

Comparative Study of Oral Health Education Given by a Dentist and Schoolteachers in Thai Grade 3 Students

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ABSTRACT

Objectives: To compare children's knowledge and attitudes toward oral health (OH) and plaque score after receiving OH education (OHE) from a dentist or trained schoolteachers. **Materials and Methods:** Third-grade students in Amphoe Meuang, Nakhon Phanom, Thailand ($n = 652$), were randomly divided into a dentist group ($n = 217$), a teacher group ($n = 216$), and a control group ($n = 219$). The students' OH knowledge, attitudes, and plaque scores before the intervention were collected as baseline data. The dentist and the teacher groups received additional OH education sessions by a dentist and trained schoolteachers, respectively. Their immediate post-test knowledge was evaluated after each session, and plaque scores were determined after the brushing session. All groups continued a monthly tooth brushing activity for two months. The final assessment was done at the three-month follow-up. **Results:** The students who received additional OHE by either a dentist or teacher demonstrated improved knowledge and attitudes towards OH, including plaque score. Interestingly, at the three-month follow-up, the knowledge score in the teacher group was significantly higher than in the dentist group. However, the dentist group had a significantly lower plaque score compared with the teacher group. **Conclusions:** Additional OHE in school significantly improved students' OH knowledge and positive attitudes regardless of the provider. However, the teacher tends to have a greater impact on their students; thus after appropriate training, schoolteachers can be efficient OH educators, especially in the long term.

KEYWORDS: Attitudes, dentist, knowledge, oral health education, school teacher

INTRODUCTION

Oral health is fundamental to overall health because it affects eating, appearance, and well-being. Although most oral problems are preventable, dental caries remain the most common chronic disease in children.^[1] OHE in schools promotes OH care, because children spend most of their time at school.^[2] OH knowledge and skills can be reinforced throughout the school year, enabling students to develop positive attitudes and maintain good OH behaviors to prevent OH problems. Many studies demonstrated that school-based OHE positively impacts children's OH knowledge, attitudes and behaviors, and OH status, including gingival

health, plaque scores, and caries increment.^[3-8] In addition to students, school-based OHE can be given at the community level. The well-being of school staff, families, and community members can be enhanced by programs based in schools.

Our previous study demonstrated that OHE given by trained schoolteachers significantly improved

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childrens' OH knowledge, attitudes, and plaque scores toward OH.^[9] However, it is unknown whether trained schoolteachers are efficient OH educators, comparable to dentists to reduce the workload of dentists. Therefore, the aim of this study was to compare the efficiency in OHE given by a dentist or schoolteachers in grade 3 students, based on children's OH knowledge, attitude towards OH, and plaque score. The results from this study may help to develop a practical health promotion model that can be operated in school and leads to reduced caries increment and improved OH in the long term.

MATERIALS AND METHODS

PARTICIPANTS

Six-hundred-fifty-two grade 3 students in Amphoe Meuang, Nakhonphanom province, Thailand

participated in this study. Participant enrollment is illustrated in Figure 1. This was a cluster-randomized trial to prevent contamination within each school. The schools were randomly selected and assigned into three groups. Each group consisted of an equal ratio of public and municipal schools. Group 1 received OHE from a dentist; group 2 received OHE from trained schoolteachers; and group 3 did not receive any additional OHE other than the national curriculum and served as the control group.

The sample size for each group was calculated by using the equation for repeated-measures independent variables for continuous outcome variables,^[10] and increased by an estimated 20% dropout rate. The principals of the sampled schools were contacted by telephone and/ or invitation letter with the study's details to offer the OHE sessions during classroom time.

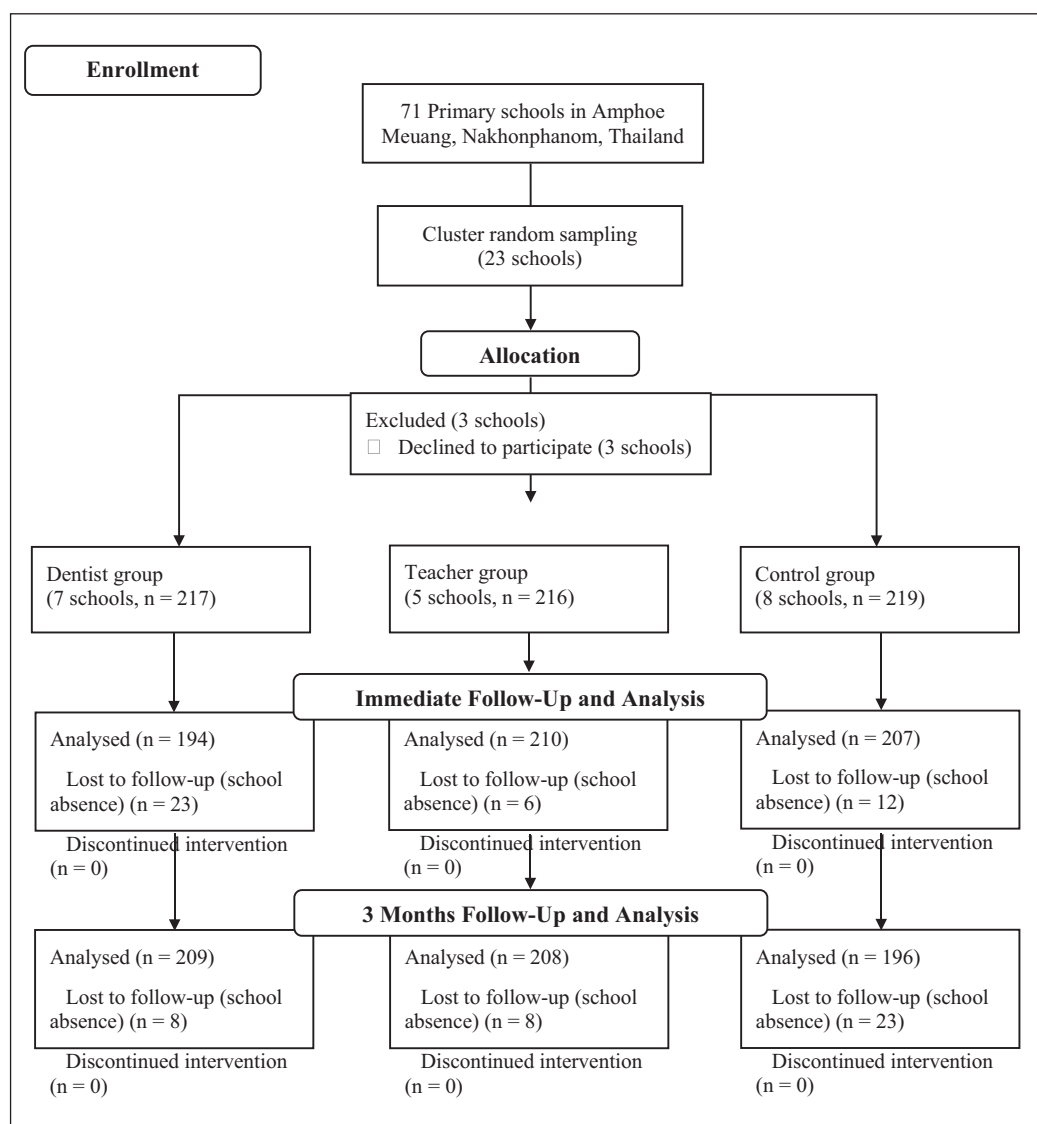


Figure 1: Participant flow

Introductory letters, demographic questionnaires, and consent forms were then sent to the parents/ caregivers in those schools. The inclusion criteria were: healthy children with no underlying disease, not involved in a similar study or program during the past six months, did not receive any extra additional OHE other than the national curriculum, and had parental consent. Children who planned to move out of the area within six months were excluded.

STUDY DESIGN

The children in the dentist and teacher groups were given the OHE handbook and attended OHE sessions during classroom time [Figure 2]. The control group did not receive extra OHE classes or the handbook until the end of the program. The participating teachers were trained during a one-day workshop. The training was performed based on the distributed materials, learning objectives, and OHE activities that covered topics in the student handbook. Trained teachers were evaluated by

the dentist for the accuracy of their OH knowledge and horizontal scrub brushing technique demonstration. Any errors were pointed out and re-evaluated until the trained teacher demonstrated their understanding of all concepts. Each teacher was provided with an instruction manual and brushing model for OHE. The teacher can self-revise to validate the accuracy of the knowledge any time or before each OHE session.

Our school-based model was designed to be flexible, which allows the teacher to adjust the OHE schedule according to their workload or the student’s schedule at that time. The OHE program was given once per week and was divided into three sessions, covering six main topics [Table 1]. During the second session, the horizontal scrub brushing technique was demonstrated before the brushing session in the dentist and teacher groups by using tooth models. Disclosing solution (erythrosine dye) was applied to aid plaque visualization while brushing. Brushing with erythrosine dye was also

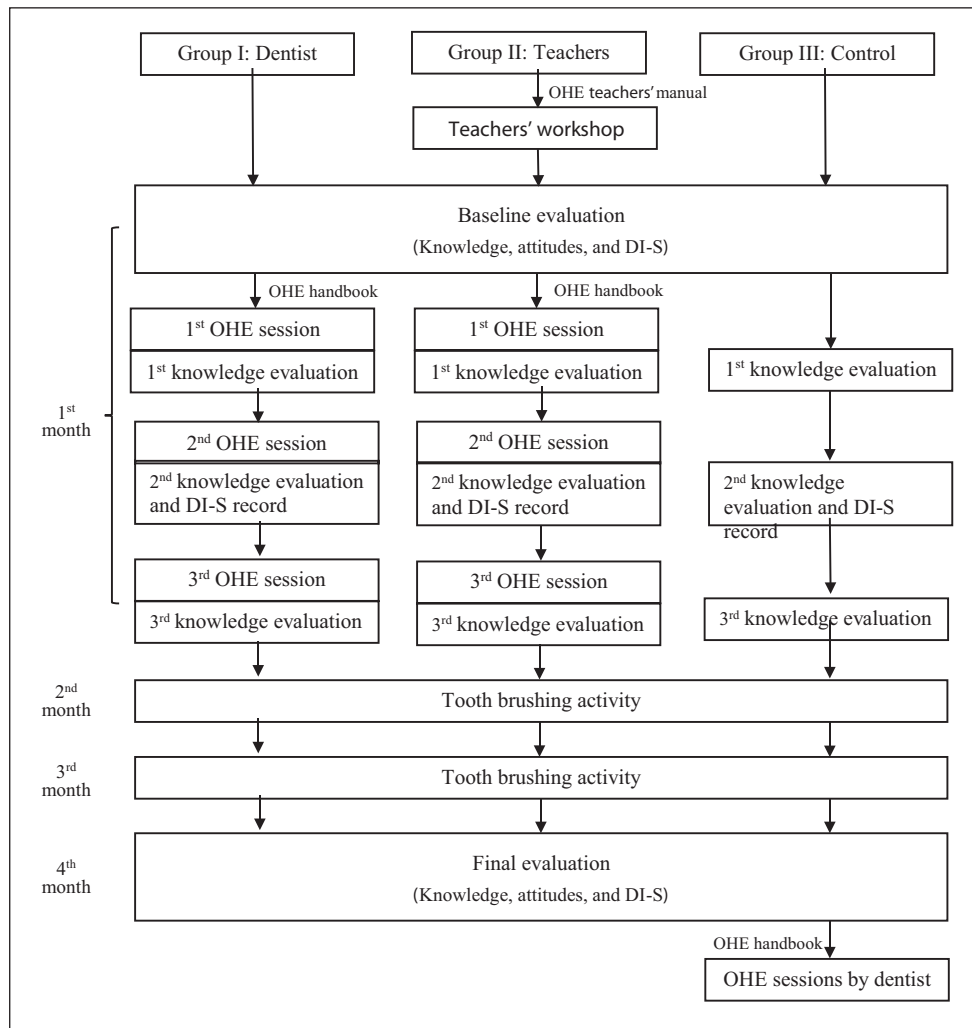


Figure 2: Diagram of the study design

performed in the control group, with no instruction or demonstration. Plaque was assessed by using the Simplified Debris Index (DI-S) on the day after the brushing session (immediate post-brushing test).

After the OHE sessions ended, the children in all groups participated in a tooth brushing activity supervised by the teachers once a month for two months. The activity served as reinforcement for the experimental groups, and as the control value in the control group. After the final evaluation, the OHE handbooks and OHE sessions were provided to the control group children.

DATA COLLECTION

The outcome measures were OH knowledge, attitudes toward OH, and the students' OH status. The multiple-choice questions and questionnaire used in this study were validated as previously described.^[9]

The OH knowledge was determined by using 16 multiple-choice questions in accordance with the learning objectives and collected before the OHE sessions (baseline), immediately after each OHE session, and three months later. A score of 1 was given for each correct answer and 0 for an incorrect answer.

Attitudes toward dental caries, OH care, foods related to OH, and dental visits were collected at baseline and three months after the OHE by using YES/NO questions [Table 2], and the scores were analyzed. The sum of the scores in each topic indicated the student's

attitudes toward that topic. A higher score represented more positive attitudes.

Based on the sample size determination by using the same equation^[10] and that compensated for an estimated 30% dropout rate,^[11] at least 33 children in each group needed to be randomly evaluated for their OH status by using the DI-S.^[12] Therefore, 40 children from each group, who did not miss school during the entire project, were randomly selected.^[9] The plaque was assessed after applying erythrosine dye. The plaque was scored as described elsewhere.^[9] The DI-S scores were the sum of the tooth surface plaque scores divided by the number of examined tooth surfaces. The data were collected at baseline (before the OHE sessions), immediately after the tooth brushing session, and three months later.

The multiple-choice questions and questionnaires were completed in the classrooms. The clinical examination was performed under natural daylight by a dentist (researcher), whose intraexaminer reliability (kappa coefficient) was 0.82.

DATA ANALYSIS

The data were analyzed by using IBM SPSS software version 22.0 (IBM, Armonk, NY, USA). The demographic data were analyzed by descriptive statistics, and the differences between groups were determined by using the χ^2 test. The knowledge scores are presented as mean and standard deviation (SD).

Table 1: The topics included in the OHE program

Session	Topics
1	The importance of teeth, type, and number of teeth in each dentition
2	Dental plaque and its relationship with dental caries and the tooth brushing method
3	Cariogenic food, frequency of sugar consumption, and regular dental visits

Table 2: Questionnaire of attitudes toward oral health

Questions	Answers
Attitudes toward dental caries	
◦ Having cavities affects studying	Yes
◦ Having cavities is normal	No
Attitudes toward OH care	
◦ You can still have cavities no matter how well you brush your teeth	No
◦ You can rinse your mouth instead of brushing	No
◦ Brushing teeth is the best way to prevent cavities	Yes
Attitudes toward foods related to dental caries	
◦ Having snacks 1–2 times/day does not cause cavities	No
◦ Fermented milk does not cause cavities	No
Attitudes toward dental visits	
◦ We should see the dentist only when we have a toothache	No
◦ I'm afraid of dental treatment	No
◦ We should see the dentist regularly	Yes

The differences within each group were analyzed by using the paired *t*-test, and those between each group were tested by using ANOVA. The Levene's test was used to test the homogeneity of variance. Games-Howell was used as post hoc. The attitudes are shown as mean and SD. The paired *t*-test was used to analyze the differences in attitudes toward OH within each group. Differences in the DI-S scores between groups at baseline were compared by using ANOVA, with the Tukey test as post hoc, whereas the differences at the immediate post-brushing and three-month follow-up were analyzed by using one-way ANCOVA, with the baseline scores as the covariate. Significance was set at $P < 0.05$.

RESULTS

DEMOGRAPHIC DATA

Students from 20 schools were recruited. The participants' demographic data are shown in Table 3. No significant differences were observed in sex, caregiver, caregiver's education level, socioeconomic status, or the number of family members between the groups. These results indicated that the participants had similar social backgrounds.

ORAL HEALTH KNOWLEDGE

The mean and standard deviation of the OH knowledge scores at each time point were determined [Table 4]. The different number of subjects at each evaluation

Table 3: Participants' demographic data

	Dentist group	Teacher group	Control group	p-value ^a
Numbers of participants (<i>n</i>)	217	216	219	
Age (years ± SD)	8.95 ± 0.38	8.95 ± 0.53	8.87 ± 0.52	
Sex (%)				.561
Boys	48.4	48.6	53.0	
Girls	51.6	51.4	47.0	
Caregiver (%)				.070
Father and/or mother	73.8	75.9	65.8	
Grandparents/other relatives	26.2	24.1	34.2	
Caregiver's education level (%)				.513
< Junior high school	68.8	65.9	69.4	
> Junior high school	31.2	34.1	30.6	
Family income (%)				.410
< 15,000 THB	82.9	81.1	86.2	
15,001–30,000 THB	10.6	9.5	9.4	
> 30,000 THB	6.5	9.5	4.4	
Family members (%)				.102
1–4 members	36.5	47.4	40.6	
members (%)	63.5	52.6	59.4	

^aChi-square test ($P < 0.05$)

Table 4: Mean and standard deviation (SD) of oral health knowledge scores, collected at pretest (before the OHE sessions), immediately after each OHE session, and three months later. Differences in the mean of oral health knowledge scores were compared within groups, using the paired *t*-test

Group	Time	<i>N</i>	Min	Max	Mean	SD	<i>P</i> -value*
Dentist	Pretest	217	1	11	5.39	2.023	< 0.001 ^a
	Immediate posttest	194	4	16	11.74	2.499	< 0.001 ^b
	Three-month follow-up	209	3	15	10.06	2.640	< 0.001 ^c
Teacher	Pretest	216	1	10	5.61	1.844	< 0.001 ^a
	Immediate posttest	210	4	16	12.04	2.834	0.001 ^b
	Three-month follow-up	208	3	16	11.63	2.595	< 0.001 ^c
Control	Pretest	219	0	12	5.50	1.883	0.001 ^a
	Immediate posttest	207	1	12	5.94	1.852	0.005 ^b
	Three-month follow-up	196	1	11	6.40	2.009	< 0.001 ^c

^aCompared between pretest and immediate post-test

^bCompared between immediate post-test and three-month follow-up

^cCompared between pretest and three-month follow-up

*Statistical analyses within groups by paired *t*-test ($P < 0.05$)

time point is because when a student missed an OHE session, their immediate post-test data were excluded.

The paired *t*-test was used to analyze the OH knowledge differences within each group [Table 4]. In the dentist and teacher group, the immediate posttest scores and the three-month follow-up scores were significantly higher than the pretest score ($P < 0.05$). However, on comparing immediate posttest scores and three-month follow-up scores, a significant decrease was found ($P < 0.05$). In the control group, the mean immediate post-test and the mean three-month follow-up scores were also significantly improved compared with the mean pretest score ($P < 0.05$). Moreover, the three-month follow-up scores were significantly higher than the immediate post-test scores ($P < 0.05$).

The differences between groups at each time point were analyzed by using ANOVA. Levene's test was used to test the homogeneity of variance. Games-Howell was used as post hoc [Table 5]. There were no significant differences in mean OH knowledge scores between students in all three groups before the OHE program. Compared with the control group, the OH knowledge scores of the dentist and teacher group were significantly higher at the immediate post-test and three-month follow-up ($P < 0.05$). Although no significant differences were found between the mean knowledge score in the dentist group and teacher group at the immediate post-test ($P = 0.483$), the mean knowledge score of the teacher group was significantly higher than that of the dentist group at the three-month follow-up ($P < 0.05$).

ATTITUDES TOWARD ORAL HEALTH

The mean and SD of each attitude are shown in Table 5. A higher score represented a more positive

attitude. The differences in the attitudes toward OH within each group were analyzed by using the paired *t*-test [Table 6]. In the dentist group, there were no significant differences in the children's attitudes toward dental caries. However, the results revealed significant differences in the children's attitudes toward OH care, foods related to dental caries, and dental visits ($P < 0.05$). The results of the teacher group were similar. Conversely, the control group had a significant difference in attitudes toward dental caries ($P < 0.05$), whereas there were no significant differences in attitudes toward OH care ($p = .281$), foods related to dental caries ($P = 0.562$), and dental visits ($P = 0.457$).

ORAL HYGIENE STATUS

Forty students from each group were randomly selected to assess their oral hygiene status by measuring plaque deposition using DI-S.^[12] The mean and SD of the plaque scores at each time point are shown in Table 7. In the dentist group, the mean DI-S scores at immediate post-brushing were significantly lower than at baseline ($P < 0.05$). However, although there was a significant increase in the mean DI-S score three months later ($P < 0.05$), there was no significant difference compared with the baseline ($P = 0.153$). Similarly, in the teacher group, the mean DI-S score was significantly reduced after the OHE brushing session ($P < 0.05$). A significant increase in the mean DI-S score at the three-month follow-up was found ($P < 0.05$). No significant difference was observed between the mean DI-S score at baseline and three months after the OHE sessions ($P = 0.496$). In the control group, the mean DI-S score was also significantly decreased after the brushing session compared with baseline ($P < 0.05$). Conversely, the mean DI-S score at the three-month follow-up was

Table 5: Oral health knowledge scores compared between groups

Compared groups	<i>P</i> -value		
	Dentist vs. control	Teacher vs. control	Dentist vs. teacher
Baseline	0.825	0.786	0.436
Immediate post-test	<0.001	<0.001	0.483
Three-month follow-up	<0.001	<0.001	<0.001

Statistical analyses between groups using ANOVA, Games-Howell as post hoc ($P < 0.05$)

Table 6: Differences of attitudes toward dental caries, oral health care, food related to dental caries, and dental visits at baseline and three months after the OHE

Attitudes	Full scores	Dentist group		Teacher group		Control group	
		Δ Mean \pm SD	<i>P</i> -value ^a	Δ Mean \pm SD	<i>P</i> -value ^a	Δ Mean \pm SD	<i>P</i> -value ^a
Attitudes toward dental caries	2.00	-0.07 \pm 0.89	0.255	0.03 \pm 0.79	0.545	-0.69 \pm 0.90	< 0.001
Attitudes toward OH care	3.00	0.20 \pm 1.06	0.006	0.15 \pm 0.86	0.014	0.07 \pm 0.95	0.281
Attitudes toward foods related to dental caries	2.00	0.31 \pm 0.88	<0.001	0.12 \pm 0.68	0.013	0.03 \pm 0.82	0.562
Attitudes toward dental visits	3.00	0.27 \pm 0.94	<0.001	0.23 \pm 0.90	<0.001	0.05 \pm 0.91	0.457

Δ Mean \pm SD was the difference of attitude scores at three-month follow-up and baseline

^aStatistical analyses within groups by the paired *t*-test ($P < 0.05$)

significantly greater than that found at immediate post-brushing and baseline ($P < 0.05$).

The differences of the plaque scores between groups at baseline were analyzed by using ANOVA with Tukey test as post hoc [Table 8]. There were no significant differences between groups at baseline. The differences in the plaque scores between groups at immediate post-brushing and three-month follow-up were analyzed by one-way ANCOVA, using the baseline scores as the covariate [Table 8]. The results revealed a significant difference in plaque scores between the dentist group and the control group at immediate post-brushing evaluation ($P = 0.023$) and three-month follow-up ($P = 0.001$). In contrast, there were no significant differences in the mean DI-S scores between the teacher group and control group immediately after the brushing session, or the three-month follow-up. The results demonstrated that there was no significance difference in the mean DI-S scores between the dentist and teacher groups ($P = 0.271$). However, the mean DI-S scores in the teacher group were significantly higher than the dentist group at the three-month follow-up ($P = 0.022$).

DISCUSSION

Behaviors and routines are acquired during childhood; thus, they become more difficult to change in adulthood due to formed patterns and automatic behavior. OH education is particularly important at the primary

school level, specifically for children in their eighth year of life, because it is perceived to be a period during which the child is more receptive to processing knowledge about self-hygiene.^[13]

Based on our previous research, an OHE program using our student handbooks and teacher manual effectively provided OH knowledge.^[9] Corresponding with other studies, teaching schoolteachers in the workshop improved the positive effects on OH knowledge, attitudes, and behavior,^[4,14-16] as well as on OH status, including gingival health, plate scores, and caries increase.^[4,11] Thus, with appropriate instruction, schoolteachers may be part of a successful plan for OHE. OHE is usually provided by dentists. However, considering the shortage of dentists, OH promotion can be difficult and needs assistance from other sectors. Teachers will play a vital role in school-based OHE, because they interact with children on a regular basis.

Here, we found that students who participated in additional OHE sessions demonstrated enhanced OH skills, strengthened behaviors toward OH, and reduced plaque scores relative to the control group, independent of the provider. Our results are consistent with other research that found that a range of approaches or OHE given by educators can effectively enhance OH skills.^[17-19] Although our findings indicated that the control group had a substantial improvement in OH knowledge in the immediate post-test and three-month

Table 7: Mean DI-S scores compared within groups

Group	Time	N	Mean	SD	P-value*
Dentist	Pretest	40	1.98	0.54	<0.001 ^a
	Immediate post-test	40	0.76	0.27	<0.001 ^b
	Three-month follow-up	40	1.91	0.35	0.153 ^c
Teacher	Pretest	40	2.01	0.49	<0.001 ^a
	Immediate post-test	40	0.83	0.36	<0.001 ^b
	Three-month follow-up	40	2.03	0.44	0.496 ^c
Control	Pretest	40	2.00	0.47	<0.001 ^a
	Immediate post-test	40	0.91	0.33	<0.001 ^b
	Three-month follow-up	40	2.08	0.48	0.003 ^c

^aCompared between pretest and immediate post-test

^bCompared between immediate post-test and three-month follow-up

^cCompared between pretest and three-month follow-up

*Statistical analyses within groups by paired *t*-test ($P < 0.05$)

Table 8: Mean DI-S scores compared between groups

Compared groups	P-value		
	Dentist vs. control	Teacher vs. control	Dentist vs. teacher
Baseline	0.973 ^a	0.999 ^a	0.961 ^a
Immediate post-brushing	0.023 ^b	0.260 ^b	0.271 ^b
Three-month follow-up	0.001 ^b	0.138 ^b	0.022 ^b

^aStatistical analyses between groups by using ANOVA, Tukey as post hoc ($P < 0.05$)

^bStatistical analyses between groups by using one-way ANCOVA ($P < 0.05$), with the baseline scores as the covariate

follow-up period, the dentist and teacher groups produced a two-fold increase in knowledge compared with the control group. The children in the control group may have gained OH-related information from other channels, such as commercials or online e-learning.

Despite a significant increase in the knowledge of the control group, the immediate post-test and three-month follow-up scores of the dentist and teacher groups were considerably higher. No significance differences were found between the mean knowledge scores in the dentist and the teacher groups at the immediate post-test. However, the mean knowledge score of the teacher group was significantly higher compared with the dentist group at the three-month follow-up. Because teachers spend more time with children than dentists who occasionally come to the school, they can help children understand and apply ideas more closely and consistently.

The Knowledge, Attitudes and Practices model, the fundamental theory of our study, believes that knowledge is the basis of and affects ones' attitudes, whereas attitudes are demonstrated through one's behavior.^[20] We found that the attitudes toward OH care, foods related to dental caries, and dental visits in the dentist and teacher groups were similarly improved, except for the attitudes toward dental caries. The children might not have understood the questions, resulting in a lower attitude score. In contrast, the test group had no major improvements in their attitudes toward OH care, dental caries-related foods, and dental visits. In comparison, the mean score of attitudes toward dental caries was significantly reduced. These findings indicate that the information provided by the instructor affects attitudes. It is noted from our study that the results on the attitude toward dental caries are quite deviate in each group. The ambiguity of the questions might confuse the students on this topic. Students might relate themselves or their experiences instead of their attitudes toward the questions. Hence, the questions on this topic need to be revised for our future study.

The plaque score in the dentist group was comparable to the teacher group at immediate post-brushing, but it was significantly lower at the three-month follow-up. Although there was a significant difference in mean DI-S scores between the dentist and the control groups at both immediate post-brushing and the three-month follow-up, there were no significant differences between the teacher and control groups. These results demonstrated that dentists may be able to teach the correct tooth brushing procedure more efficiently than schoolteachers, or the teacher group in our study may not be fully engaged in the brushing session. Likewise, Petersen *et al.*^[21] reported that the plaque scores between the control and noncooperative

schools were not significantly different at the 24-month examination. Thus, schoolteachers should also be motivated repeatedly. In contrast, Eden *et al.*^[17] found that the plaque scores in the dentist and teacher groups were similar at one month after OHE, which conflicts with our results. The discrepancies of the results may be because of the differences in the teaching method used.

Compared within each group, the plaque scores in the dentist and teacher groups were not significantly different between baseline and the three-month follow-up. In contrast, the control group had significantly higher plaque scores at the three-month follow-up compared with baseline. These results suggested that supervised tooth brushing is still needed. The frequency of tooth brushing activity could affect these results. In our study, the monthly tooth brushing activity might not be enough to reduce plaque scores between baseline and three-month follow-up in the dentist and teacher groups. As shown in other studies, more frequent tooth brushing sessions effectively improve OH.^[4,5,11] Daily or regular brushing sessions should also be recommended. However, many schools will find it difficult to have tooth brushing practice because there are no suitable locations, and because of their low socioeconomic status, most children in rural areas may lack adequate hygiene amenities.

Many studies have shown that dentists have played the role of OH instructors in avoiding miscommunication. Thus, the OHE initiative could not be readily expanded nationwide due to a shortage of dentists. Our research has shown that schoolteachers can be successful OH instructors equal to dentists after adequate preparation. If the school-based OHE continues to collaborate with well-trained schoolteachers, it could influence the curriculum and provide long-term benefits, because teachers can help children understand and incorporate lessons more closely and more consistently than dentists. Teachers are also more familiar with most of the children and their families. However, the teacher-student relationship or the training and teaching abilities of teachers and classroom administrators can affect the results, particularly if lessons have been discontinued. In addition, other lessons that unintentionally feature OH can be integrated. Thus, there may have been a slight degree of contamination in our study; however, it supports the potential of qualified schoolteachers to be successful key people in OHE and to produce positive outcomes over the long term.

Due to the limitation of time allocated by schools, only short-term (three months) follow-up was conducted in this study. From our results, retention of the knowledge

and brushing skill were decreased after three months; therefore, the stimulation or revision of these knowledge and skills might be necessary in our future study. Although the delivery of OHE during class can cause extra workload for teachers, it can be resolved by incorporating OHE into the general curriculum and activities. In addition, school-based OHE helps children develop positive views and activities, maintain proper OH and avoid OH issues, and also to have a positive impact on school staff and their families. These would be the benefits of the implementation of a cost-effective school-based OH education program that is realistic and viable in the Thai education curriculum. It could also contribute to community-level promotion of OH, which will decrease caries and long-term care needs.

In conclusion, children obtaining OHE delivered by dentists and qualified schoolteachers had significantly higher OH knowledge and more favorable attitudes toward OH than children who had not undergone the program. After adequate preparation, schoolteachers can be the successful OH teachers who are equivalent to dentists.

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CONFLICT OF INTEREST

There are no conflicts of interest.

AUTHOR CONTRIBUTIONS

All authors had contributed to study conception, data collection, data acquisition and analysis, data interpretation, and article writing. All authors have read and approved the article.

ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

The study protocol was approved by the Ethics Committees of the Faculty of Dentistry, Chulalongkorn University (HREC-DCU 2017-031) and Nakhon Phanom hospital (IEC-NKP1-No.3/2560).

PATIENT DECLARATION OF CONSENT

The authors certify that they have obtained all appropriate consent forms.

DATA AVAILABILITY STATEMENT

Data will be available on request from authors.

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