbrushing, Toothpaste, Tea with sugar, Sweets, Dental visit, Health knowledge score, Oral health information source score

Discussion

The initial focus of our local health promotion activities was the training of oral healthcare workers. In this region, where dentists and other oral health professionals are virtually nonexistent, we began by holding a one-week training course to train local people in basic oral healthcare knowledge and skills. This first course was held in 1994, and participants consisted of local health center employees and public officials. However, it became clear that these participants were not very motivated and showed little enthusiasm for the course. The next year, therefore, we shifted our focus and held a similar course for schoolteachers, who turned out to have far more motivation and interest.

The one-week curriculum-based healthcare personnel training courses were held during our missions at Thecho village. We used three textbooks written in Nepali and English. The curriculum consisted of lectures and practical training, and covered the basics of tooth anatomy as well as the cause and prevention of dental caries and gum disease. Beginning in 1998, we also held an advanced course for graduates of the beginner course. The advanced course introduced health education skills, the making of health-related educational materials, and dental check-up skills. And now the Nepali graduates of this program are playing an increasingly important role, taking on teaching responsibilities.

Health education in schools is one of the most effective measures for promoting lifelong oral health among individuals in both developed and developing countries[12, 13]. There are a number of benefits that make school oral health programs particularly effective : 1) the elementary school years are the time when children' s permanent teeth come in, making the risk of dental caries especially high during these years ; 2) the majority of children in a community can be reached as a single group ; 3) teachers provide a reliable source of manpower to implement the program ; 4) education and evaluation systems are already in place; and 5) joint activities with local businesses can also be facilitated. Additionally, oral health education is a good way for schools to teach positive daily health practices related to eating habits and hygiene. We began introducing school oral health activities in 1994. The Japanese volunteers began by visiting several schools in Thecho and holding tooth-brushing lessons for the students and discussions with the teachers. From that point, as the number of graduates from our oral health personnel training courses increased, we began spending more of our time in discussion and curriculum planning with these trainees, gradually leaving more and more of the in-school education to them. Within 4 years, we were able to implement oral health education programs in all the elementary schools in Thecho, and then these programs spread out to the nearby villages.

During this time, we also found that there was great disparity between schools in terms of the children's health and environment. For this reason, we worked on establishing lines of communication between teachers at different schools, and we also began the mother/child health program to teach about the dangers of increased sugar intake. We encouraged the spread of knowledge and skills from teacher to teacher by having graduates of our oral health personnel training course go to nearby villages and teach the same course there. At this point, we were already seeing the birth of an independent school health education program administered by the Nepalis themselves, and this program has now reached a total of four villages.

The other aspect of our school oral health program was the fluoride mouth-rinsing program. Since education programs take years to establish

and even longer to produce results, we needed a more immediate preventive program to combat the rapid increase in caries that was resulting from increased sugar intake due to urbanization. Because of its teeth-strengthening properties, fluoride application is the most effective method of caries prevention. Fluoride toothpaste is widely considered the most practical way of achieving this effect, but it requires an economic environment in which families have the means to buy the toothpaste. Therefore, in our region of operations, we decided to implement the more cost-effective fluoride mouth-rinsing program. This program consisted of a weekly one-minute rinse with a 0.2% NaF solution. It is a very simple method of administration, but special training and safety precautions were required in order to ensure the safe storage, measurement, and use of fluoride powder at these elementary schools.

In 1994, we selected two Nepalis who had participated in our other activities and carefully trained them in the proper procedures for measuring the fluoride powder and mixing the mouth-rinsing solution. We were concerned about whether they would be able to master these procedures during the short period of our 10-day mission. However, their eagerness to learn proved quite strong, and it was decided that they would go ahead and begin a 6-month trial program with 2 classes (50 students) in one of the Thecho elementary schools. That summer when we returned to Nepal, we found the students carrying out the fluoride mouth-rinsing program perfectly. From that starting point, we began expanding the distribution of the fluoride powder, along with an evaluation system for this program, to other schools. Today, 5,138 elementary school students in 4 villages are taking part in the program. In addition to preventing cavities, the other benefit of this program is that it brings students together regularly for a weekly health-related activity, resulting in a heightened awareness of health and hygiene issues.

Our goals for the school oral health program were in three areas. The first was that students would achieve basic knowledge of oral health issues (causes of oral diseases and preventive methods). Specifically, we wanted students to understand the relationship between sugar and tooth decay, to learn how to brush their teeth adequately, and to understand the effects of fluoride mouth rinsing.

The second goal was for teachers to understand oral health issues (causes of oral diseases and preventive methods) and develop oral health education skills in order to teach age-appropriate oral health information to their students. The third goal was to put in place an oral health education curriculum that is integrated into the schools' general health and primary health care (PHC) programs[14, 15].

In the multivariable analyses, dental caries prevalence in children was associated with involvement in the fluoride mouth rinsing program, presence of school oral health workers, oral health knowledge/belief, and oral health information sources.

In conclusion, this study shows that the school oral health program contributed to improvement of the oral health status and oral health behavior of children.

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