The effect of improving oral health literacy among teachers on the oral health condition of primary schoolchildren in Cambodia



Y. Asao[1], Y. Iwamoto[1], C. Chea[2], T. Chher[3], C. Mitsuhata[1], M. Naito[4], K. Kozai[1]

[1]*Department of Pediatric Dentistry, Graduate School of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan*
[2]*Department of Oral Pathology, Faculty of Odonto-Stomatology, Health Sciences Institute of Royal Cambodian Armed Forces, Phnom Penh, Cambodia*
Faculty of Odonto-Stomatology, University of Health Sciences, Phnom Penh, Cambodia
Faculty of Dentistry, University of Puthisastra, Phnom Penh, Cambodia
Faculty of Dentistry, International University, Phnom Penh, Cambodia
[3]*Oral Health Bureau, Preventive Medicine Department, Ministry of Health Cambodia*
[4]*Department of Oral Epidemiology, Graduate School of Biomedical and Health Sciences, Hiroshima University, Hiroshima, Japan*

E-mail: yuko-tulip@hiroshima-u.ac.jp

DOI 10.23804/ejpd.2022.23.04.12

Abstract

Aim In Cambodia, civil unrest has led to insufficient and inaccessible dental health services. Oral health education and awareness are lacking, thus childhood dental caries is highly prevalent. This study aimed to examine the effects of an oral health education programme for public primary school teachers on the pupils' oral health.

Material and methods Between 2011 and 2015, an oral health education workshop was presented annually to primary school educators employed at a public school in Siem Reap, Cambodia. Oral screenings of 2,637 pupils (grades 1–6; subdivided between the lower 1–3 and upper 4–6 grades) were undertaken and the prevalence of dental caries, mean number of DFT, and mean percentage of DFT rate were calculated.

Results Caries affecting the primary and permanent teeth was highly prevalent (exceeding 90% annually). Prevalence declined significantly among the upper-grade pupils. The mean DFT and mean DFT rate decreased significantly in both groups between 2011 and 2015.

Conclusions Despite the persistently high prevalence of dental caries, the oral health status of the schoolchildren improved every year. Participation in the workshops may have improved the teachers' ability to provide oral healthcare instructions, leading to the reduced dental caries prevalence among pupils.

KEYWORDS Dental caries; Oral health; Education; Schoolchildren; Cambodia.

Introduction

During the late 1970s, large numbers of intellectuals, including teachers and doctors, were executed in the Cambodian Genocide [North, 2008]. Dentists were no exception, and the number of dentists decreased, at that time, to approximately 30 nationwide [Todd and Durward, 1994]. Moreover, the collapse of the education system made the development of new human resources difficult. Lack of capacity building within the oral healthcare sector [Chu et al., 2008] meant that the current number (335) [Nash et al., 2008] of practicing dentists remains low, mostly concentrated in the capital, Phnom Penh [Chu et al., 2008; Shidara et al., 2007]. Due to the prevailing shortage of dentists and rural-urban inequalities [Chher et al., 2016], many people in Cambodia have limited access to dental care. In addition, the current parental generations are poorly educated as they grew up during the civil war, within a severely compromised schooling system. Therefore, these parents lack knowledge around basic hygiene practices, and are unable to adequately educate their children in this regard. In 2008, alarming statistics indicated that 44% of 6-year-old children and 22% of 12-year-olds had no toothbrushing habits [Chu et al., 2008]. Furthermore, exposure to a sucrose-rich diet has increased with the recent economic growth, and many children and adolescents consume sweets, such as candy and biscuits daily [Chher et al., 2016]. Extended night-time nursing and increased feeding of sweetened foods to babies have also been observed [Chher et al., 2016;Turton et al., 2015]. Eating habits from infancy to childhood are generally considered inappropriate.

The "Cambodian National Oral Health Survey (CNOHS)" was conducted in 2011. This survey reported a caries prevalence of 97% for 6-year-olds, 80% for 12-13-year-olds, and dmft/DMFT scores of 9.0 (SD 4.9) for 6-year-olds, and 3.8 (SD 3.6) for 12-13-year-olds. Therefore, most children were observed to have caries experience [Chher et al., 2016; Turton et al., 2015]. Likewise, previous fieldwork undertaken in Cambodia by the authors of the present study demonstrated a high prevalence of dental caries and poor oral hygiene conditions, especially in children [Iwamoto et al., 2016; Asao et al., 2022].

The oral health status of school children has been surveyed in multiple countries. Some countries have reported a decline in mean dmft/DMFT scores relative to the initial surveillance data, due to the introduction of toothbrushing programmes in schools [Lai et al., 2016; Cakar et al., 2018; Takeuchi et al., 2017; Yekaninejad et al., 2012]. It has also emerged that health education targeting schoolchildren can indirectly improve the health of their immediate family [He et al., 2015]. Implementing health education at school level is regarded as

important to the growth and development of children. Despite numerous papers documenting health, especially oral health, education among children, few have focussed on the provision of health-related knowledge to primary schoolteachers. Schools are ideally positioned to educate children on health and organise health activities within a community, while properly trained schoolteachers are instrumental in promoting oral health [World Health Organization, 2003].

In the present study, workshops on oral health education for primary schoolteachers were conducted at a public primary school in Cambodia, and an educational programme and curriculum on oral health was established. In addition, oral examinations of the schoolchildren were conducted over several years. The present study aimed to evaluate the effect of increasing teachers' oral health knowledge on the oral condition of schoolchildren.

Material and methods

Participants

The fieldwork described in the present paper was carried out as part of the Cambodian dental care support activities, and mainly undertaken by staff from the department of paediatric dentistry at Hiroshima University. The target of this study was a public primary school located in the centre of Siem Reap City, Siem Reap Province, where the Angkor Wat archaeological site is located, a prospering tourist destination. Of all the public primary schools in Cambodia, this one supports the largest number of children (about 6,000). From 2011 to 2015, staff from the department of paediatric dentistry at Hiroshima university, visited Cambodia once annually for a duration of about 10 days between late February and early March. During that time frame, the researchers spent two days at the target school, conducting a workshop on oral health education for teachers and screening the oral status of the schoolchildren.

Workshop for primary schoolteachers

During the four years from 2011 to 2014, a workshop was conducted for schoolteachers who were present on that day. From 2011 to 2013, approximately 90 teachers across all grades were targeted, while in 2014, approximately 35 teachers responsible for the lower grades were selected. In Cambodia, lessons are frequently held according to a morning/afternoon exchange system. Teachers either work in the morning or afternoon, and spend the remaining half day employed in secondary jobs to earn a living. Consequently, workshops were presented both in the morning and afternoon to avoid to cancel the regular classes. However, in 2014, as participation was restricted to the lower grade teachers, the workshop was held only in the afternoon.

Each workshop was scheduled for an hour, with approximately 45 minutes devoted to theory and a practical exercise, and 15 minutes to a question and answer session. The staff from Hiroshima University simulated lessons and exercises using Kamishibai (Japanese story-telling; picture-story show), dental models, puppet shows, and so on. The content of the workshop was translated by a local Cambodian staff member and distributed to the primary schoolteachers. The picture-stories used in the simulated lessons were created by the staff of Hiroshima University to accord with Cambodian culture by referring to past fieldwork experiences, and the content was further developed year-on-year. After the workshop, the teaching materials were donated to the target school to enable the provision of oral health education to the schoolchildren.

Oral examination of the primary schoolchildren

During the five years from 2011 to 2015, an oral examination was conducted on a total of 2,637 children in the 1st to 6th grades; 1,322 (50.1%) were boys, 1,302 (49.4%) were girls and 13 (0.5%) were of unknown gender. In each survey year, target classes were randomly selected from each grade. Oral examinations were conducted with the children in a supine position, in the classroom, and mainly by paediatric dentists from Hiroshima University Hospital. For each pupil, the number of teeth, number of untreated teeth, and number of filled (treated) teeth were recorded. The outcomes of the oral examination were communicated with each pupil and his/her guardian through completion of a return form written in Khmer.

Data analysis

The results of the oral examinations were totalled, and the prevalence of dental caries, mean number of DFT (the sum of the individual DFT values divided by the total sample size, where DFT is the sum of the decayed and filled permanent teeth per person), and mean percentage of the DFT rate (the sum of the individual DFT values divided by the total number of permanent teeth sampled, expressed as a percentage) were calculated.

Missing teeth are those that are not currently present in the oral cavity; these were not included in the results as oral examination alone cannot determine whether the loss was due to caries, or other causes such as trauma or congenital defects.

The family register is not maintained in Cambodia, and the exact age is unknown. Therefore, in order to minimise the effect of tooth replacement from deciduous to permanent teeth, calculations were performed separately for grades 1–3 (the lower grade group) and grades 4–6 (the higher grade group). The prevalence of dental caries indicates the percentage of target children who have dental caries in their oral cavity. Therefore, the percentage of those who had dental caries were considered regardless of whether they had milk or permanent teeth. The DFT and DF rate for permanent teeth were calculated among the teeth that erupted into the oral cavity of the target child. Since this was a cross-sectional survey, we could not conclude whether caries caused the loss of milk teeth. We excluded deciduous teeth because the number of deciduous teeth lost due to normal tooth replacement could affect the results.

Statistical analyses were performed using PASW® Statistics Base 18 (SPSS Inc., Chicago, USA). Chi-square testing was used to analyse caries prevalence, while one-way analysis of variance (ANOVA) was performed to analyse the differences in the mean DFT and mean DFT rate (%) between survey years. The significance level was set at $p < 0.05$.

Ethical considerations

A series of activities was carried out as a support project for Cambodia. After the activity, with ethical permission, we conducted this research using that information. This study was conducted with the approval of the Hiroshima University Epidemiology Research Ethics Review Committee (Permission number: No. E-1556; Permission date: March 20, 2019).

Results

Study participants

Tables 1 and 2 present information on the number of teachers

who participated in the workshops and the number of children (subdivided according to grade and gender) who underwent oral examination during each survey year, respectively.

Workshop for primary schoolteachers

Table 1 details the information incorporated into each workshop during each survey year. Efficacy of the workshops

Date	Schedule	Participants	Contents	Teaching tools
17/2/2011 (Thursday)	approximately 60 minutes 45 min: lecture and exercise 15 min: question time	all teachers (about 90)	Lecture -Role of teeth -Introduction to caries and periodontics -Prevention of dental disease Exercise -Self-application of plaque-disclosing solutions and toothbrushing	-original picture-story show[1] (n. 1) -dental model for instruction (Tooth Brushing Demonstration Model® / Nissin Dental Products INC.) -hand mirror -tooth brush -plaque disclosing solution
1/3/2012 (Thursday)	approximately 60 minutes 45 min: lecture and exercise 15 min: question time	all teachers (about 90)	Lecture -Significance of chewing -Tooth shape and brushing Exercise -Toothbrushing instruction -Teaching method using a dental model	-original picture-story show[1] (n. 2) -dental model for instruction (Tooth Brushing Demonstration Model® / Nissin Dental Products INC.) -Toothbrushing instruction poster
21/2/2013 (Thursday)	approximately 60 minutes 45 min: lecture and exercise 15 min: question time	all teachers (about 90)	Lecture -Primary and parmanent teeth -Tooth exfoliation and eruption -Importance of the first molar Exercise -Toothbrushing instruction for the mixed dentition period -Teaching method using handmade dental models	-original picture-story show[1] (n. 3) -photographs -dental model for instruction (Tooth Brushing Demonstration Model® / Nissin Dental Products INC.) -handmade dental models for instruction[2]
27/2/2014 (Thursday)	approximately 60 minutes 45 min : lecture and exercise 15 min : queston time	lower grades teachers (about 35)	Lecture -Cause of dental caries -Desirable dietary habits for snacks (Stephan curve) Exercise -Teaching method using puppets	-original picture-story show[1] (n. 4) -puppet for instruction (Hamigaki Daisuki Ronta-kun® / Nissin Dental Products INC.)

[1]Original picture-story show: created by the reseachers to align with Cambodian culture. A series (n. 1-n. 4) of picture-stories were created to ensure progressive development of the content year-on-year.
[2]Handmade dental model for instruction: teachers were guided on how to craft teaching tools with familiar items, such as PET bottles and clothes, eliminating the need to purchase these tools.

TABLE 1 Design of workshop for primary schoolteachers.

			Grade																			Total		
			1			2			3			4			5			6						
			male (%)	female (%)	unknown (%)	male (%)	female (%)	unknown (%)	male (%)	female (%)	unknown (%)	male (%)	female (%)	unknown (%)	male (%)	female (%)	unknown (%)	male (%)	female (%)	unknown (%)	male (%)	female (%)	unknown (%)
Year	2011	Total	61			58			37			41			42			43			282		
		Number	35	26	0	27	31	0	17	20	0	16	26	0	18	24	0	14	29	0	127	155	0
		%	57.4	42.6	0	46.6	53.4	0	45.9	54.1	0	39.0	61.0	0	42.9	57.1	0	32.6	67.4	0	45.0	55.0	0
	2012	Total	51			61			59			54			53			57			335		
		Number	28	23	0	36	25	0	31	28	0	23	30	1	25	27	1	24	33	0	167	166	2
		%	54.9	45.1	0	59.0	41.0	0	52.5	47.5	0	42.6	55.6	1.9	47.2	50.9	1.9	42.1	57.9	0	49.9	49.6	0.6
	2013	Total	157			151			181			66			59			53			667		
		Number	85	72	0	69	78	4	102	73	6	29	37	0	26	33	0	24	29	0	335	322	10
		%	54.1	45.9	0	45.7	51.7	2.6	56.4	40.3	3.3	43.9	56.1	0	44.1	55.9	0	45.3	54.7	0	50.2	48.3	1.5
	2014	Total	100			135			155			184			62			58			694		
		Number	53	47	0	74	61	0	73	81	1	107	77	0	30	32	0	25	33	0	362	331	1
		%	53.0	47.0	0	54.8	45.2	0	47.1	52.3	0.6	58.2	41.8	0	48.4	51.6	0	43.1	56.9	0	52.2	47.7	0.1
	2015	Total	112			102			103			111			121			110			659		
		Number	58	54	0	55	47	0	54	49	0	48	63	0	68	53	0	48	62	0	331	328	0
		%	51.8	48.2	0	53.9	46.1	0	52.4	47.6	0	43.2	56.8	0	56.2	43.8	0	43.6	56.4	0	50.2	49.8	0
	Total	Total	481			507			535			456			337			321			2637		
		Number	259	222	0	261	242	4	277	251	7	223	232	1	167	169	1	135	186	0	1322	1302	13
		%	53.8	46.2	0	51.5	47.7	0.8	51.8	46.9	1.3	48.9	50.9	0.2	49.6	50.1	0.3	42.1	57.9	0	50.1	49.4	0.5

Due to rounding totals may not equate to exactly 100%.

TABLE 2 Number of schoolchildren who received oral examination.

was assessed through evaluation of the oral health status of schoolchildren, and the results presented below.

Oral examination of the primary schoolchildren

- Prevalence of dental caries: In each survey year, caries prevalence was exceptionally high, indicating that most schoolchildren had caries (Table 3). In the lower grades (1–3), the result exceeded 98% in each survey year (from 99.4 in 2011 to 98.4 in 2015 ($p = 0.669$), due to the chronological age of the schoolchildren and presence of deciduous teeth. Conversely, in the upper grades (4–6), despite a high caries prevalence a significant decline from 99.2% in 2011 to 93.9% in 2015 ($p = 0.013$) was observed. Furthermore, in each survey year caries prevalence among the 1st grade schoolchildren was calculated at 98% or more: 98.4 (2011), 100 (2012), 98.7 (2013), 99.0 (2014), and 99.1 (2015), demonstrating that almost all children experienced caries at the time of enrolment regardless of the survey year.
- Mean number of DFT: For grades 1–3, the mean DFT ranged from 2.60 in 2011 to 1.45 in 2015 ($p < 0.001$), and for grades 4-6, from 5.40 in 2011 to 3.31 in 2015 ($p < 0.001$) (Table 3). In both groups, the mean DFT decreased significantly from 2011 to 2015.
- Mean percentage of the DFT rate: To consider the relationship between the mean number of DFT and the number of permanent teeth, the DFT rate (%) was calculated. Grades 1–3 and grades 4–6 showed similar rates. For grades 1–3, the mean percentage of the DFT rate changed from 27.3% in 2011 to 14.1% in 2015 ($p < 0.001$), and for grades 4–6, from 25.7% in 2011 to 15.7% in 2015 ($p < 0.001$) (Table 3). DF rate (%) was similar in both groups, the mean percentage of the DFT rate decreased significantly from 2011 to 2015.

Discussion

In the present study, annual workshops that aimed to improve the oral health knowledge of primary schoolteachers in a target school in Cambodia appeared to improve the oral health status of the schoolchildren. The mean DFT and mean DFT rate decreased significantly in both the lower (1–3) and upper (4–6) grade children from 2011 to 2015, indicating a decline in caries experience over time in the target school.

In Cambodia, opportunities to learn about oral health at school and at home have been limited, and public awareness around oral health has been low [Chu et al., 2008]. Moreover, there is neither a school lunch program nor any school dietitians in Cambodia; therefore, when children are hungry, they buy fast food and beverages for consumption from the school stand [Shikanai et al., 2014]. Within this context, the authors have delivered dental treatment in previous fieldwork excursions to the target school. However, merely visiting the site to provide treatment over a short time period did not solve the fundamental problem, and promoting oral health through oral health education became undeniably indispensable. Due to time and dental human resource constraints, it was difficult to provide direct guidance to all children. Consequently, a workshop on oral health education targeting the primary schoolteachers who were regularly involved with the children's education was developed and implemented.

Initially, the school curriculum comprised almost no classes on health education. However, as a result of the fieldwork, and more specifically, the educational workshops for primary schoolteachers that were undertaken in the target school, the curriculum for all grades was expanded to include lessons on oral health using teaching tools, such as Kamishibai, which is a Japanese story-telling art, and a culture unique to Japan; compared to paper puppet theatre and Flannelgraph, Kamishibai is easy to use and the narrator does not require special skills [Abe and Akamatsu, 2012]. Additionally, since it can be easily executed for groups [Sato, 2008], it was adopted as an educational tool in this study.

In addition, the target schoolteachers implemented a brushing programme. At a dedicated "brushing time", during the school day, all schoolchildren were given the opportunity

Year	Prevalence of dental caries (%)		Mean number of DFT[1] (SD[5])				Mean percentage of DFT rate[4] (SD[5])(%)	
			Mean number of DT[2] (SD[5])	Mean number of FT[3] (SD[5])	Mean number of DT[2] (SD[5])	Mean number of FT[3] (SD[5])		
	Grades 1-3	Grades 4-6	Grades 1-3		Grades 4-6		Grades 1-3	Grades 4-6
2011	99.4	99.2	2.60 (1.9)		5.40 (3.2)		27.3 (20.5)	25.7 (12.8)
			2.59 (1.9)	0.01 (0.1)	5.26 (3.2)	0.14 (0.5)		
2012	99.4	97.6	2.47 (1.8)		4.61 (2.9)		23.9 (18.2)	21.4 (11.8)
			2.36 (1.8)	0.11 (0.5)	4.23 (2.9)	0.38 (1.2)		
2013	98.6	96.1	2.20 (2.1)		3.54 (2.8)		21.0 (18.1)	17.2 (11.6)
			2.11 (2.1)	0.09 (0.4)	3.06 (2.7)	0.48 (0.9)		
2014	99.5	94.1	1.93 (2.3)		2.83 (2.8)		17.6 (19.0)	14.6 (13.9)
			1.79 (2.3)	0.14 (0.6)	2.45 (2.7)	0.38 (1.0)		
2015	98.4	93.9	1.45 (1.7)		3.31 (2.7)		14.1 (15.9)	15.7 (12.3)
			1.30 (1.7)	0.15 (0.6)	2.82 (2.7)	0.49 (1.0)		

[1]DFT: Total number of Decayed and Filled permanent teeth per person
[2]DT: Total number of Decayed permanent teeth per person
[3]FT: Total number of Filled permanent teeth per person
[4]DFT rate: Proportion of the total number of Decayed and Filled permanent teeth per person
[5]SD: Standard deviation
Prevalence of dental caries: Chi-square test, $p<0.05$
Mean number of DFT, Mean percentage of DFT rate (%): One-way analysis of variance, $p<0.05$

TABLE 3 Results of caries morbidity status in primary school children.

to brush their teeth and toothbrushing became a firmly established habit. It was speculated that the oral condition of the target schoolchildren improved due to adoption of these new approaches/behaviours towards oral health.

Prior to the research that was undertaken at the target school, teachers' meetings were held once weekly, instead of secondary jobs, indicative of a school with a high motivation for education, especially in Cambodia. Although several support mechanisms, such as the donation of toothbrushes by support groups to the target school, existed, no medical personnel had intervened prior to the present study. For this reason, the teachers expressed a need for educational content that could use the donated toothbrushes (e.g., for correct tooth brushing technique). It is thought that the provision of teacher-centric workshops enabled the teachers to take concrete actions, such as inclusion of a toothbrushing programme and introduction of an oral health syllabus. This syllabus was based on a teaching plan for oral health education, created by the researchers. Moreover, the workshops presented to the schoolteachers included simulated lessons to further enable the teachers to easily incorporate oral health education into their classes. Consequently, the teachers' skills in oral health education were developed, making it possible for the teachers to educate the children on a consistent, daily basis.

Apart from the aid provided through the present study, other activities supporting primary schools in Cambodia exist [Miyata et al., 2005; Iwasaki et al., 2018; Iwasaki et al., 2014; Jed et al., 2018]. However, most of these are limited to once-off or short-term activities. It is believed that the continuous support provided to the target school as well as the ongoing annual revision and development of the activity content, over the 4 years during which the workshops were presented, maintained and improved the motivation of the targeted teachers. Likewise, it is speculated that the establishment of an educational syllabus on oral health, which had not been incorporated in the curriculum until now, gradually improved the oral condition of the schoolchildren, contributing to the reduction in dental caries over time.

A number of papers describing the provision of oral health education in conjunction with the assessment of oral conditions have also been published. In 2011, researchers in Iran provided oral examinations and oral health education to target children who were divided into three groups [Yekaninejad et al., 2012]. Greater improvements in perceptions of oral disease and brushing and flossing behaviours were observed for the group in which not only the children but also the schoolteachers and parents were exposed to the educational intervention in comparison to the group in which only the children received the intervention. In a study undertaken in the Kingdom of Tonga, a Japanese team visited and provided oral health education to a target population, similar to the approach adopted in the present study. In addition to oral hygiene education (toothbrushing with fluoride-containing dentifrices and rinsing with fluoride-containing oral rinses) for primary and kindergarten children, a workshop to promote dental health was held for the staff of the Ministry of Education and other teachers. As a result, the mean DMFT of 12-year-old children decreased [Takeuchi et al., 2017].

Oral health has been previously surveyed in Cambodia. In a study that focused on adults and that used oral examination and a questionnaire (relating to living conditions and systemic diseases) to collect data, plaque accumulation and living conditions were found to be significantly associated with the periodontal inflammatory status [Miyata et al., 2005]. Similarly, other surveys, using similar research instruments, have been undertaken among Cambodian children [Iwasaki et al., 2018; Iwasaki et al., 2014; Kubota et al., 2020]. In one such study, the calculated caries prevalence exceeded 90%. Many children consumed sugary foods daily and brushed infrequently [Iwasaki et al., 2018; Iwasaki et al., 2014]. In a study concerned with early childhood caries (ECC), ECC prevalence in a sample of 1- and 2-year-olds was estimated at 50%, and all carious teeth were untreated [Kubota et al., 2020]. Bottle-feeding beyond 12 months among the 2-year-old children was significantly associated with ECC. Likewise, a paper that reported on the relationship between nutritional status and dental caries concluded that underweight children presented with high dt (number of decayed/untreated deciduous teeth per individual) and pufa (the number of untreated deciduous teeth presenting with pulpal exposure, ulceration, fistula and abscesses) scores, and higher dt and DT scores at baseline were significantly associated with an increased odds of being underweight at follow-up.

In the present survey, the exact ages of several schoolchildren remained unknown. Hence, the children were divided into two groups according to grades and the results were calculated accordingly. In Cambodia, as the family register is not adequately maintained, it is often difficult to source the exact date of birth of an individual; sometimes, even the individual may not know his/her own date of birth. In addition, due to family circumstances, some children are unable to enroll in school at the appropriate age, or may repeat years, meaning that differences between the academic year/grade and chronological age can occur. To minimize the bias that may have been introduced through the replacement of deciduous teeth by permanent teeth, data analysis was divided into two groups, grades 1–3 (the lower grades) and grades 4–6 (the higher grades).

The present study provided teachers of a targeted primary school with knowledge on oral health through workshops, and this knowledge was transmitted from the teachers to the children. However, it was not possible to evaluate the extent to which the oral health knowledge was retained by the schoolteachers and children. In future, an additional investigation will be performed to evaluate oral health literacy levels among the teachers and children and identify the changes in oral hygiene habits.

As the present survey was conducted over a period of 5 years, socioeconomic development within Cambodia during that time may have improved the oral health status of the children. Regardless, caries prevalence remained persistently high, exceeding 98%, in the first-grade students every year.

Conclusion

In the present study, workshops were held once annually for 4 years at a public primary school in Cambodia for promoting oral health education for primary school teachers. During that time, decreases in the mean DFT and mean DFT rate of the schoolchildren were observed. To sustain the progress that has been made, ongoing intervention and consistent development of the workshop content to align with the needs of the educational site are planned. In addition to activities in primary schools, the intention is to translate similar workshops to higher educational institutions where students

train to become teachers. By promoting the development of human resources that can provide oral health education, more children will have access to oral health messages, and improvements in nationwide quality of life and oral health are anticipated.

Acknowledgements

The authors wish to thank to NPO "NGO Hiroshima", The Ministry of Health of Cambodia, Wat Bo primary school, Anacott Cambodia, Dr. Takashi Takata (Tokuyama University), Dr. Akiko Iwamoto(Hiroshima Dental Academy), Dr. Hisako Sasahara(Hiroshima University Graduate Schoool of Biomedical Science), Dr. Atsushi Simazu(Fukuoka Dental College), and all staff of our department of pediatric dentistry for cooperation of this research. This fieldwork in Cambodia was supported by NPO "NGO Hiroshima", The Hiroshima University Education and Research Support Foundation, Hiroshima Center Rotary Club and others. This work was partly supported by JSPS KAKENHI Grant Number JP19K19330.

Conflict of interest

The authors declare no conflict of interest.

Authors' contribution

KK, YI considered study design. YI, CC, TC contributed to data collection. MN, CM, YI discussed the result and contributed to the manuscript design. YA aggregated and analysed the data, discussed the result, and contributed to the final manuscript.

References

› Abe K, Akamatsu R. Development and process evaluation of using picture-story-show teaching material based on Social Cognitive Theory for nutrition education during lunch time to reduce lunchtime plate waste in elementary schools. JJHEP 2012;20(Special Issue):43-51.
› Asao Y, Iwamoto Y, Mitsuhata C, Naito M, Kozai K. Three-year survey of oral hygiene conditions of Cambodian public primary school children. J Oral Sci 2022;64:208-211.
› Cakar T, Barry LH, Pukalllus ML, Kazoullis S, Seow WK. Caries experience of children in primary schools with long-term tooth brushing programs: A pilot Australian study. Int Dent Hygiene 2018; 6:233-240.
› Chher T, Turton BJ, Hak S, Beltran E, Courtel F, Durward C, Hobdell M. Dental Cries Experience in Cambodia: Findings from the 2011 Cambodia National Oral Health Survey. J Int Oral Health 2016;8(1):1-7.
› Chu GH, Wong AWY, Lo ECM. Oral health status and behaviours of children in rural districts of Cambodia. Int Dent J 2008;58:15-22.
› He F, Wu Y, Feng XX, Ma J, Ma Y, Wang H, Zhang J, Yuan J, Lin CP, Nowson C, MacGregor GA. School based education programme to reduce salt intake in children and their families (School-EduSalt): cluster randomised controlled trial. BMJ 2015;350:h770.
› Iwamoto Y, Iwamoto A, Niizato N, Goto N, Tatsukawa N, Sakurai K, Amano H, Katsuyuki K. Improvement of Oral Health Conditions of Cambodian School Children by Oral Health Education. Jpn j. Ped. Dent. 2016;54(2):244.
› Iwasaki H, Takanashi N, Nakayama A, Iwata M, Maeda T, Miyazawa H. Dental caries status of Cambodian children and the effects of living environment factors. Pediatr Dent J 2014; 24:137-147.
› Iwasaki H, Iwata M, Kondo T, Takanashi N, Miyazawa H, Wakamatsu N, Tamura Y, Iinuma M. Incidence of Caries in Cambodian Children's Immature Permanent Teeth and Effectiveness of Fluoride Application. J. Gifu Dent. Soc. 2018;44(2):159-162.
› Jed DN, Denise D, Habib B, Roswitha HW, Amphayvan H, Bella M, Hak S, Nicole S, Sri S, Katrin KH. Nutritional status, dental caries and tooth eruption in children: a longitudinal study in Cambodia, Indonesia and Lao PDR. BMC Pedatrics 2018;18:300.
› Kubota Y, Pech NS, Durward C, Ogawa H. Early childhood caries status and its associated factors among young chidren in a rural area of Cambodia. Pediatr Dent J 2020;30:17-23.
› Lai H, Fann JC-Y, Yen AM-F, Chen L-S, Lai M-H, Chiu SY-H. Long-term effectiveness of school-based children oral hygiene program on oral health after 10-year follow-up. Community Dent Oral Epidemiol 2016; 44:209-215.
› Miyata T, Sophorn U, Borey C, Chea S, Sokun L. A Study of Risk Factors Concerned the Onset of Periodontal Infection in the Least Developed Countries : The First Report -The Influences of the Living Environments Risk Factors at Rural Area in Kingdom of Cambodia-. J Jpn Soc Periodontol 2005;47(4):258-268.
› Nash DA, Friedman JW, Kardos TB, Kardos RL, Schwarz E, Satur J, Berg DG, Nasruddin J, Mumghamba EG, Davenport ES, Kentucky RN. Dental therapists: a global perspective. Int Dent J 2008;58:61-70.
› North P. Culture Shock! A Survival Guide to Customs and Etiquette Cambodia. New York: Marshall Cavendish Editions; 2008. 69 p.
› Sato A. Producing picture stories as a means for teacher education. The bulletin of Japanese curriculum research and development 2008;31(2):47-56. (in Japanese).
› Shidara EK, McGlothlin JD, Kobayashi S. A vicious cycle in the oral health status of schoolchildren in a primary school in rural Cambodia. Int Dent Hygiene 2007; 5:165-173.
› Shikanai S, Ry LK, Takeichi H, Suzuki E, San P, Sakura N, Kamoshita S,Yamamoto S. Sugar Intake and Body Weight in Cambodia and Japanese Children. J Med Invest 2014;61:72-78
› Takeuchi R, Kawamura K, Kawamura S, Endoh M, Uchida C, Taguchi C, Nomoto T, Hiratsuka K, Fifita S, Fakakovikaetau A, Kobayashi S. Evaluation of the child oral health promotion 'MaliMali' Programme based on schools in the Kingdom of Tonga. Int Dent J 2017;67:229-237.
› Todd R, Durward CS. Utilisation of dental service in Cambodia and the role of traditional dentists. Community Dental Health 1994;11:34-37.
› Turton BJ, Durward CS, Manton DJ. Early childhood caries and maternal caries experience in convenience sample of Cambodian pre-schoolers. Pediatr Dent J 2015;25:14-18.
› Turton B, Chher T, Sabbah W, Durward C, Hak S, Lailou A. Epidemiological survey of early childhood caries in Cambodia. BMC Oral Health 2019;19:107.
› World Health Organization 2003. WHO INFORMATION SERIES ON SCHOOL HEALTH DOCUMENT ELEVEN Oral Health Promotion: An Essential Element of a Health-Promoting School https://apps.who.int/iris/bitstream/handle/10665/70207/WHO_NMH_NPH_ORH_School_03.3_eng.pdf Accessed June 1, 2020.
› Yekaninejad MS, Eshraghian MR, Nourijelyani K, Mohammad K, Foroushani AR, Zayeri F, Pakpour AH, Moscowchl A, Tarashi M. Effect of school-based oral health-education program on Iranian children: result from a group randomized trial. Eur J Oral Sci 2012;120:429-437.